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IS THE EXPORT-LED-GROWTH HYPOTHESIS, VALID FOR EGYPT? A TIME SERIES APPROACH

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ABSTRACT

This research addresses important empirical questions regarding the relationship between Egyptian exports and Egyptian economic growth by extending the Dirtsakis's model (Dritsakis, 2004, p. 1834) with the addition of the labor force into the model. The hypothesis to be tested is, does export expansion cause economic growth in Egypt? In other words, is the Export-Led-Growth (ELG) hypothesis valid for Egypt?

This study analyzes the issue of ELG hypothesis in Egypt using the VAR analysis, quarterly time-series data over the period 1991:q1-2009:q4. The results tend to favor the effectiveness and validity of the ELG hypothesis for Egypt.

Keywords: Export-Led-Growth Hypothesis, ELG, Economic Growth, Developing Countries, Egypt, Time Series.
JEL calcification: C01, C12, C13, C32, O10, O16, O40, O47.

1- INTRODUCTION

Traditionally the Energy[(1)] sector has been important for Egypt's economy. Macro-economically, it directly contributes to the country's commodity exports, consumption, investment, government budget, and employment. Microeconomically, energy bill is a significant part of a house-hold's, firm's and state's budget. Moreover, privatization of energy production, distribution, and electricity generation offers great potential for both domestic and foreign firms (Kandeel, 2006, p.2).

The Oil and gas sector's value chain (for exploration, to extraction, to production and distribution), on average, has been accounting for approximately 8.4% of the Egyptian gross domestic product (*GDP*) since 2006 to 2009. Table (1) shows that petroleum exports, on average, accounted for almost 42% of total exports over the period 1991 to 2005 and increased, on average, to 50% of total exports over the period 2006 to 2009. This increase maybe due to the expansion of natural gas exports ("Central

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[(1)] There are three types of energy resources in the world: renewable, non-renewable, and perpetual. *Renewable resources* are natural resources that can be replaced by natural processes at a rate comparable or faster than its rate of consumption. Wood, solar energy, hydropower, geothermal power, and biomass are examples. By contrast, *non-renewable resources* are natural resources that cannot be produced, re-grown, regenerated, or reused on a scale which can sustain its consumption rate. These resources often exist in fixed amounts, or are consumed much faster than the nature can recreate them. Fossil fuel (such as coal, petroleum, and natural gas) and nuclear power are examples. *Perpetual resources* are not affected by human use. Sunlight and wind are examples ("U.S. Energy Information Administration (eia)," 2010).

Bank of Egypt," 2009).

In the mid-1990s, Egypt reached its peak oil production at around 47.5 million tons per year. Since then, crude oil production has been falling, with the latest data putting it at 35.3 million tons in 2009 ("BP Statistical Review of World Energy," 2010).

Table (1): Percentage Share of Petroleum Exports in Egyptian *GDP*, 1991 to 2009.

	L.E. Million			%	
Year	*GDP* * (Real)	Petroleum Exports** (Real)	Total Exports** (Real)	Petr. Exports /Total Exports	Petroleum Exports/ *GDP*
1991	226397.63	15697.06	28584.13	54.92	6.93
1992	221728.10	10631.91	21738.36	48.91	4.80
1993	222412.06	10748.53	18964.31	56.68	4.83
1994	227382.65	8372.13	15766.77	53.10	3.68
1995	243653.50	9428.08	21477.47	43.90	3.87
1996	255048.00	8977.61	18589.74	48.29	3.52
1997	277027.32	9794.27	20309.68	48.22	3.54
1998	284752.94	6251.90	18550.23	33.70	2.20
1999	290713.44	3495.81	15543.91	22.49	1.20
2000	315667.00	7841.51	22037.57	35.58	2.48
2001	324734.89	9469.19	25461.48	37.19	2.92
2002	338041.90	10047.34	30048.33	33.44	2.97
2003	360932.67	14953.97	38820.34	38.52	4.14
2004	389845.04	20598.72	55061.80	37.41	5.28
2005	397852.22	25043.59	65378.00	38.31	6.29
2006	437908.43	44290.83	79960.84	55.39	10.11
2007	482772.16	39197.33	85381.46	45.91	8.12
2008	520467.88	48483.10	98341.70	49.30	9.32
2009	519242.06	31368.25	71743.77	43.72	6.04

Sources: * Ministry of Economic Development
** Central Bank of Egypt

Table (2) reports the oil production and local consumption in Egypt from 1991 to 2008.

