A Multivariate Causality Analysis of Export and Growth for Turkey
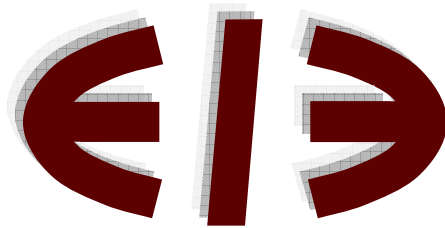
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Abstract

This study seeks to validity of the export-led growth hypothesis using quarterly data from 1980 to 2005. The bounds testing approach to cointegration is employed to test the causal relationship between industrial production, exports and terms of trade. An augmented form of Granger causality analysis is implemented to identify the direction of relationship among the variables both in the short-run and the long-run. The empirical findings suggest uni-directional causation from exports to industrial production.

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1. Introduction

The pace of economic development of a nation poses one of the most fundamental issues in economics debate. It is argued that a nation could accelerate the rate of economic growth by promoting exports since it will stimulate the production of goods and services. This argument has led to export-led growth (ELG) hypothesis in the literature. The linkages between export performance and economic growth are established through different channels, which include allowing the diffusion of technical knowledge, easing the foreign exchange constraint, providing positive economies of scale, increasing degree of competition, and leading to progressive trade liberalization measurements.

A large number of studies tested the ELG hypothesis using different econometric procedures ranging from simple OLS to multivariate cointegration but previous empirical studies have produced mixed and conflicting results on the nature and direction of the causal relationship between export growth and output growth.

Giles and Williams (2000a, 2000b) provide an excellent literature review of the ELG hypothesis until the late 1990s. In addition to this extensive survey, one notes that the literature on the ELG hypothesis has been constantly expanding with more recent studies such as Balaguer *et al*. (2001) for Spain; Panas and Vamvoukas (2002) for Greece; Chandra (2003) for India; Abual-Foul (2004) for Jordan; Mah (2005) for China; Siliverstovs and Herzer (2006) for Chile; and Narayan and Narayan (2007) for Papua New Guinea and Fiji.

As far as the Turkish empirical evidence for the ELG hypothesis is concerned, Bahmani-Oskooee and Domac (1995) offers support it but Ozmen and Furtun (1998) does not provide any favorable empirical evidence for it.

This paper contributes to the literature on export-output growth nexus in the following ways. A recent cointegration technique, the so-called autoregressive distributed lag (ARDL) of Pesaran *et al.* (2001) is employed to test the existence of long-run equilibrium among the variables. This study firstly extends the Pesaran *et al.* procedure into multivariate analysis. Secondly, the direction of causal relationships among variables is examined through short-run and long-run augmented Granger causality tests.

The rest of article is organized as follows. Section II outlines the econometric methodology adopted. Section III presents the empirical results. Section IV summarizes and concludes.

2. The Econometric Methodology

This study adopts a three-stage procedure to test the direction of causality between the variables. In the first stage, the order of integration of the variables is established by implementing the augmented Dickey-Fuller (ADF, 1979) and Phillips-Perron (PP, 1988) unit root tests.

The second stage involves testing for the existence of a long-run relationship between real industrial production index (Y), real exports (E) and terms of trade (T) within a multivariate framework. Terms of trade is utilized in this study in order to eliminate possible mis-specification bias of previous bivariate analyses in addition to a fact that terms of trade has had an influence on export earnings.

The bounds testing approach of Pesaran *et al.* (2001) is employed to test the existence of a cointegration relationship amongst the variables. The Pesaran *et al.* procedure involves investigating the existence of a long-run relationship in the form of the unrestricted error correction model for each variable as follows:

$$\Delta \ln Y_t = a_{0Y} + \sum_{i=1}^{m} a_{iY} \Delta \ln Y_{t-i} + \sum_{i=1}^{m} b_{iY} \Delta \ln E_{t-i} + \sum_{i=1}^{m} a_{iY} \Delta \ln T_{t-i} + \\ d_{1Y} \ln Y_{t-1} + e_{2Y} \ln E_{t-1} + f_{3Y} \ln T_{t-1} + v_{1t}$$ (1)

