

**ARE THE TURKISH EXTERNAL DEFICITS SUSTAINABLE?  
EVIDENCE FROM THE COINTEGRATING RELATIONSHIP  
BETWEEN EXPORTS AND IMPORTS**

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**ABSTRACT**

*This paper aims to understand the recent history of Turkish external imbalances by examining the long-run tendency of the Turkish trade balance. The size of the Turkish external deficits especially during the 1990s has worried politicians, academicians and the general public. Following recent work in the field, the paper examines the sustainability of the external deficits in the long-run by employing the cointegration framework.*

**I. INTRODUCTION**

Unit root and cointegration tests have provided useful tools in gaining insight into the long-run implications of a government's or nation's intertemporal solvency. Thus, researchers have attempted to test the solvency condition within the unit root and cointegration framework recently. In short, cointegration is a necessary condition for the economy to be obeying its intertemporal budget constraint. The test determines whether a government or country is likely to be able to sustain its budget or external deficits without defaulting on the debt. Such tests are first found in the literature regarding a government's solvency, beginning with the contribution by Hamilton and Flavin (1986) and developed by Wilcox (1989), Trehan and Walsh (1988, 1991), Hakkio and Rush (1991a), Corsetti and Roubini (1991), Buiter and Patel (1992), Tanner and Liu (1994), Liu and Tanner (1995), Tanner (1995). Özatay (1994) applies the procedure to the Turkish case to test the sustainability of the Turkish public sector deficits. All the above mentioned studies test the sustainability of the government's (internal) deficits in closed economy settings.

In evaluating the sustainability of the external deficits in open economy settings, one may apply the methodology developed by Trehan and Walsh (1991). In Trehan and Walsh's procedure, the stationarity of the discounted real external debt stock is a sufficient condition for sustainability of the external deficits. Alternatively, Hakkio and Rush (1991a) propose a method in which cointegrating (long-run equilibrium) properties of the exports and imports variables are tested. In this framework, cointegration of the exports and imports variables is a necessary condition for the country to have sustainable external deficits (ie. intertemporal external solvency). Both Trehan and Walsh, and Hakkio and Rush start with a balance of payments identity, and then obeying

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### *External Deficits Sustainability*

intertemporal budget constraints, they derive some testable empirical models. Sawada (1994), e.g., gives some clear explanation about the theoretical reasons behind such empirical models. Sawada, using Trehan-Walsh and Hakkio-Rush propositions, reaches some testable sustainability conditions and applies them to some heavily indebted developing countries to evaluate their external solvency. Recently, some works such as Bean (1991), Dolado and Vinals (1991), Trehan and Walsh (1991), Husted (1992), Wickens and Uctum (1993), Bahmani-Oskooee (1994) analyze the sustainability of external deficits (i.e. external solvency) in developed countries. Bahmani-Oskooee and Domac (1995) applies the methodology to the growing Turkish external deficits. They are able to find evidence of cointegration between imports and exports, only when the structural break in 1973 is incorporated into cointegrating equations.

Recent history of the growing Turkish external deficits has caused some concern in both the academic and political worlds on the sustainability issue. The aim of this paper is to investigate the long-run relationship between exports and imports to see if Turkish external deficits are sustainable by employing the cointegration method. The presence of a long-run relationship between Turkish exports and imports would imply that the two series would never drift “too far” apart, i.e. the difference between them is stationary in time although they are not. What we do, in that sense, is to test if the discrepancy between Turkish exports and imports grows without bound or not. The remainder of the paper is organised as follows. Section II sets out the econometric methodology used. The data and empirical results are presented in Section III. The final section offers some concluding remarks on the results obtained.