Table (2): Oil production and local Consumption, 1991to 2008.

Million Ton

Year	Production	Consumption	Year	Production	Consumption
1991	45.40	23.40	2000	38.80	27.20
1992	46.00	22.70	2001	37.30	26.10
1993	47.50	21.60	2002	37.00	25.20
1994	46.50	21.50	2003	36.80	25.90
1995	46.60	23.30	2004	35.40	26.80
1996	45.10	24.60	2005	33.90	29.80
1997	43.80	26.00	2006	33.70	28.70
1998	43.00	27.30	2007	34.10	30.60
1999	41.40	27.80	2008	34.60	32.60

Source: British Petroleum statistical review of world energy, 2010.

The decline in oil production affected the Share of Petroleum Exports in the Egyptian *GDP*. The decrease in this ratio, obviously, has a negative effect on the foreign currency flowing in Egypt and thus decreases national income. As we can see from table (1), this ratio has declined rapidly from 4.83% in 1993 to 2.97% in 2002, and then there was another decline from 10.11% in 2006 to 6.04% in 2008.

This research addresses important empirical questions regarding the relationship between exports and Egyptian economic growth by applying the *Dirtsakis's* model (Dritsakis, 2004, p. 1834), in aggregated framework, to Egypt. The research hypotheses to be tested is that export expansion cause economic growth in Egypt, in other words, the Export-Led-Growth (ELG) hypothesis valid for Egypt.

2- THEORETICAL FRAMEWORK

How does trade affect productivity?

Hung, Salomon, and Sowerby (2004) identified "four channels through which international trade can affect productivity: (1) economies of scale[(1)] effects; (2) competition effects; (3) reallocation effects; and (4) spillover effects." (p. 3). Economies of scale effects and competition effects can affect productivity directly at the firm level, while the last two affect productivity growth at the aggregate level (Hung, et al., 2004, p. 3).

2.1 Economies of scale effects

According to this channel, as the scale of production grows, often the efficiency of the production can improve. This can lead to an advantage in the potential to lower the average cost of the goods being produced. There are two ways in which firm's productivity can be affected by international trade: (1) by moving output to a lower cost point on the average cost curve[(2)] as the scale is increased. Through this along-the-cost-curve effect, if exports lead to an increase in firm's output we can say that its productivity rises; and (2) by shifting the overall average cost curve downward, the expectation of higher output through exporting offers the motive for exporting firms to pursue fixed cost investment, including R&D, by that means enhancing their potential productivity. These "dynamic" economies of scale effect thus helps raise TFP through the added motive for exporters to pursue "true technological progress" (Hung, et al., 2004, p. 4).

2.2 Competition effects

In the case of an open economy, international competition may have influence in the growth of productivity. The pressure of lower priced foreign goods may force domestic companies to lower the prices of their products[(3)]. Lowering of prices has the unwelcome effects of cutting into their profit margins, unless production costs are simultaneously lowered. So in order for domestic manufacturing companies to stay in the market they may need to enhance productivity as one of their tools to remain competitive. The US auto industry is a prime example to consider when looking at the effects of international competition. In 1995, *Baily, M. N., Gersbach, H., Scherer, F. M., and Lichtenberg, F. R. (1995)* analyzed and reported how the US auto industry had been affected by strong

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(1) Economies of scale are the cost advantages that a business obtains due to expansion. They are the factors that cause a producer's average cost per unit to fall as scale is increased. Economies of scale are a long run concept and refer to reductions in unit cost as the size of a facility, or scale, increases (Arthur & Sheffrin, 2007, p. 157).

(2) "Assuming variable costs do not rise too quickly as output increases, an increase in a firm's output decreases its average unit costs by reducing the share of average fixed costs in the unit costs of output." (Hung, et al., 2004, p. 4).

(3) They may instead choose to maintain prices, and promote other features or quality for example as competitive options.

international competitors versus their domestic rivals. Focusing mainly on the domestic competition did not compensate for the international entrants that were eroding their local markets. “Under competitive pressures, domestic firms can raise TFP in a number of ways: (1) by investing in R&D; (2) by corporate restructuring; (3) by learning from foreign competitors through the reverse engineering of their products; and (4) by imitating foreign competitors’ production processes.” (Hung, et al., 2004, p. 4).