$$\Delta \ln E_t = a_{0E} + \sum_{i=1}^{m} a_{iE} \Delta \ln E_{t-i} + \sum_{i=1}^{m} b_{iE} \Delta \ln Y_{t-i} + \sum_{i=1}^{m} a_{iE} \Delta \ln T_{t-i} + \\ d_{1E} \ln E_{t-1} + e_{2E} \ln Y_{t-1} + f_{3E} \ln T_{t-1} + v_{2t}$$ (2)

$$\Delta \ln T_t = a_{0T} + \sum_{i=1}^{m} a_{iT} \Delta \ln T_{t-i} + \sum_{i=1}^{m} b_{iT} \Delta \ln Y_{t-i} + \sum_{i=1}^{m} a_{iT} \Delta \ln E_{t-i} + \\ d_{1T} \ln T_{t-1} + e_{2T} \ln Y_{t-1} + f_{3T} \ln E_{t-1} + v_{3t}$$ (3)

where *lnY* is the logarithm of real industrial production index, *lnE* is the logarithm of real exports, *lnT* is the logarithm of terms of trade, and Δ is the first difference operator.

The third stage includes forming standard Granger-type causality tests augmented with a lagged error-correction term. The Granger representation theorem suggests that there will be Granger causality in at least one direction if there exists a cointegration relationship among the variables in equations (1)-(3), providing that they are

integrated order of one. Engle-Granger (1987) caution that the Granger causality test, which is conducted in first difference via a vector autoregression (VAR) will be misleading in the presence of cointegration. Therefore, an inclusion of an additional variable to the VAR system, such as the error-correction term, would help us to capture the long-run relationship. To this end, an augmented form of Granger causality test involving the error-correction term is formulated in a multivariate pth order vector error-correction model (VECM), as follows:

$$\begin{bmatrix} \Delta \ln Y_t \\ \Delta \ln E_t \\ \Delta \ln T_t \end{bmatrix} = \begin{bmatrix} k_1 \\ k_2 \\ k_3 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} n_{11i} n_{12i} n_{13i} \\ n_{21i} n_{22i} n_{23i} \\ n_{31i} n_{32i} n_{33i} \end{bmatrix} \begin{bmatrix} \Delta \ln Y_{t-i} \\ \Delta \ln E_{t-i} \\ \Delta \ln T_{t-i} \end{bmatrix} + \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{bmatrix} \begin{bmatrix} EC_{t-1} \end{bmatrix} + \begin{bmatrix} \omega_{1t} \\ \omega_{2t} \\ \omega_{3t} \end{bmatrix} \qquad (4)$$

EC_{t-1} is the error correction term, which is derived from the long-run relationship, and it is not included in equation (4) if one finds no cointegration amongst the variables in question. The Granger causality test may be applied to equation (4) as follows: i) by checking statistical significance of the lagged differences of the variables for each vector; this is a measure of short-run causality; and ii) by examining statistical significance of the error-correction term for the vector that there exists a long-run relationship.

3. The Empirical Results

Quarterly data over 1980I-2005IV period were used to estimate equations (1)-(3). Data definition and sources of data are cited in the Appendix. The results of the ADF and PP unit root tests are not reported here due for brevity; however, the variables in question are integrated of order one.

Equations (1)-(3) were estimated in two stages. In the first stage of the ARDL procedure, the order of lags on the first–differenced variables for equations was obtained from unrestricted VAR by means of Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), which both indicated the optimal lag level as five quarters. Then an F deletion test was applied to equations (1)-(3) in order to test the existence of a long-run relationship, by using lags from five to eight, following Bahmani-Oskooee and Goswami (2003), as they have shown that the results of this stage are sensitive to the order of VAR. The summary results of bounds tests are presented in Table 1. As can be seen from Table 1, it is clear that there is a long-run relationship amongst the variables when Y is the dependent variable because its F-statistic exceeds the upper bound critical value at the 5% and 10% levels. The null hypothesis of equations (2) and (3), however, cannot be rejected.

