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Export-led growth hypothesis and the Turkish data: An empirical investigation*

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Abstract

This paper investigates the validity of the export-led growth hypothesis for the post-1970 quarterly Turkish data by using Johansen cointegration techniques. We consider three systems nested by a four-variable space postulated to explain aggregate real exports, and test the robustness of the results of the cointegration and long-run weak exogeneity analyses to omitted relevant variables. The results suggest that the non-rejection of the no-cointegration null for a bivariate system containing real exports and real output is due to the omission of a relevant variable, namely real effective exchange rates (rer). When the bivariate system is augmented with rer, the no-cointegration null is strongly rejected. The same result is obtained for a four-variable general system containing also real world output. The cointegration vectors for each of the relevant systems explain real exports with real output being weakly exogenous for the parameters of the corresponding long-run aggregate exports equations. This result suggests the rejection of the empirical validity of the export-led growth hypothesis for the Turkish data.

1. Introduction

The export-led growth (ELG) hypothesis has generated considerable controversy especially in the development economics literature. The literature on both the theoretical arguments for the ELG hypothesis and the empirics for the test of it is large and several comprehensive reviews are available (see

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Edwards (1993), Greenaway and Sapsford (1994) and Riezman *et al.* (1996) for the most recent surveys). Empirical tests of the hypothesis have often yielded conflicting conclusions. The evidence appears to be crucially dependent upon both the variable space considered and the appropriateness of the empirical method to test the hypothesis.

The necessary conditions for the empirical validity of the ELG hypothesis are that there is a long-run relationship between output and exports, and output is not weakly exogenous[1] in the long-run variable space containing the variables in question. Relevant empirical literature to test the ELG hypothesis can be divided into three broad categories. The first consists of earlier cross-country studies most of which interpreted significant cross-country contemporary (positive) correlations between export and output variables as evidence supporting the hypothesis (see, e.g., Balassa (1978) and Tyler (1981)). These results, however, have no valid empirical bearing on the necessary conditions for the ELG hypothesis. The second includes time series studies which employ Granger non-causality tests for the variables in question. Jung and Marshall (1985), Hsiao (1987) and Riezman *et al.* (1996) are some examples of these studies. Although a Granger non-causality test result is informative about short-run feedback relationships between stationary variables, it can alone provide no sufficient evidence to assess the existence of the necessary conditions. Fortunately, recent advances in time series econometrics, specifically, the investigation of long-run equilibrium relationships by means of cointegration techniques, offer tests for the existence of the necessary conditions for the validity of the ELG hypothesis. The third category of the related literature includes studies employing cointegration techniques (see, e.g., Oxley (1993), Bahmani-Oskooee and Domaç (1995)[2], Kwan and Kwok (1995), and Kwan *et al.* (1996). Our analysis falls into this final category.

The primary purpose of this paper is to test the validity of the export-led growth hypothesis for Turkish data. Turkey, after the policy regime change of 1980 from an import substitution industrialization strategy to a strategy of outward orientation, has often been cited as a successful example of an export-oriented growth[3]. Thus, Turkey appears to be a natural candidate to investigate

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[1] See Engle et al. (1983) for various exogeneity concepts. An excellent review of the concepts with a special reference to cointegration literature is provided by Ericsson (1992).

[2] Bahmani-Oskooee and Domac (1995) considers Turkish annual data over 1923-1990, and finds that exports and output are cointegrated. In the study, the weak exogeneity properties of the variables are not investigated, and Granger non-causality test results are interpreted as providing evidence supporting bi-directional causality between the variables.

[3] See, for examples, Krueger and Aktan (1992) and Dornbusch (1992). Celasun and Rodrik (1989), Şenses (1991) and Boratav *et al.* (1995) provide reviews of the Turkish economy

this issue.

