J. King Saud Univ., Vol. 10, Admin. Sci. (2), 99-106, (A.H. 1418/1997)

Exports and Economic Growth in Egypt: Evidence from Cointegration Analysis: A Note

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(Received on 12/11/1416 A.H., accepted for publication on 11/6/1417 A.H.)

Abstract. The purpose of this study is to investigate the long-run relationship between real exports and economic growth in Egypt using cointegration analysis. Previous studies suggested that these two variables are cointegrated which is considered as evidence of a long-run equilibrium relationship. We employed cointegration analysis and error-correction modeling and annual data for the period 1960-1992 to study the relationship between real export and its domestic production. We found strong evidence of cointegration between real exports and economic growth. Results from error-correction models showed that there is a unidirectional causality between output and exports i.e. output causes exports but not exports cause output.

Introduction

The studies in the field of economic development have investigated the causal relation that may exist between economic growth and export growth. Some studies found support for the export-led growth hypothesis, such as Michaely (1977), Tyler (1981) and Feder (1983). However, more recent studies provided mixed evidence [e.g. Chow (1987), Darrat (1986), Bahmani (1991)]. Chow (1987) adopted a sins test found a two way causality in most countries. However, Bahmani (1991) who used Granger concept of causality did not find strong evidence in support of export led growth hypothesis. Darrat (1986) rejected the export-led growth hypothesis for most LDC's.

All the previous studies mentioned above suffer from a major problem. None of them have checked for the cointegration properties of the time series involved. Standard Granger test is only valid if the original time series from which growth rates are

generated are not cointegrated. If the time series are cointegrated, rejection of a causal relation will be invalid (Granger 1988).

The purpose of this paper is to investigate the export-led growth hypothesis for Egypt using cointegration analysis and annual data over the period 1960-1992. Our finding could be best summarized by saying that there is a long run equilibrium relationship between export and output in Egypt. The result from error correction modeling reveals a unidirectional causality between export growth and economic growth. Section I outlines the methodology adopted in this paper. Section II reports the empirical results. Section III concludes.

1. The Methodology

Let Ry_t denote real output (real output is measured by GDP) and Rx_t denote the real exports. The cointegration idea says that these two variables (Ry_t and Rx_t) may drift in the short run but they converge toward an equilibrium in the long run. To test such an idea, Engle and Granger (1987) first define the degree of integration of a variable to be the number of times that we need to difference that variable in order to achieve stationary. For example, if Ry_t needs to be differenced d times to achieve stationarity, it is said to be integrated of order d denoted Ry_t I(d).

Consider now two variables Ry_t and Rx_t both integrated of order d. According to Engle and Granger (1987) two I(d) variables Ry_t and Rx_t are cointegrated if a linear combination between Ry_t and Rx_t such as $Z_t = Ry_t - \beta Rx_t$ is integrated at any order less than d. Usually as a proxy for Z_t, the residuals from OLS regression of one variable on the other are tested for their degree of integration. Once we establish that the two variables are cointegrated, we can rely upon error correction models to detect causality between them. Following Engle and Granger (1987) the error correction models are formulated as follows:

$$\Delta Ry_t = a_1 + b_1\mu_{1t-1} + \sum_{i=1}^{m} c_{1i}\Delta Ry_{t-i} + \sum_{i=1}^{n} d_{1i}\Delta Rx_{t-i} + \varepsilon_{1t} \qquad (1)$$

$$\Delta Rx_t = a_2 + b_2\mu_{2t-1} + \sum_{i=1}^{m} c_{2i}\Delta Rx_{t-i} + \sum_{i=1}^{n} d_{2i}\Delta Ry_{t-i} + \varepsilon_{2t} \qquad (2)$$

where Rx_t is the logarithm of the real exports and Ry_t is the logarithm of the real GDP, and Δ is the first difference operator and the term μ_{1t-1} in Eq. (1) is the stationary residual from the OLS regression of Ry_t on Rx_t, and the error correction term μ_{2t-1} in Eq. (2) is the stationary residual from the regression of Rx_t on Ry_t. In equation (1), Rx_t is said to cause Ry_t not only if the d_{1i}'s are jointly significant but also if b_1 is significant. Therefore, the error correction model allows for the finding that Rx_t Granger causes Ry_t, as long as the error correction term carries a significant coefficient even if the d_{1i}'s are

not jointly significant (Granger 1988, 203). However if two variables Rx_t, Ry_t are not cointegrated then the error correction terms are dropped from Eqs. 1 and 2 and the simple Granger test for causality is carried out.

2. The Empirical Results

In this Section we try to apply the cointegration technique and error-correction models to investigate the relation between real exports (Rx_t) and real output (Ry_t) in Egypt using annual data that covers the period 1960-1992. Nominal GDP and nominal Exports in millions of Egyptian pounds are deflated by GDP deflator (1990=100) to obtain real GDP and real exports. All data are from International Financial Statistics.

In order to determine the degree of integration of each variable we rely upon the Augmented Dickey-Fuller (ADF) test. For a time series w the ADF test statistic is usually obtained from estimating the following equation:

$$\Delta w_t = a + cw_{t-1} + \sum_{i=1}^{m} c_i \Delta w_{t-i} + \varepsilon_t$$

where a is a constant and ε_t an error term. The test is whether the estimate of c = 0. The ADF test statistic is calculated by dividing the estimate of c by its standard error. The cumulative distribution of the ADF statistic is provided by Mackinnon (1991) for any sample sizes. If the calculated ADF statistics is less than its critical value, then w is said to be stationary or integrated of order zero, i.e., w I(0). Table 1 reports these ADF test results for the level as well as for the first difference variables. Comparing our calculated ADF statistic to its critical value, it is obvious from Table 1 that the level of each variable is non-stationary. However, when the ADF test was applied to first difference variables, it was revealed that all first difference variables are stationary, thus, they are all I(1).