2.3 Reallocation effects

According to this channel, there are three types of reallocation effects through which international trade could raise aggregate productivity growth: (1) factories and firms with higher productivity are more willing to enter foreign markets because they have what it takes to recover their initial entry costs. The more foreign markets that factories and firms can access to try to sell their products, allows for the opportunity to drive more production through their manufacturing operation, and may lead to an increases in international trade and thereby could help to increase the level of the industry as a whole by allowing edge higher productivity of companies exporting to represent a greater share of their industries; (2) The cheap imports will take place of local production in lower productivity industries. The release and reallocation of local resources in these industries to industries in highest technological development may lead to an increase in average productivity growth in the manufacturing sector as a whole; and (3) “As the more efficient of import competing firms survive while the less efficient are forced to exit, the average productivity growth at the industry level will rise” (Hung, et al., 2004, p. 5).

2.4 Spillover effects

Paul M. Romer (1986) has pointed out that the stock of knowledge that is available to all firms may be affected by an individual firm’s R&D efforts. “A firm faces constant returns to scale to all private inputs, but the level of technology depends on the aggregate stock of all firms’ knowledge, so that the production function of firm *i* is characterized as $Y_i = A(R)F(K_i, L_i, R_i)$, where Y_i, K_i, L_i, and R_i are respectively output, capital input, labor input, and the stock of knowledge of firm *i*, while *R* is the aggregate stock of knowledge in the economy.” (Hung, et al., 2004, p. 5). From this point of view, an overall productivity growth may be increases as a result from international trade through two types of spillover effects:

(1) The increase in R&D by domestic firms in response to international exposure[1] will increase the aggregate stock of knowledge, thereby raising aggregate productivity; and

(2) Domestic firms, both import-competitors and exporters, could upgrade their technology by learning from and adopting the best practice technologies of foreign-competitors. The aggregate stock of knowledge available to domestic firms thus could increase as their exposure to foreign firms and foreign stocks of knowledge increases, thereby raising aggregate productivity (Hung, et al., 2004, p. 5).

(1) Through exporting firms’ motive to exploit the economies of scale effect through exports and import competing firms’ responses to international competition (Hung, et al., 2004, p. 5).

In his conclusion *Hung, et al., (2004)* has pointed out that through these four channels:

> An increase in international trade is likely to have a net positive impact on domestic productivity growth. To be sure, some import-competitors' productivity growth will be adversely affected by international exposure through the economies of scale channel. However, it is questionable that the negative economies of scale effect will dominate the positive effects for all import-competing firms. Moreover, even as some firms' productivity growth are being eroded by international exposure, aggregate productivity growth will still benefit from international trade through the reallocation channel as productivity-losing firms become a smaller share, while productivity-gaining firms become a bigger share, of their industries. (p. 6)

3- LITERATURE REVIEW

The debate on whether countries should promote the export sector to obtain economic growth culminated into what is known as *the export-led growth (ELG) hypothesis*. According to this hypothesis, countries that adopt an outward orientation tend to obtain better economic performance. It holds that the overall growth of countries can be generated not only by increasing the amounts of labor and capital within the economy, but also by expanding exports. According to ELG hypothesis advocates, exports can perform as an "engine of growth" (Galimberti, 2009, p. 1).

The early studies reviewed include Emery (1967), Michaely (1977), Balassa (1978), Tyler (1981), Feder (1982), and Jung and Marshall (1985). Most of these studies used simple correlation tests such as Spearman rank correlation and ordinary least squares (OLS) estimation methods. The correlation coefficient between exports and economic growth was tested, and it was found that exports and growth are highly correlated.

These results supported the ELG hypothesis. However, the empirical results of the early studies were derived from traditional econometrics, and have been criticized for being spurious. Thus, most of early studies were misleading in that they advocated export growth in an arbitrary way based on unreliable analysis.

The recent studies reviewed include Chow (1987), Fosu (1990), Jaleel and Harnhirun (1995), Thornton (1996), Dritsakis (2004), Awokuse (2007), and Narayan and Smyth (2009). These recent studies have used different techniques from the previous ones. They have employed Granger causality tests based on Vector Autoregressive (VAR) models to determine the direction of causality in this relationship. This technique is important to determine the links between exports and economic growth and to verify the direction of causality. The following paragraphs review the studies in more detail.