The plan of the paper is as follows. Section 2 considers a general four-variable system containing real exports, real industrial output, trade-weighted real effective exchange rate and real world output postulated to explain basically exports, and analyzes integration and cointegration properties of the data. Johansen cointegration and weak-exogeneity test results for this system are interpreted in the context of testing for the existence of the necessary conditions for the validity of the ELG hypothesis. In Section 3, a trivariate system obtained by a data-acceptable restriction on the four-variable system is considered. Section 4 considers a bivariate system containing only real exports and real output to test the robustness of the results to the omission of a relevant variable, namely real exchange rates. This bivariate system is the most often considered variable space to test the ELG hypothesis in the literature. Thus, a result suggesting that the test of the hypothesis is conditional upon the system specification may be interpreted as leading us to be cautious on the validity of such bivariate analysis. Section 5 concludes.

2. Long-run relations in a general system for exports

We start with a four-variable system $z_t = (x_t, y_t, rer_t, yw)$ postulated to explain real exports. In the system, X is real exports, Y is real domestic output (proxied by the industrial production index), RER is the real exchange rate for a basket of DM and US $ (a RER increase indicates a real depreciation of the Turkish Lira (TL), and *vice versa*) and YW world output[4]. All series are seasonally unadjusted. Throughout the paper lower-case letters signify natural logarithms of capitals, and Δ denotes the first difference operator defined by $\Delta z_t = z_t - z_{t-1}$. The sample period is from 1970:1 to 1995:4, but effective estimation periods are reduced so as to accommodate the dynamic structure of the estimated equations.

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during the period. For the studies on Turkey's export performance, see Erlat and Erlat (1992), Erlat (1993), Celasun (1994), Arslan and Celasun (1995) and Barlow and Şenses (1995).

[4] Real export (X) is defined as the volume of exports in current US $ deflated by export price index (in US $). The source for the variables used to compute X is the Central Bank of the Republic of Turkey (CBRT) *Quarterly Bulletins*. Due to the lack of quarterly real GNP data for the sample period, the CBRT industrial production index (quarterly averages) is used as a proxy for Y. The trade-weighted effective exchange rate (RER) is taken from the CBRT *Monthly Bulletins* for the post-1980:1 period. Values for the sample prior to 1980:1 are calculated by using the CBRT formulation and data sources. The real world output (YW) is proxied by the industrial production index for all industrial countries taken from the *International Financial Statistics* (IFS) CD-ROM. The data can be obtained by request from the authors at their internet addresses.

The integration properties of the individual series in the system are investigated by conducting augmented Dickey-Fuller (1981) (ADF(k)) tests with the lag length (k) selected to remove any manifest serial correlation. The results recorded in Table 1 suggest that each of the variables in z_t is integrated of order 1 (I(1)). This evidence is consistent with the results of the multivariate statistics presented below which suggest the strong rejection of the null hypothesis of stationarity for each of the variables in the system.

Table 1

Augmented Dickey-Fuller (ADF) Test Statistics

	Levels		First differences
Series	$\lambda_t(k)$	$\lambda_m(k)$	$\lambda_m(k)$
y	-2.08(4)	-0.62(4)	-5.43(3)*
x	-2.10(6)	-0.77(6)	-5.42(5)*
rer	-2.15(4)	-0.36(4)	-6.60(3)*
yw	-3.12(4)	-1.23(4)	-4.87(4)*

Notes: All the test regressions contain three seasonal dummies and a constant term. The equations for λ_t include a linear trend as well. Numbers in parentheses are the lags (k) used in the augmentation of the ADF regression. An asterisk (*) indicates that the unit root null hypothesis is rejected at the 5 % level, using MacKinnon (1991)'s critical values.

For the 4x1 system z_t, we consider a reparameterized VAR(k) process:

$$\Delta z_t = \Pi z_{t-1} + \Gamma_1 \Delta z_{t-1} + ... + \Gamma_{k-1} \Delta z_{t-k+1} + \mu + \delta D_t + \varepsilon_t \quad (1)$$

where μ is a vector of constants, D is a matrix of centred seasonal dummies and ε_t is a multivariate disturbance term. Given that each of the variables in z_t is I(1), the equation is unbalanced unless the rank of Π, denoted by r, is such that $0 < r < 4$. For $0 < r < 4$, Π can be expressed as $\Pi = \alpha\beta'$, where α and β are 4 x r matrices of full column rank. The columns of the matrix β are cointegrating vectors, and α is the matrix of adjustment coefficients. Under these conditions, the system (1) can be interpreted as representing a vector error correction mechanism (VECM) for long-run endogenous variables:

$$\Delta z_t = \alpha\beta' z_{t-1} + \Gamma_1 \Delta z_{t-1} + ... + \Gamma_{k-1} \Delta z_{t-k+1} + \mu + \delta D_t + \varepsilon_t \quad (2)$$

