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The long-run relation between imports and exports in an LDC: Evidence from Turkey

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Abstract

The purpose of this paper is to investigate the relationship between exports and imports in Turkey. In the paper cointegration analysis is employed using annual data for the period 1947-90. The major finding is that the long-run relationship between exports and imports disappears when imports of raw materials are excluded from the analysis. This implies that policies aimed at encouraging exports will be successful if Turkey reduces its reliance on imported raw materials by developing domestic substitutes.

1. Introduction

Most previous empirical researchers who employed time-series data to estimate their models, did not pay attention to the stationarity of their data. They relied on standard t-ratios to infer the significance of their estimated

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coefficients. However, it has now become clear that when data are non-stationary, such as most macroeconomic variables, the t-ratios cannot be used for statistical inferences. Cointegration analysis is a recent development aimed at remedying the above mentioned problem. Cointegration analysis has been used to establish the long-run relationship among many variables or to estimate the variety of economic models. The most well known areas for which the cointegration analysis have been applied are the demand for money (Hafer and Jansen, 1991; Hoffman and Rasche, 1991; Miller, 1991; McNown and Wallace, 1992; Bahmani-Oskooee and Hyun-Jae, 1994) and the purchasing power parity (McNown and Wallace, 1989; Kim, 1990; Layton and Stark, 1990; Bahmani-Oskooee, 1993).

When Granger (1986: 213) tried to explain the cointegration analysis in an intuitive manner, he made a reference to a pair of variables for which the cointegration technique could be applied, i.e., imports and exports. Of course, with the easy availability of computer packages, it is not too difficult to apply the cointegration technique. It is the economic interpretation and policy implication of the empirical results that make any study interesting. As far as the relation between imports and exports are concerned, to the best of our knowledge two studies have already investigated the long-run relation between imports and exports with different policy implications. Husted (1992) who examined the long-run relationship between the US imports and exports found no simple cointegration and interpreted his finding as an indication of the fact that the US is in violation of its intertemporal budget constraint. However, when Husted introduced a dummy variable into his analysis to capture the 1983 structural change, he found evidence of cointegration which was interpreted as the US current account being sustainable in the long-run. Bahmani-Oskooee (1994) is another study which considered Australia's experience and showed that not only Australia's imports and exports are cointegrated, but the slope coefficient is very close to one. He interpreted his finding not only as an indication of sustainability of Australia's trade balance in the long-run but also as an indication of the effectiveness of fiscal, monetary and exchange rate policies. As Bahmani-Oskooee (1994: 531) wrote "Australia's macroeconomic policies have indeed been effective in making exports and imports converge toward an equilibrium in the long-run".

The purpose of this paper is to investigate the long-run relationship between imports and exports of a developing country, i.e., Turkey from which new policy implications are derived for developing nations. Section 2 briefly explains the method. Section 3 reports empirical results showing that total imports and total exports are cointegrated only when the developments

in the early 1970s are captured in the analysis. However, when imports of raw materials are excluded from total imports, cointegration between total imports and total exports disappears. Section 4 concludes. Data definition and sources are cited in an appendix.

2. Methodology

A casual glance at the literature clearly demonstrates that the tools and the techniques of cointegration have rapidly been assimilated into applied work. In this paper following Husted (1992) and Bahmani-Oskooee (1994) we too employ Engle-Granger (1987) cointegration procedure. The procedure consists of two steps. First, the order of integration of each variable is determined, mostly by the ADF test. For a variable Y, the ADF test is formulated by equation (1).

$$Y_t = \gamma + \delta t + \alpha Y_{t-1} + \sum_{j=1}^{k} \theta_j \Delta Y_{t-j} + e_t \qquad (1)$$

where t is a trend term, Δ is the first difference operator, and e is white noise residuals. The test is whether estimate of $\alpha = 1$. If a variable is found to be stationary, it is said to be integrated of order zero, denoted by I(0). If the first differences are found to be stationary, that variable is said to be integrated of order one, denoted by I(1). In selecting the number of lags, following many other studies we relied upon t-ratios.

Consider now two variables Y_t and X_t, both integrated of order one or I(1). According to Engle and Granger (1987), these two variables will be cointegrated if in the OLS regression of one variable on the other, the residuals (as a proxy for a linear combination) are I(0).