The purpose of this study is to identify whether the ELG hypothesis, at aggregate level is valid for Egypt or not. The effectiveness and validity of this hypothesis for Egypt is not yet known. The study has two distinctive features, in contrast to the empirical studies of growth that have been published previously:

First, we have gone beyond the traditional neoclassical theory of production by using "endogenous" growth theory, that is, by estimating production function in a form that includes TFP growth variable, exports[1], and by using quarterly time series data over the period 1991:q1-2009:q4.

Second, it has gone beyond analysis of the traditional short-term effects, and uses contemporary time series analysis to examine empirically the dynamic economic long-run relationships through a VAR model, employing several procedures to test for cointegration using the *Engle Granger* (1987) methodology as well as the *Johansen* (1988) and *Stock-Watson* (1988) methodologies.

4- DATA AND METHODOLOGY

In conformity with the availability of the necessary data and an accepted number of observations, this study analyzes the issue of ELG hypothesis in Egypt, in the context of VAR analysis, using quarterly time-series data over the period 1991:q1-2009:q4.

In order to analyze the issue of ELG hypothesis in Egypt, we follow *Dritsakis's (2004)* model, so a three-variable standard VAR model has been developed:

$$U = f\,(Y, INV, EXP),$$

Where the economic growth variable (*Y*) is measured as real Gross Domestic Product (*GDP*) (nominal *GDP* adjusted by *GDP* deflator)[2]. This variable was collected from the Egyptian Ministry of Economic Development. The exports variable (*EXP*) is measured as real exports. This variable was collected from the Central Bank of Egypt (CEB). The investment variable (*INV*) is measured as the foreign direct investment (FDI) plus domestic investment (public and private sectors), in real terms. This variable was collected from the Egyptian Cabinet, Information and Decision Support Center (IDSC).

We applied cointegration tests using the *Engle and Granger (1987)* methodology, as well as *Johansen and Stock-Watson (1988)* methodologies. Also, both of methodologies require performing more tests on the variables [i.e., stationarity and order of integration using unit root tests developed by *Dickey and Fuller (1979, 1981)*, and Granger causality tests].

5- RESULTS AND DISCUSSION

5.1 Testing for cointegration: *"Engle-Granger"*

Engle-Granger (1987) [3] proposes a four step procedure to determine if a set of variables are cointegrated or not:

Step (1): *Pretest the variable for their order of integration*

(1) *Dritakis* stated that the inclusion of exports as a third variable of production function provides an alternative procedure to capture TFP growth (p. 1834).

(2) In most systems of national accounts the GDP deflator measures the ratio of nominal (or current-price) GDP to the real measure of GDP. So we get the real GDP by dividing the nominal GDP by the GDP deflator and multiplying it by 100. The GDP deflator is collected from the International Financial Statistics published by the International Monetary Fund (IMF).

(3) For more details about Engle and Granger methodology, see *(Enders, 2004, pp.320-346).*

The cointegration test among the variables used in the above model requires a previous test for the existence of a unit root for each variable; using the Augmented *Dickey-Fuller* (ADF) (1979) test on the following regression:

$$\Delta y_t = a_0 + a_2 t + \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \, \Delta y_{t-i} + \varepsilon_t$$

The (ADF) regression test for the existence of unit root of y_t, namely in the logarithm of all model variables at time t. The variable Δy_{t-i} express the first difference with p lags, the null and the alternative hypothesis for the existence of a unit root in variable y_t is $H_0: \gamma = 0$ vs $H_1: \gamma < 0$. The results of these tests appear in table (3).

Table (3): Unit Root Test for (LY), (LINV) and (LEXP).

		lag	Constant but no time trend (Intercept)	No constant or time trend (None)	Constant + time trend (Trend and intercept)
Level	LY	4	-.307	2.780	-2.775
	LINV	4	-2.473	0.182	-2.843
	LEXP	8	-1.450	0.873	-1.931
First	LY	3	-3.487**	---	---
	LINV	3	-2.063	-2.106**	---
	LEXP	3	-2.895	-2.797***	---

- Sample size 1991:q1 to 2009:q4.
- *** and ** denotes statistical significance at 1% and 5% level, respectively.
- Lag orders used in tests are selected according to the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC).