A necessary condition for the long-run weak exogeneity of a variable in the system, say z_{it}, is that no error correction term is significant ($\alpha = 0$) in the Δz_{it} equation. Johansen (1988, 1995) and Johansen and Juselius (1990) provide a maximum likelihood procedure for cointegration analysis of an I(1) system, and it is this method we shall employ in this paper.

We started with VAR (5) and based our final choice of k on both information-based tests (Schwarz (SC) and Hannan-Quinn (HQ)), and an

approximate F-form of the likelihood ratio (LR) statistic to test sequentially the joint significance of the parameter estimates of the short-run coefficients Γ_i under the maintained VAR(k-j), $1 \leq j < k$, null against the VAR (k) alternative. Table 2 reports the results. The LR tests (adjusted for degrees of freedom, see Doornik and Hendry, 1994) of sequential system reductions from VAR(k, k = 5,4,3) to VAR(2) are all insignificant at the 5 % level. The sequential reductions from VAR(k, k= 5,4,3,2) to VAR(1), however, are all strongly rejected. These results show that it is statistically acceptable to simplify sequentially from VAR(5) to VAR(2) but not to VAR(1). This choice of k=2 is also supported by both the SC and HQ criteria[5].

Table 2

Some statistics for the sequential reduction from VAR(5) to VAR(2)

Null hypothesis				Maintained hypothesis			
VAR(k)	p	SC	HQ	VAR(5)	VAR(4)	VAR(3)	VAR(2)
VAR(5)	96	-21.52	-23.02				
↓							
VAR(4)	80	-21.97	-23.21	1.39			
↓				F(16,220)			
VAR(3)	64	-22.45	-23.45	1.34	1.27		
↓				F(32,267)	F(16,232)		
VAR(2)	48	-22.92	-23.67	1.38	1.35	1.42	
↓				F(48,279)	F(32,281)	F(16,245)	
VAR(1)	32	-22.84	-23.34	2.33*	2.59*	3.22*	5.02*
				F(64,284)	F(48,284)	F(32,296)	F(16,257)

Notes: The first four columns report the results for VAR(k): p is the number of unrestricted parameters in VAR(k), SC and HQ are the Schwarz and Hannan-Quinn information criteria, respectively. The last four columns report the approximate F-form of the likelihood ratio test for testing the null hypothesis against the maintained hypothesis, and the degrees of freedom for the F statistic (in parentheses). See Doornik and Hendry (1994) for details of these statistics. Here and elsewhere in this paper an asterisk (*) indicates rejection at the 5 % level.

[5] The appropriateness of this choice depends also on the empirical validity of the maintained system. For this, we considered also the residual diagnostics offered by Pc-Fiml 8.0. The diagnostics for each of the systems considered, however, were not significantly different from each other, and hence did not suggest a particular choice of k. Furthermore, the results of N-Increasing Chow Tests (see Doornik and Hendry 1994) suggested the non-rejection of the parameter constancy null for each of the equations in the VAR(2) system. According to these results (not reported to save space but available on request), VAR(2) can be interpreted as a valid approximation of the data generation process for at least one of the variables in z_t.

Table 3
Cointegration analysis for the general system

Eigenvalues (λ)	0.339	0.126	0.088	0.007
Hypotheses	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
λ_{max}	42.27*	13.69	9.38	0.67
λ^{df}_{max}	38.96*	12.62	8.64	0.62
95% fractiles	27.1	21.0	14.1	3.8
λ_{trace}	66.01*	23.74	10.05	0.67
λ^{df}_{trace}	60.84*	21.88	9.26	0.62
95% fractiles	47.2	29.7	15.4	3.8
Standardized eigenvectors β				
variable	β_1	β_2	β_3	β_4
x	1.000	0.395	-0.378	-0.185
y	-0.890	1.000	1.915	-0.891
rer	1.520	0.021	1.000	0.237
yw	-0.453	-4.290	-1.073	1.000
Standardized adjustment coefficients α				
equation	α_1	α_2	α_3	α_4
Δx	-0.610	-0.020	0.030	0.020
Δy	-0.005	-0.008	-0.046	0.004
Δrer	-0.135	-0.004	-0.000	-0.011
Δyw	-0.011	0.016	-0.000	0.000
Multivariate statistics for testing stationarity: $Q_s \sim \chi^2(3)$				
Variable:	x	y	rer	yw
	40.89*	41.17*	39.67*	39.70*