3. Empirical results

In this section we try to investigate the long-run relationship between total nominal exports, TNX, and total nominal imports, TNM, of Turkey using annual data over the 1947-1990 period in one relation and total real exports, TRX, and total real imports, TRM, in another relation. The choice of the 1947-1990 period is due to the availability of data on real variables over this period only. As we indicated before first we need to determine the degree of integration of each variable involved in our analysis. The results of

the ADF test applied to the level as well as to the first differenced variables appear in Table 1.

From Table 1 it is clear that all four variables have achieved stationarity after being differenced once. Thus, they are all I(1) variables. What remains to be determined is the stationarity of the residuals from the cointegration equations in which a trend term is included. The results of the ADF test applied to the residuals along with other information are reported in Table 2.

From Table 2 we gather that at the 5% level of significance the null hypothesis of no cointegration cannot be rejected for any of the four cases. However, at the 10% level of significance the null of no cointegration is rejected in the last cointegration equation, a rather weak result. The positive sign of the slope coefficient in all equations is an indicative of a positive association between imports and exports. Given the size of the adjusted R^2 and highly significant slope coefficients one wonders why there is lack of long-run relationship between imports and exports. To get some more insight to the relationship between TNX and TNM as well as TRX and TRM we plotted them in Figures 1 and 2.

In both figures it is evident that two variables track each other very closely until the early 1970s and they depart there after. In 1970 Turkey experienced major political antagonisms and several economic problems which all together could contribute to a structural break in the relationship between imports and exports. On the political ground, the Justice Party having won the election in 1969 faced growing opposition that resulted in violence in 1970 and 1971. As a result, the military intervened in March 1971 and forced Prime Minister Demirel to resign. The economic problems were several. First, the demand for Central Bank credit to finance budget deficits was growing. Second, servicing of the Turkish external debt was becoming problematic. Third, there was a huge salary increase in the public sector. Fourth, the Turkish lira was devalued by 66%.[1] As Celasun and Rodrik (1989: 622) note "the 1970 devaluation contributed favourably to export and GNP expansion from 1971 to 1973". Finally, like many other oil importing countries, Turkey experienced its first oil price shock.[2] All these political and economic problems could be the contributing factors to the deviation of imports from exports as depicted in Figures 1 and 2. To determine whether such deviations are short-run drifts and whether in the

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1 For more on these points see Onis and Riedal (1993: 26).