Table 1. The Results of F-test for Cointegration

	Calculated F-statistic for different lag lengths			
	5 lags	6 lags	7 lags	8 lags
$F_Y(Y|E,T)$	3.97	3.88	5.09	5.23
$F_E(E|Y,T)$	3.03	2.06	1.05	1.78
$F_T(T|Y,E)$	1.56	1.93	1.76	1.80

The critical value ranges of F-statistics with two explanatory variables are 3.79 - 4.85 and 3.18 – 4.12 at 5% and 10% level of significances, respectively. See Pesaran *et al.* 2001, pp.300-301, Table CI, Case III.

Table 2 reports the results of short-run and long-run Granger causality within the VECM frame work. The short-run causal effects are demonstrated via the F-statistics on the explanatory variables in each of the three equations. Given the results of the bounds test in Table 1, the only long-run Granger causality test with an error-correction term was conducted to equation (4) in which the dependent variable is the real industrial production index.

Table 2. Results of Granger Causality

Dependent Variable	$\Delta \ln Y_t$	$\Delta \ln E_t$	$\Delta \ln T_t$	EC_{t-1} (t-statistics)
		F statistics (probability)		
$\Delta \ln Y_t$	-	2.19** (0.06)	1.41 (0.19)	-0.17* (2.08)
$\Delta \ln E_t$	1.22 (0.30)	-	1.40 (0.21)	-
$\Delta \ln T_t$	1.16 (0.33)	2.61* (0.01)	-	-

Causality inference: E⟹Y and E⟹T

* and ** denote significance at 5% and 10 % respectively, the lag length selected on the basis of SBC criterion.

On analyzing the long-run results, one can ascertain that the coefficient on the lagged error-correction term is significant with the expected sign in the real industrial production index equation at 5%, which also confirms the result of the bounds test for cointegration. This implies that real exports and terms of trade Granger cause the real industrial production index in the long-run and the direction of causality runs interactively through the error-correction term from real exports and real terms of trade. The value of error-correction term is rather small; therefore restoration of the equilibrium level of the real industrial production index in the case of a deviation will take considerably longer. As for the short-run, the F-statistics on the explanatory variables demonstrate that there is uni-directional Granger causality between real exports and real industrial production index, in which the direction of causality runs from real exports to real industrial production index confirming the ELG hypothesis. Nevertheless, the strength of this causation is rather weak as far as the F-statistic is concerned. Similarly, there is uni-directional Granger causality between real exports and terms of trade.

4. Conclusion

The objective of this article was to determine if the ELG hypothesis is valid for Turkey. In order to establish the direction of causality, the bounds testing to cointegration was utilized to test the existence of a long-run relationship among variables. Empirical evidence from the bounds testing to cointegration indicated that there existed only one long-run relationship between the variables in which real industrial production index is the dependent variable. Augmented Granger causality tests suggested that changes in real exports and terms of trade through the error-correction term precede changes in real industrial index in the long-run. In the short-run, there is also a unilateral causation running from changes in real exports to real industrial production index. The results from this study are consistent with the fundamental development policy changes in 1980 and the subsequent substantial export promotions and incentives policies that Turkey has been pursuing. Therefore, Turkey should continue to promote the export sector for faster economic growth.

Appendix

Data definition and sources

The data set used in this study cover the period 1980I to 2005IV. All data are collected from International Financial Statistics (IMF) and Turkish Treasury Annual Foreign Trade Statistics (TT).

Y is Turkish industrial production index, which is deflated by the consumer price index of Turkey. Industrial production index is used as a proxy variable for real income since there is no quarterly data available for the concerning variable before 1987. Source: IMF.

E is exports in millions of US dollars, which is deflated by the US consumer price index. Source: IMF

T is terms of trade defined as the unit value index of exports as a percentage of the unit value index of imports. Source: TT.

All indexes are based on year 2000=100.

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