The result in table (3) suggest that, in levels, we cannot reject the null hypothesis of $H_0: \gamma = 0$ which means that all three variables, (*LY*), (*LINV*) and (*LEXP*) are non stationary on the logarithmic level whether we include an intercept or both an intercept and a time trend in the regression.

If we take the first difference, the ADF test's results support the stationarity of all three variables. The null hypothesis of $H_0: \gamma = 0$ was rejected for all three variables. The ADF test shows that, by talking the first difference, (*LY*) is *I*(1) with drift at 5% level, (*LINV*) is *I*(1) without drift at 5% level, and (*LEXP*) is *I*(1) without drift at 1% level. Since all variables are *I*(1), this allow us to proceed to perform the cointegration test.

Step (2): *Estimate the long-run equilibrium relationship: Residual-Based Tests for Cointegration:*

Since it has been determined that the variables under examination are integrated of order (1), then a cointegration test is preformed through estimating the long-run equilibrium relationship in the form:

$$LY_t = \beta_{01} + \beta_{11} LINV_t + \beta_{21} LEXP_t + e_{1t}$$
$$LINV_t = \beta_{02} + \beta_{12} LY_t + \beta_{22} LEXP_t + e_{2t}$$
$$LEXP_t = \beta_{03} + \beta_{13} LY_t + \beta_{23} LINV_t + e_{3t}$$

Since we have saved the residuals $\{\widehat{e_{it}}\}$, $\forall\, i$ = 1, 2, 3; the second step was using the Augmented *Dickey-Fuller* (ADF) (1979) test on these residuals as shown in the following regression:

$$\Delta\widehat{e_{it}} = \gamma \widehat{e_{i,t-1}} + \varepsilon_{it}$$

The null and the alternative hypothesis for the existence of a unit root in these residuals are $H_0: \gamma = 0 \; vs \; H_1: \gamma < 0$. If we cannot reject the null hypothesis $\gamma = 0$, we can conclude that the residual series $\{\widehat{e_{it}}\}$ contains unit root. The results of these tests appear in table (4).

Table (4): Residual-based tests for Cointegration in (LY), (LINV), and (LEXP).

	Dependent Variables	Number of right hand Variables in regression	lag	No constant or time trend (None)
Level	LY	2	4	-1.50
	LINV	2	4	-2.75
	LEXP	2	8	-2.17
Test critical values when applied to residuals form spurious cointegrating regression				-3.80

- Sample size 1991:q1 to 2009:q4.
- Critical values of the residual based ADF tests in Table B.9 in Hamilton (1994).
- *** and ** denotes statistical significance at 1% and 5% level, respectively.
- Lag orders used in tests are selected according to AIC and SIC.

The residual-based tests for cointegration tests, shown in table (4), conclude that the residuals $\{\widehat{e_{it}}\}$, $\forall\, i$ = 1, 2, 3, are not $I(0)$, which means that they are not stationary and the variables are not cointegrated. To confirm these results, we applied another methodology to confirm the existence (or non-existence) of a long-run relationship among the variables. Johansen's approach is performed in order to explore the cointegration relationship.

5.2 Testing for cointegration: *"Johansen and Stock-Watson"*

Johansen (1988) and Stock-Watson (1988) propose a four step procedure when testing for cointegration, but since we already know that (*LY*), (*LINV*), and (*LEXP*) are $I(1)$ variables, we will perform Johansen's methodology starting step (2).

Step (2): *Estimate the model and determine the rank of π (r)*

Given the fact that in order to apply the Johansen's methodology a sufficient number of time lags is required, a procedure that is based on calculating of Likelihood Ratio Test Statistics (LRTS) has been followed. The results showed that, based on (SIC), the value $p = 5$ is the appropriate lag length for the standard VAR, the order of the corresponding VECM is always one less than the VAR.

In order to confirm the existence of a long run relationship among (*LY*), (*LINV*), and (*LEXP*), we used λ_{trace} and λ_{max} tests to determine the rank of π. According to these tests if the LRTS of the unconstrained model that includes the cointegrating equations is significantly different from the LRTS of the constrained model that does not include the cointegrating equations, we reject the null hypothesis.