2 For a comprehensive study of Turkish economic development see Celasun and Rodrik (1989).

Figure 1

Total Nominal Exports, TNX, and Total Nominal Imports, TNM

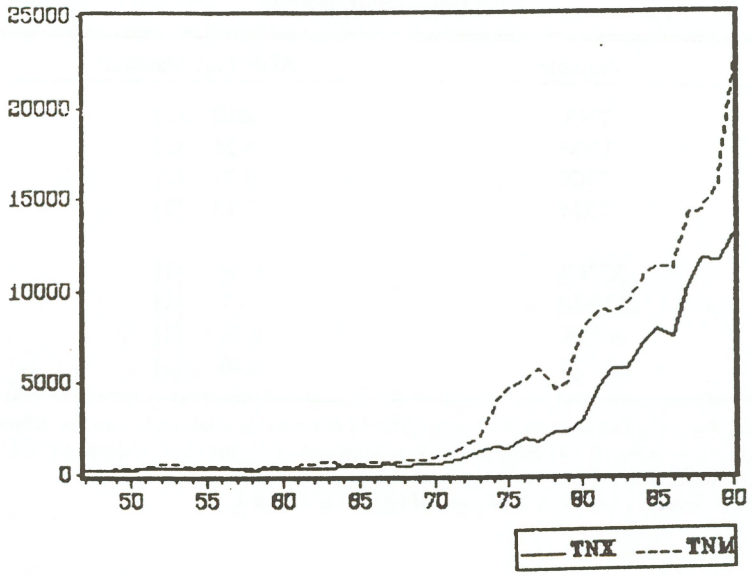

Figure 2

Total Real Exports, TRX, and Total Real Imports, TRM

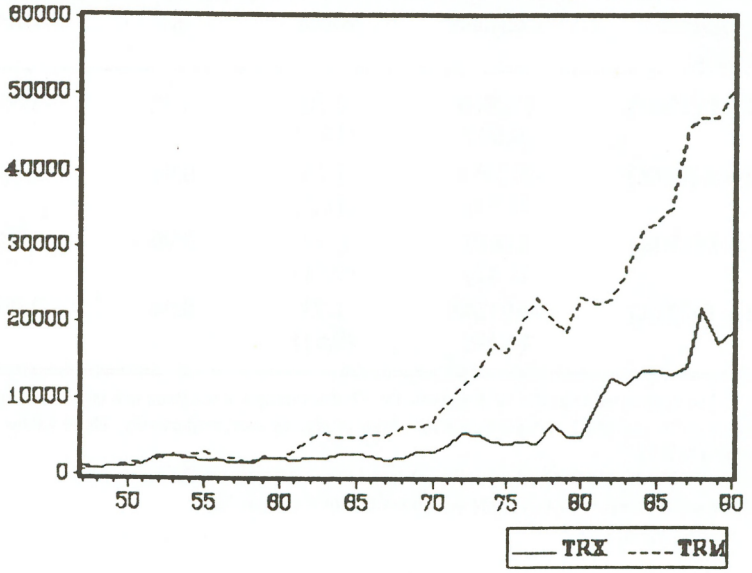

Table 1
Stationarity Tests for the Level and First Differenced Variables over the 1947-1990 period

Variable	ADF Test Statistic[a]
TNX	4.12 [2][b]
TNM	3.24 [2]
TRX	0.39 [2]
TRM	1.12 [2]
ΔTNX	-6.06 [1]
ΔTNM	-4.22 [1]
ΔTRX	-6.75 [1]
ΔTRM	-6.90 [1]

Notes: a. The critical value of the ADF statistic for 53 observations when a trend term is included in the ADF procedure, at the 5% and 10% levels of significance are -3.52 and -3.19, respectively. These values are from MacKinnon (1991).
b. Number inside the bracket is the number of lags in the ADF test.

Table 2
The Cointegration Results

Cointegration Equation	Constant	Slope	R^2	ADF[a]
TNX = f (TNM)	172010 (0.58)[c]	0.70 (16.5)	0.95	-3.65 [1][b]
TNM = f (TNX)	-712453 (1.89)	1.23 (16.5)	0.96	-3.58 [1]
TRX = f (TRM)	11810 (1.82)	0.39 (9.51)	0.90	-3.34 [4]
TRM = f (TRX)	-4891248 (4.14)	1.73 (9.51)	0.94	-3.98 [4]

Notes: a. The critical value of the ADF statistic for 53 observations when there is a trend in cointegration equation is -4.01 and -3.67 at the 5% and 10% level of significance, respectively. These values are from MacKinnon (1991).
b. Number inside the bracket is the number of lags in the ADF test for the residuals.
c. Number inside the parenthesis is the absolute value of the t-statistic.

long-run imports and exports would converge, we carry out the cointegration tests after identifying the beak point in the series and after including the dummy variables in the procedures for testing unit roots and cointegration.

Although the above facts as well as Figures 1 and 2 may give us an indication that the structural break took place in 1970, the impact of the break could take place with some lags. To identify the year of structural break in each variable, we employed the F-Max test of Christiano (1992: 243). The result indicated that most variables experienced a break in 1973. Next, to determine the degree of integration of each variable, we employed the Perron (1989) test which modified the ADF test by including two dummy variables as in equation (2):

$$Y_t = \gamma + \delta t + \eta D + \lambda DT + \alpha Y_{t-1} + \sum_{j=1}^{k} \theta_j \Delta Y_{t-j} + e_t \qquad (2)$$

where D is dummy variable that equals 1 in the post-1973 period (including 1973 itself) and zero in the pre-1973 period. DT is a dummy variable that equals one only in 1973 and zero before and after 1973. The test of unit root in Y or $\alpha = 1$ is basically an ADF test with new critical values provided by Perron. The results of this test for all variables together with the Perron's critical values are reported in Table 3.[3]

As can be seen from Table 3, all variables have achieved stationarity after being differenced once. The last step is to test the stationarity of the residuals from cointegration equations. To this end, following Husted (1992) and Bahmani-Oskooee and Payesteh (1994) we include only dummy variable D in the cointegration equations and test for the stationarity of the residuals using the simple ADF test. The results are reported in Table 4.