Notes: The critical values (CV) for λ_{max} and λ_{trace} are from Table 2 of Osterwald-Lenum (1992).

In Table 3, we report the results of the cointegration analysis obtained by the estimation of (1) with the lag length $k = 2$. The maximal eigenvalue (λ_{max}) and trace (λ_{trace}) statistics strongly reject the null of no cointegration ($r = 0$), but not the null of at most one cointegrating vector ($r \leq 1$), so that there appears to be a single cointegrating vector for the system. Statistics with degrees of freedom adjustment (see Reimers, 1992), λ^{df}_{max} and λ^{df}_{trace}, also support this result.

Table 3 reports also the values of a multivariate statistic Q_s for testing the stationarity of a given variable in the system. This statistic tests the restriction that the coefficients of the designated variable and the rest of the variables in the maintained cointegrating vector are unity and zero, respectively. For instance, the I(0) null for x when $r = 1$ implies that $\beta_1' = (1\ 0\ 0\ 0)$. The results of Q_s, under the assumption that $r = 1$, suggest the rejection of the stationarity null

strongly for each of the variables in z_t.

The first vector β_1 normalized by x_t can be interpreted as representing a long-run export equation:

$$x_t = 0.89y_t - 1.52rer_t + 0.45yw_t$$
$$(26.3)^* \quad (10.5)^* \quad (28.6)^* \quad (0.7)$$

The values in parentheses are the LR statistics to test the hypothesis that the corresponding variable can be excluded from the long-run relation (see Johansen and Juselius, 1990). The test statistics (to be compared with a $\chi^2(1)$ distribution under r = 1) strongly suggest that all variables except yw are individually significant in the cointegration vector. The real exports equation coefficient estimates are all consistent with their expected a priori signs. However, real world income appears to be statistically insignificant in determining Turkey's long-run real exports during the sample period. This may be due to the possible inappropriateness of YW as a proxy for the real incomes of Turkey's main trade partners.

The normalized adjustment coefficients for the first vector β_1 are:

$$\alpha_{\Delta x} = \underset{(25.9)^*}{-0.610}, \quad \alpha_{\Delta y} = \underset{(0.02)}{-0.005}, \quad \alpha_{\Delta rer} = \underset{(6.45)^*}{-0.134}, \quad \alpha_{\Delta yw} = \underset{(2.06)}{-0.011}$$

The adjustment coefficient vector α_1 suggests that the main effect of the (lagged) disequilibrium $\beta_1'z_{t-1}$ is on real exports and to a significant extent on real exchange rates, whereas its influence on the evolutions of real domestic output (y) and world output (yw) real income is almost zero. Since Turkey can reasonably be classified as a small country in the world market for her aggregate exports, the result for yw can be interpreted as being perfectly consistent with the priors of international trade theory. The result for the domestic income, however, does not support the ELG hypothesis. The values in parentheses record the LR tests for the significance of the predicted error correction terms in the corresponding equations. As shown in Johansen (1992), these tests are equivalent to the corresponding variable being weakly exogenous for the long-run parameters in β_1, and under r = 1, they are asymptotically distributed as $\chi^2(1)$. The long-run weak exogeneity of exports in the system is strongly rejected. Real output, on the other hand, appears to be weakly exogenous for the parameters of the long-run export equation. This result suggests the rejection of the validity of the ELG hypothesis for the Turkish data. Real world output is weakly exogenous as expected. Consistent with the theoretical argument that the evolutions of real exchange rates and exports in an open economy is not independent of each other, the weak exogeneity null for the rer in the system is strongly rejected.