λ_{trace} tests have the null hypotheses of (r = 0, less than or equal to 1, and less than or equal to 2) against the alternative hypotheses of (r is greater than 0, greater than 1, and greater than 2), respectively. λ_{max} tests have the null hypotheses of (r is equal to 0, equal to 1, and equal to 2), against the alternative hypotheses of (r is equal to 1, equal to 2, and equal to 3), respectively. The calculated values of λ_{trace} and λ_{max} for the various possible values of r are reported in the center of table (5).

Table (5): Johansen tests for rank of cointegrating vectors in (LY), (LINV) and (LEXP).

Null hypothesis	Alternative hypothesis		5% critical value	1% critical value
λ_{trace} tests		λ_{trace} values		
r = 0	r > 0	48.15**	42.44	48.45
r ≤ 1	r > 1	20.61	25.32	30.45
r ≤ 2	r > 2	7.88	12.25	16.26
λ_{max} tests		λ_{max} values		
r = 0	r = 1	27.55**	25.54	30.34
r = 1	r = 2	12.72	18.96	23.65
r = 2	r = 3	7.88	12.52	16.26

- Sample size 1992:q2 to 2009:q4. Maximum lag in VECM = 4.
- *** and ** denotes statistical significance at 1% and 5%, level, respectively.
- We have chosen case (2): Restricted trend, by setting $\tau = 0$ in (4.20), we assume that the trends in the levels of the data are linear but not quadratic. This specification allows the cointegrating equations to be trend stationary.

The result table (5) shows the calculated values for both λ_{trace} and λ_{max} tests. If we are interested in the null hypothesis of no cointegrating vectors ($r = 0$) against the alternative of the existence one or more of cointegrating vectors ($r > 0$), the calculated $\lambda_{trace} = 48.15$. Since 48.15 exceeds the 5% critical value of the λ_{trace} statistic (42.44), it is possible to reject the null hypothesis and accept the alternative of one or more cointegrating vectors. Next, using the λ_{trace} statistics to test the null of $r \leq 1$ against the alternative of two or three cointegrating vectors, the calculated $\lambda_{trace} = 20.61$. Since 20.61 is less than the 5% critical value of the λ_{trace} statistic (25.32), we cannot reject the null hypothesis at this significance level. The λ_{trace} indicates that the variables are cointegrated and we have one cointegrating vector.

λ_{max} tests match the above conclusion so we cannot accept the null hypothesis ($r = 0$) because the calculated λ_{max} (27.55) exceeds the 5% critical value (25.54). However, we cannot reject the null hypothesis ($r = 1$) since the calculated $\lambda_{max} = 12.72$ is less than the 5% critical value (18.96), which means that the long-run relationship exists among (LY), (*LINV*), and (*LEXP*). Thus, they are cointegrated.

After we have determined that the logarithms of the model variables are cointegrated, a VCEM must be estimated. There are three types of parameters of interest, (1) the parameters in the cointegrating equation β, (2) the adjustment coefficient α, and (3) the short run coefficients.

Since we estimated the VCEM using case (2)(1) with $r = 1$, $p - 1 = 4$, and $v = \alpha\mu + \gamma$, it can be rewritten as:

$$\Delta x_t = v + \alpha(\beta\, x_{t-1} + \rho t) + \sum_{i=1}^{4} \pi_i\, \Delta x_{t-i} + \varepsilon_t$$

where: x_t : 3×1 vector of $(LY_t, LINV_t, LEXP_t)'$.

v: 3×1 vector of constants.

α: The adjustment coefficient.

β: 3×3 parameters in the cointegrating equation.

π_i: The short run coefficients

ε_t : 3×1 vector of disturbance, an independently and identically distributed *n*-dimensional vector with zero mean and variance matrix $\sum_{\varepsilon}$.

(1) "Restricted trend, $\tau = 0$, by setting $\tau = 0$, we assume that the trends in the levels of the data are linear but not quadratic. This specification allows the cointegrating equations to be trend stationary." (StataCorp, 2005, p. 358).