The question now is what critical values should be used to judge the significance of the ADF test when a dummy variable is included in the cointegration equation. Here we follow three paths. First, we can rely upon new critical values reported by Husted. He reports critical values of -3.88 and -3.57 at the 5% and 10% significance levels, respectively, for a sample size of 100 observations. Although our sample size is 44, the calculated ADF of the residuals are much less than his critical values, indicating that we can assume stationary residuals. Second, we can follow Ireland and Wren-Lewis

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[3] For applications of Perron's (1989) test see Husted (1992) and Bahmani-Oskooee and Payesteh (1993).

Table 3
Stationarity Test for the Level and First Differenced Variables Using Perron's Test

Variable	Perron's ADF Statistic[a]	
TNX	3.60	[1]b
TNM	2.62	[4]
TRX	0.36	[2]
TRM	-0.12	[3]
ΔTNX	-6.50	[1]
ΔTNM	-4.30	[2]
ΔTRX	-4.42	[4]
ΔTRM	-6.86	[1]

Notes: a. The critical value of the ADF statistic at the 5% and 10% of significance are -3.76 and -3.46 respectively. These values are from Perron (1989: 1376, Table 4.B). Note that the ratio of the pre-break sample size to total sample size is almost 0.6 in this case.
b. Number inside the bracket is the number of lags in the test.

(1992: 221) who argued that since the dummy variable is not stochastic, it could be interpreted as modification to the intercept term. This enables us to use the same critical values when there were two (imports and exports) stochastic variables in the cointegration equations. The ADF statistics in Table 4 are all less than the Mackinnon (1991) critical values (reported at the bottom of the Table), except in the third equation, providing evidence of cointegration between TNX and TNM in the first two equations and between TRX and TRM in the fourth equation. Finally, we can follow Bahmani-Oskooee (1993) and assume that there are three variables in each cointegration equation (exports, imports and D) and use the Mackinnon critical values for cointegration among the three variables. Once again, by this approach there is evidence of cointegration in all cases except in the third equation.

What economic interpretation can we attach to our findings? When imports are the dependent variable in the cointegration equation, the positive slope coefficient means that an increase in exports results in an increase in imports. This is due to the fact that usually, export earnings are used to finance imports. Alternatively, a decline in export earnings brings about a shortage of international reserves which may force policy makers to restrict imports. Similarly when exports are the dependent variable in the

Table 4
The Cointegration Results When the Dummy Variable is Included in the Cointegration Equations

Cointegration Equation	Constant	Dummy	Slope	R^2	ADF[a]	
TNX = f (TNM)	-148440	-1370800	0.74	0.92	-4.68	[1][b]
	(0.51)[c]	(3.07)	(18.2)			
TNM = f (TNX)	-117010	1998200	1.21	0.97	-5.47	[1]
	(0.31)	(3.62)	(18.2)			
TRX = f (TRM)	683560	-2435100	0.43	0.91	-3.58	[4]
	(1.06)	(2.42)	(10.3)			
TRM = f (TRX)	-2910700	6318200	1.68	0.95	-4.56	[4]
	(2.41)	(3.37)	(10.3)			

Notes: a. The critical value of the ADF statistic for 44 observations when there is a trend and two variables in the cointegration equation is -3.99 and -3.67 at the 5% and 10% level of significance respectively. When there three variables in the equation, comparable figures are -4.38 and -4.04. These values are from MacKinnon (1991).
b. Number inside the bracket is the number of lags in the ADF test for the residuals.
c. Number inside the parenthesis is the absolute value of the t-statistic.

cointegration equation, the positive slope coefficient indicates that an increase in imports results in an increase in exports. This is due to the presence of imports of raw materials that are necessary for the production of non-traded goods as well as exportables.[4] To support this conjecture we subtract the imports of raw materials from total imports (call this new imports *partial nominal imports,* PNM, and *partial real imports, PRM*) and carry out the cointegration analysis between imports and exports to determine whether cointegration between exports and imports less raw materials disappears. Table 5 reports the cointegration results with and without the dummy variable in the cointegration equations.