3. Trivariate system cointegration analysis

Table 4 reports the results of cointegration analysis for the trivariate system containing real exports (x), real output (y) and real exchange rate (rer). According to the maximal eigenvalue and trace statistics, there exists one cointegrating vector in the system. The results of the multivariate stationarity statistic Q_s, suggest the rejection of the I(0) null strongly for each of the variables in the system.

The first vector β_1 normalized by x_t represents a long-run export equation:

$$x_t = 1.009y_t - 1.63rer_t$$
$$(26.9)^* \quad (15.0)^* \quad (25.9)^*$$

The LR statistics to test the hypothesis that the corresponding variable can be excluded from the long-run relation (in parentheses) strongly suggest that all the variables are individually significant in the cointegration vector.

The coefficient estimates of the real exports equation are approximately the same as those estimated for the four-variable general system. The long-run income elasticity of exports is unity. The elasticity of exports with respect to real exchange rate is approximately -1.5. This elasticity is substantially larger (in absolute value) than the one estimated by Krueger and Aktan (1992) (-0.43), but within the range of those estimated by Arslan and Celasun (1995) (around -1.0) and Barlow and Şenses (1995) (-1.88 for manufactured exports and -0.44 for agricultural exports). This significant high elasticity is consistent also with the findings of Erlat and Erlat (1992). The high real exchange rate elasticity of exports, as noted by Arslan and Celasun (1995: 148) "underline the central role of real exchange rates in Turkey's export performance in the 1980's". Significant relative price responsiveness of Turkish exports suggests that a variable space excluding real exchange rates may be expected to be unsuccessful in explaining exports, and may therefore not provide a valid system to test the ELG hypothesis. The effects of omitting this relevant variable are investigated in the following section.

The normalized adjustment coefficients for the first vector β_1 are:

$$\alpha_{\Delta x} = -0.512, \quad \alpha_{\Delta y} = -0.010, \quad \alpha_{\Delta rer} = -0.118$$
$$(22.53)^* \qquad (0.11) \qquad (6.24)^*$$

Table 4
Cointegration analysis for the trivariate system

Eigenvalues (λ)	0.302	0.072	0.006
Hypotheses	$r = 0$	$r \leq 1$	$r \leq 2$
λ_{max}	36.74*	7.67	0.60
λ^{df}_{max}	34.58*	7.22	0.56
95% fractiles	21.0	14.1	3.8
λ_{trace}	45.01*	8.27	0.60
λ^{df}_{trace}	42.36*	7.78	0.56
95% fractiles	29.7	15.4	3.8
Standardized eigenvectors β			
variable	β_1	β_2	β_3
x	1.000	0.300	1.630
y	-1.009	1.000	0.601
rer	1.630	-4.638	1.000
Standardized adjustment coefficients α			
equation	α_1	α_2	α_3
Δx	-0.512	0.060	0.003
Δy	-0.010	-0.064	-0.001
Δrer	-0.118	-0.071	-0.002
Multivariate statistics for testing stationarity: $Q_s \sim \chi^2(2)$			
Variable:	x	y	rer
	36.06*	35.53*	34.11*

Notes: The critical values (CV) for λ_{max} and λ_{trace} are from table 2 of Osterwald-Lenum (1992).

The adjustment coefficients suggest that the main effect of the (lagged) disequilibrium $\beta_1'z_{t-1}$ is basically on real exports and, to a relatively smaller extend, on real exchange rates. Real output, on the other hand, responds very little, if at all, to the disequilibrium. The adjustment coefficient vector indicates a rapid adjustment (approximately two quarters) of real exports to disequilibria arising from changes in real exchange rates and/or real output. Such a rapid adjustment can be interpreted as being consistent with the high price responsiveness of Turkish exports. The adjustment of real exchange rates is relatively slow. When tested formally, only the real output appears to be weakly exogenous in the trivariate system. As for the four-variable case, this result strongly rejects the validity of the export-led growth hypothesis for the Turkish data.

4. An omitted relevant variable case: Bivariate system analysis

The empirical literature often considers a bivariate system containing exports and output to test the ELG hypothesis. In this section, we consider such a bivariate system which excludes a relevant variable, -namely, real exchange rates-, in explaining exports, and investigate the implications of this misspecification on the issue.