Using the previous notation, we have estimated:

$\hat{v}$ = (0.026, -0.016, 0.022)

$\hat{\alpha}$ = (-0.285, 0.752, 0.874)

$\hat{\beta}$ = (1, -0.304***, -0.0691***)(1)&(2)

$\hat{\pi}_i =$

$$\begin{array}{c} \\ LY_t \\ LINV_t \\ LEXP_t \end{array} \left[\begin{array}{cccc|cccc|cccc} \multicolumn{4}{c|}{\overbrace{}^{LY_{t-i}}} & \multicolumn{4}{c|}{\overbrace{}^{LINV_{t-i}}} & \multicolumn{4}{c}{\overbrace{}^{LEXP_{t-i}}} \\ L_1 & L_2 & L_3 & L_4 & L_1 & L_2 & L_3 & L_4 & L_1 & L_2 & L_3 & L_4 \\ -.349 & -.421 & -.366 & .502 & -.033 & -.012 & .008 & -.031 & .078 & .072 & .066 & -.040 \\ -.422 & -.308 & -.071 & .178 & -.001 & -.050 & .032 & .722 & .140 & .010 & .237 & -.225 \\ -1.55 & -1.21 & -1.11 & -.09 & .539 & .399 & .282 & .286 & .136 & .063 & .009 & .121 \end{array} \right] \begin{array}{c} \\ eq._1 \\ eq._2 \\ eq._3 \end{array}$$

Inference on the parameters in $\hat{\alpha}$ depends crucially on the stationarity of the cointegrating equation, so we should check the specification of the VCEM.

As the *first check* after estimating the VCEM, we can check the eigenvalue stability condition, the companion matrix of the VCEM with (n=3) endogenous variables and (r =1) cointegrating equation has (n - r = 2) unit eigenvalues. If the process is stable, the moduli of the remaining eigenvalues are strictly less than one. All results indicate that the process is stable and, also, indicate that our VCEM is not misspecified.

The *second check* is to test the residual serial correlation for each individual equation. *Ljung and Box (1978) Q*-statistics(3) test can be used under the null hypothesis of no serial correlation between residuals against the alternative of existence of serial correlation. The results indicate that the calculated values of Q-statistics did not exceed the critical values at all lags. Thus, we cannot reject the null hypothesis of no serial autocorrelation.

Step (3): *Analyze the normalized cointegrating vector(s) and speed of adjustment coefficients*

The cointegration vector of the VCEM was determined using case (2) and p-1 =4 under the condition that the rank of $\pi = 1$. The normalized cointegrating vector, with respect to β_1, is $\hat{\beta}$ = (1, -.304, -.0691) and the speed of adjustment parameters are $\hat{\alpha}$ = (-.285, .752, .874)

As we can see from step (3), the output indicates that the VECM fits quite well; the coefficients on the cointegrating equation are statistically significant and have the correct signs.

The adjustment parameters are easy to interpret, and we can see that the estimates have the correct signs and imply rapid adjustment toward equilibrium. When the prediction from cointegrating equation is positive, (LY_t) is above its equilibrium value because the coefficient on (LY_t) in the cointegrating equation is positive. The estimate of the adjustment parameter for (LY_t) is -.285, thus when the (LY_t) is too high, it quickly falls back toward the equilibrium. $(LINV_t)$ and $(LEXP_t)$ are below their

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(1) Normalized cointegrating vector.

(2) ***, **, and * denotes statistical significance at 1%, 5%, and 10% level, respectively.

(3) "Q is asymptotically x^2, and the intuition behind the use of the Q-statistics is that high sample autocorrelation lead to large values of Q." (Enders, 2004, p. 68).

equilibrium value because their coefficients in the cointegrating equation are negative. The estimate of the adjustment parameters of ($LINV_t$) and ($LEXP_t$) are 0.752, 0.874, respectively, which implies that when ($LINV_t$) and ($LEXP_t$) are too low, they quickly rise back toward the equilibrium.

Step (4): *Granger causality tests*

In VAR analysis, it is often difficult to interpret the coefficient estimates because the error terms tend to be contemporaneously correlated and the estimated coefficient on successive lags tend to switch in signs. We therefore follow the standard practice and investigate the causal relationship between (*LY*), (*LINV*), and (*LEXP*) in the VCEM, using pair-wise Granger causality tests.