As can be seen from Table 5, in none of the cointegration equations the calculated ADF statistic for the stationarity of the residuals supports cointegration between exports and partial imports (total imports less imports of raw materials), because the ADF statistic in each case is not less than its

[4] Note that the slope coefficient is not close to unity in any of the equations. This is usually interpreted as an indication of the ineffectiveness of fiscal, monetary, and exchange rate policies to bring imports and exports (specially in nominal terms) to an equilibrium.

critical value by any of the three standards which we used in order to assess the cointegration in Table 4.

4. Summary and conclusion

The purpose of this paper is to investigate the relationship between exports and imports in Turkey. Previous studies suggested that these two variables are cointegrated which is considered as an evidence of a long-run equilibrium relationship. In this paper we employed cointegration analysis using annual data for the period 1947-90 to study the relationship between Turkish exports and imports. When the structural break in 1973 was excluded from analysis, we were unable to find evidence of cointegration. However, when the structural break in 1973 was incorporated into cointegration equations, we were able to find strong evidence of cointegration between total imports and total exports. However, the long-run relationship between these variables collapsed when the imports of raw materials were subtracted from total imports.

The major policy implication of our finding could be summarized by saying that if Turkish authorities rely upon import restriction policies, specially imports of raw materials to cope with external imbalances, those policies could result in a decline in Turkey's exports. Conversely, any policy aimed at stimulating exports will result in an increase in Turkish imports. The fact that long-run relationship between exports and imports disappears when imports of raw materials are excluded from the analysis implies that policies directed at encouraging exports will be successful if Turkey reduces its reliance on imported raw materials by developing domestic substitutes. Our conclusion based on our empirical results supports the recent findings and arguments put forward by Little *et al.* (1993) who wrote:

> Historically, countries often responded to balance of payments crises by imposing restrictions on imports. We found that such restrictions usually did not solve the payments problem, and they often starved domestic production of critical inputs or parts, leading to a decline in production.

Table 5
The Cointegration Results when the Imports of Raw Materials are Excluded from Total Imports

Cointegration Equation	ADF[a]
	Excluding the Dummy Variable
TNX = f (PNM)	-3.06 [1][b]
PNM= F (TNX)	-2.99 [1]
TRX = f (PRM)	-2.41 [3]
PRM = f (TRX)	-3.51 [3]
	Including the Dummy Variable
TNX = f (PNM)	-2.39 [4]
PNM= F (TNX)	-2.82 [4]
TRX = f (PRM)	-2.33 [3]
PRM = f (TRX)	-3.07 [3]

Notes: a. The critical value of the ADF statistic for 44 observations when there is a trend and two variables in the cointegration equation is -3.99 and -3.67 at the 5% and 10% level of significance, respectively. When there three variables in the equation, comparable figures are -4.38 and -4.04. These values are from MacKinnon (1991).
b. Number inside the bracket is the number of lags in the ADF test for the residuals.

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Appendix

All data are annual over the 1947-1990 period and obtained from Statistical Indicators published by the State Institute of Statistics, Prime Ministry, Republic of Turkey.

Variables:

TNX = Total Nominal Exports measured in millions of US. dollars.

TNM = Total Nominal Imports measured in millions of US. dollars.

TRX = Total Real Exports measured in tons.

TRM = Total Real Imports measured in tons.

PNM = Partial Nominal Imports defined as total nominal imports (in US. dollars) less nominal value (in dollars) of imports of raw materials.

PRM = Partial Real Imports defined as total real imports (in tons) less real (in tons) imports of raw materials.

Özet

Gelişmekte olan bir ülkede ihracat ve ithalat arasındaki uzun dönemli ilişki: Türkiye örneği

Makalenin amacı Türkiye'de ihracat ve ithalat arasındaki ilişkiyi incelemektir. Bu amaçla 1947-90 yılları için yıllık veriler kullanılarak koentegrasyon analizi yapılmıştır. Makalenin en önemli sonuçlarından bir tanesi, analizden hammadde ithali çıkarıldığında ihracat ve ithalat arasındaki uzun dönemli ilişkinin önemini kaybetmesidir. Bu nedenle ihracatın teşvikine yönelik politikaların başarılı olabilmesi için Türkiye'nin yurtiçi hammadde üretimine önem vererek ithal hammadde bağımlılığını azaltması gerekmektedir.