Table 1. Stationary tests over the period 1960-1992

Variable	ADF test statistic [a]
Rx	-1.89 [2] [b]
Ry	-1.55 [2]
ΔRx	-3.95 [1]
ΔRy	-5.05 [1]

Notes: a) The Augmented Dickey-Fuller (ADF) test is based on the regression

$$\Delta w_t = a + cw_{t-1} + \sum_{i=1}^{m} c_i \Delta w_{t-i} + \varepsilon_t$$

The critical value of the ADF statistic from the Mackinnon (1991) for 31 observations is -2.95 and -2.62 at 5% and 10% level of significance respectivcly.

b) The number inside the brackets is the number of lags in the ADF test.

The next step is to determine the degree of integration of the residuals from the cointegration equations. Note that if the two variables Rx_t and Ry_t are to be cointegrated, the residuals from the cointegration equations must be stationary, i.e. they must be I(0). Table 2 reports the results of ADF test applied to the residuals of the cointegration equations.

Table 2. The cointegration results

Cointegration equation	Constant	Slope	$\bar{R}^2$	ADF [a]
Ry = f (Rx)	8.43	0.22	0.98	-2.63 [1] [b]
	(42.1)	(5.1) [c]		
Rx = f (Ry)	-15.79	2.17	0.97	-3.67 [2]
	(-3.9)	(5.1) [c]		

Notes: a) The Augmented Dickey-Fuller (ADF) test is based on the regression:

$$\Delta w_t = a + cw_{t-1} + \sum_{i=1}^{m} c_i \Delta w_{t-i} + \varepsilon_t$$

The critical value of the ADF statistic from the Mackinnon (1991) for 31 observations is -2.95 and -2.62 at 5% and 10% level of significance respectively.

b) The number inside the brackets is the number of lags in the ADF test for the residuals.

c) The number inside the parentheses is the absolute value of the t-statistic.

From Table 2 we gather that at 5% and 10% level of significance the null hypothesis of no cointegration can be rejected for any of the two cases. This is an indication of the fact that there is a long-run equilibrium relation between real exports and real output. The positive sign of the slope coefficient is indicative of a positive association between exports and output.

To investigate the direction of causation we turn to estimates of error-correction models outlined by Eqs. 1 and 2. In selecting the optimum number of lags in error correction models we minimize Akaike's final prediction error (FPE) statistic. The results are reported in Table 3.

Table 3. Result for error-correction models using FPE criteria

Exogenous variables	Dependent variable	
	Rx_t	Ry_t
Constant	0.053	0.045
	(0.61)	(1.66)
ΔEc_{t-1}	-0.986	-0.195
	(-3.749) *	(-1.034)
ΔRx_{t-1}	0.592	0.014
	(2.54) *	(0.27)
ΔRx_{t-2}	0.449	-0.037
	(2.12) *	(-0.69)
ΔRx_{t-3}	0.303	0.056
	(1.41)	(1.02)
Δy_{t-1}	-0.631	0.063
	(-0.78)	(0.27)
Δy_{t-2}	-0.754	-0.093
	(-0.974)	(-0.41)
Δy_{t-3}	-0.408	0.246
	(-0.43)	(0.93)
$\bar{R}^2$	0.46	0.20
D.W.	2.11	1.84
F	2.59	0.79

Notes: Numbers inside the parentheses are the absolute values of the t-ratios.
* denotes significant at 5% level.

From Table 3 we observed that the error-correction term denoted by EC_{t-1} does not carry a significant coefficient in model (1). This means that export growth has no effect on output growth in Egypt that have pursued import substitute strategies and may be subject to some speculation. If such strategies distort the economy because of protective measures, then export growth could increase the extent of such distortions particularly if the export sector itself has benefited from protection, thus not contributing to economic growth. Further empirical analysis certainly is needed to explore this possibility.

As for causality from economic growth to export growth, our study indicates

positive causality where the error correction term denoted by EC_{t-1} carries a highly significant coefficient in model (2). This finding implies that Egypt can promote industrialization without relying on export growth.

3. Summary and Conclusion

This paper investigates the long-run relationship between real exports and economic growth in Egypt using cointegration analysis. Previous studies suggested that these two variables are cointegrated which is considered as evidence of a long-run equilibrium relationship. We employed cointegration analysis and error-correction modeling and annual data for the period 1960-1992 to study the relationship between real export and its domestic production. We found strong evidence of cointegration between real exports and economic growth. Results from error-correction models showed that there is a unidirectional causality between output and exports i.e. output causes exports but not exports cause output.

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الصادرات والنمو الاقتصادي في مصر
أدلة من تحليل التكامل المشترك

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ملخص البحث. تهدف هذه الدراسة إلى التحقق من وجود علاقة طويلة الأجل بين الصادرات والنمو الاقتصادي في مصر باستخدام تحليل التكامل المشترك. ولقد بينت الدراسات السابقة في حقل التنمية الاقتصادية أن هذين المتغيرين بينهما تكامل مشترك مما يعتبر في حد ذاته دليل على وجود علاقة توازنية طويلة الأجل.

ولقد طبقنا تحليل التكامل المشترك ونموذج تصحيح الأخطاء على البيانات السنوية للفترة ١٩٦٠-١٩٩٢م لدراسة العلاقة بين الصادرات والنمو الاقتصادي. ولقد وجد دليل قوي على التكامل المشترك بين الصادرات والنمو الاقتصادي، وأظهر نموذج تصحيح الأخطاء أن هناك علاقة سببية ذات اتجاه واحد بين النتائج والصادرات.