5.3 Granger causality

A common method for testing Granger causality is to regress (LY_t) on its own lagged values and on lagged values of i.e. ($LEXP_t$) and test the null hypothesis that the estimated coefficients on the lagged values of ($LEXP_t$) are jointly zero. Failure to reject the null hypothesis is equivalent to failing to reject the hypothesis that ($LEXP_t$) does not Granger cause (LY_t).

For each equation, in The VCEM, and each endogenous variable that is not the dependent variable in that equation, this test computes and reports Wald tests that the coefficients on all the lags of an endogenous variable are jointly equal to zero. In other words, for each equation in the VECM, we test the hypothesis that each of the other endogenous variables does not Granger cause the dependent variable in that equation.

The VCEM is used to investigate the causal relation among the variables (LY_t), ($LINV_t$), and ($LEXP_t$). Such analysis provides the short-run dynamic adjustment towards the long-run equilibrium.

We can summarize the conclusions in table (6) as following:

Table (6): Summary of the Granger causality tests for (LY), (LINV), and (LEXP).

(Eq.1)	Causality direction		(Eq.2)	Causality direction		(Eq.3)	Causality direction	
LY_t	$\leftarrow$	$LINV_{t-i}$	$LINV_t$	$\nleftarrow$	LY_{t-i}	$LEXP_t$	$\leftarrow$	LY_{t-i}
LY_t	$\leftarrow$	$LEXP_{t-i}$	$LINV_t$	$\leftarrow$	$LEXP_{t-i}$	$LEXP_t$	$\nleftarrow$	$LINV_{t-i}$
LY_t	$\leftarrow$	All	$LINV_t$	$\nleftarrow$	All	$LEXP_t$	$\leftarrow$	All

- Sample size 1992:q2 to 2009:q4. $\forall\, i = 1,2,3,4$.
- Arrows indicate the direction of Granger causality between the variables.

6- CONCLUSION AND POLICY IMPLICATIONS

6.1 Conclusion

The study investigates the existence of a unit root for each variable in the model using the Augmented *Dickey-Fuller* (ADF) (1979) test. The findings indicate that all three variables, real exports, real investment, and real *GDP*, are non-stationary in their logarithmic level. However, they became stationary in the first difference, and they are *I*(1). The results of the study also suggest that there is a long run equilibrium relationship among them.

Using *Engle-Granger* methodology, the results from the cointegration tests did not confirm the existence of a long-run relationship among these three variables. However, using *Johansen and Stock-Watson* methodologies, the results from the cointegration tests confirm the existence of a long-run relationship among them. The VECM is used to demonstrate the short run adjustment of the variables toward the long run equilibrium.

The pair-wise Granger Causality test was used to determine whether export expansion promotes economic growth or/and economic growth promotes export growth. The results of Granger causality tests suggest that there is causality between exports and economic growth, indicating that exports promote economic growth and growth supports exports for Egypt. These results tend to favor the effectiveness and validity of the ELG hypothesis for Egypt.

This conclusion consistent with the economic theory, which suggests that export expansion is believed to promote economic growth via two paths: (1) by improving efficiency in the allocation of productive resources; and (2) by spillover effects.

6.2 Policy implications

From our proven ELG hypothesis it is easy to come up with the following suggestions:

- Attract global investment in research, exploration, and development. Also, continue to apply the latest technology in deep water drilling, particularly the Nile Delta and eastern Mediterranean.(1)
- Egypt should be the key oil and gas "trader" for decades to come, because based on geographical location we are the African gate to the European and Central Asia gas markets.
- Invest foreign currency that flowing into Egypt due to non-renewable resources export in large investments, such as heavy industry and petrochemicals, coupled to private investment in order to play the key role as "economic growth engine", and move the economy to more productive stage.
- Utilize new energy, and renewable resources, in particular: solar, wind, and biomass. Take advantage of biologically generated methane from landfills and waste.
- Revive the Egyptian nuclear energy program to generate electricity and desalination of sea water.
- Educate citizens about the Egyptian methods of energy conservation, and incorporated that into various stages of education, to achieve energy savings.

(1) The *U.S. Geological Survey (USGS)* estimated mans of 1.8 billion barrels of recoverable oil, 223 Trillion cubic feet of undiscovered, technically recoverable natural gas in the Nile Delta Basin Province, located in the Eastern Mediterranean region.
Retrieved from http://www .usgs.gov/ newsroom/article.asp?ID=2466.

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