Table 5 reports the results of the cointegration analysis for the bivariate system containing real exports (x) and real output (y). The maximal eigenvalue and trace statistics do not reject the null of no cointegration ($r = 0$) even at the 10 % level, so that there appears to be no cointegrating vector for the system. As the no-cointegration null was strongly rejected for the trivariate system, this result is clearly due to the omission of the relevant variable rer. Therefore, it may be argued that the specification of the correct variable space to explain the variable(s) of interest (exports and/or output) is crucially important for testing the existence of the necessary conditions for the validity of the ELG hypothesis.

Table 5

Cointegration Analysis for the Bivariate System (Omitted Relevant Variable Case)

Eigenvalues (λ)	0.099	0.004
Hypotheses	$r = 0$	$r \leq 1$
λ_{max}	10.67	0.433
λ^{df}_{max}	10.25	0.416
95% fractiles	14.1	3.8
λ_{trace}	11.10	0.433
λ^{df}_{trace}	10.66	0.416
95% fractiles	15.4	3.8

Notes: The critical values (CV) for λ_{max} and λ_{trace} are from table 2 of Osterwald-Lenum (1992).

5. Conclusions

This paper investigated the validity of the export-led growth hypothesis for the post-1970 quarterly Turkish data using Johansen cointegration procedures. We considered three alternative systems nested by a four-variable space postulated to explain aggregate real exports. We then tested the robustness of the results to an omitted relevant variable.

The no-cointegration null for the variables in the four-variable (real exports, real output, real exchange rates and real world output) general system was rejected in favour of one. However, neither the hypothesis that real world output can be excluded from the long-run relation nor its weak exogeneity rejected. Thus, we omitted this variable and considered a trivariate system. The results suggested that the stationary combinations of the variables in these two systems could be interpreted as valid long-run export equations with a unitary income elasticity and a high (around -1.5) real exchange rate elasticity. With its crucial role in the long-run evolution of Turkish exports, a variable space excluding real exchange rates may be expected not to provide a valid system to test the ELG hypothesis. The results suggested that the non-rejection of the no-cointegration null for the bivariate system containing real exports and real output was due to the omission of the relevant variable, namely, the real exchange rate.

The cointegration vectors for the relevant systems explain real exports with real output being weakly exogenous for the parameters of the corresponding long-run exports equations. This result is inconsistent with the ELG hypothesis which states that output is the endogenous variable in a variable space containing exports and output. In contrast, the evidence reveals an economy in which the long-run evolution of real output cannot be explained solely by an export variable space. To conclude, the analysis has provided no support for the validity of the ELG hypothesis for Turkey.

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Özet

İhracata Dayalı Büyüme Hipotezi ve Türkiye Verileri: Ampirik Bir İnceleme

Bu çalışmada ihracata dayalı büyüme hipotezinin 1970 sonrası üç aylık Türkiye verileri için geçerliliği Johansen eşbütünleşme yöntemleri kullanılarak sınanmaktadır. Toplam reel ihracatı açıklamayı hedefleyen dört değişkenli bir uzayın kapsadığı üç sistemin incelendiği bu çalışmada, eşbütünleşme ve uzun dönem zayıf içsellik sonuçlarının geçerli değişkenlerin dışarda bırakılmasına duyarlılığı araştırılmaktadır. Sonuçlar reel ihracat ve reel gelirden oluşan ikili uzayda eşbütünleşme olmadığı hipotezinin reddedilememesinin gerekli bir değişken olan reel döviz kurlarının dışarda bırakılmasından kaynaklandığını göstermektedir. İkili uzaya reel döviz kurları eklenince eşbütünleşme olmadığı hipotezi reddedilmektedir. Aynı sonuç, dünya reel gelirinin eklendiği dörtlü sistemde de görülmektedir. Sistemlerdeki eş bütnleşme vektörleri reel ihracatı açıklamakta, ve reel gelir uzun dönem reel ihracat denklemi parametreleri için zayıf dışsal bulunmaktadır. Bu sonuç, ihracata dayalı büyüme hipotezinin Türkiye verileri için geçerli olduğu hipotezini reddetmektedir.