## **II. ECONOMETRIC METHODOLOGY**

In this paper, Engle and Granger (1987) cointegration procedure<sup>1</sup> is employed following Husted (1992), Bahmani-Oskooee (1994) and Bahmani-Oskooee and Domac (1995). This is a two-step procedure. First, a time series, say,  $X_t$  is said to be integrated of order  $d$  if, after differencing  $d$  times, it becomes stationary, denoted as  $X \sim I(d)$ . Let us now outline the *augmented Dickey-Fuller* (*ADF* hereafter) test procedure for unit roots. In practice, the following model is estimated by OLS:

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<sup>1</sup> There exists a huge literature in this field. For a clear and practical explanation of integration and cointegration procedures, see Charemza and Deadman (1992). For more detailed information, see e.g. Banerjee *et al.* (1993).

$$\Delta y_t = \beta + \alpha t + \delta y_{t-1} + \sum_{i=1}^p \phi_i \Delta y_{t-i} + e_t \quad (1)$$

where  $t$ ,  $\Delta$ ,  $\beta$  and  $e_t$  represent the time trend, the first-difference operator, the constant term and a sequence of uncorrelated stationary error terms with zero mean and constant variance respectively. An easy and appropriate method of testing the order of integration of a series, say  $y_t$ , is suggested by Dickey and Fuller (1979, 1981). The DF test consists of testing the negativity of  $\delta$  in regression (1). rejection of the null hypothesis  $\delta=0$  in favour of the alternative  $\delta<0$  implies that  $y_t$  is stationary (i.e. integrated of order zero,  $y_t \sim I(0)$ ). For equation (1), the  $t$  and  $F$  distributions are not appropriate (due to nonstationarity) for testing the null. Corrected critical value tables of the  $t$  statistic in the ADF regression of (1) are reported by Fuller (1976), MacKinnon (1991), and Charemza and Deadman (1992). Since the distribution of the  $t$  statistic in this case is not known precisely, it should be obtained by simulation, and thus the critical values are subject to some error. The null is rejected if the value of the  $t$  statistic has a larger negative value than the corresponding critical value. In practice, it is not clear whether one should use the ADF regression (1) with or without intercept term and time trend. Charemza and Deadman (1992, 134) argue that regression with intercept term sometimes produce results that are rather difficult to interpret. In the next Section, we report the results with intercept only. But, to ensure the robustness of the results we also checked for the test results without intercept which are in line with our reported test results. Evidence suggest that in practice most macroeconomic data have mixed underlying processes (i.e. a mixture of ‘deterministic’ (TSP) and ‘stochastic’ (DSP) processes). Perhaps, a more reasonable explanation would be that in many cases we have a DSP (difference stationary process) dominant mixed process. This is why we include the time trend in the ADF equation as long as it is statistically significant.

Two time series,  $X_t$  and  $Y_t$  are said to be cointegrated of order  $d,b$  where  $d>b>0$ , denoted as

$$X_t, Y_t \sim CI(d,b), \text{ if:}$$

**(a)** both are  $I(d)$ , and

**(b)** their linear combination  $a_1 X_t + a_2 Y_t$  is  $I(d-b)$ ; that is, the residuals of the long-run regression should be stationary (i.e. integrated of order zero). The vector  $[a_1, a_2]$  is referred to as the "cointegrating vector" (see Engle and Granger, 1987). We employ the ADF test and the residual-based ADF test to determine the integration level and the possible cointegration between the variables

respectively.<sup>2</sup> Therefore, in testing for cointegration we should first make sure that both series are integrated of the same order. Next we estimate the following cointegrating regressions by OLS:

$$X_t = \alpha_0 + \beta_0 Y_t + u_t \quad (2)$$

$$Y_t = \alpha_1 + \beta_1 X_t + u'_t \quad (3)$$

Finally, we test for the stationarity of the residuals from equations 2 and 3 to make sure that  $u_t$  and  $u'_t \sim I(d-b)$ , where  $b > 0$ . e.g. if  $X_t \sim I(1)$  and  $Y_t \sim I(1)$ , in order for  $X_t$  and  $Y_t$  to be cointegrated,  $u_t$  and  $u'_t$  should be  $I(0)$ .

In determining the optimal lag structure in the ADF testing procedure (both for unit roots and cointegration), in addition to t-ratios, we also rely on the model selection criterions of Akaike Information, Schwarz Bayesian, Maximized log-likelihood and Hannan-Quinn since arbitrary choice of the lag structure may easily result in wrong conclusions.

### **III. DATA AND EMPIRICAL RESULTS**

Cointegration is essentially a long-run concept and hence requires long spans of data to give tests for cointegration much power rather than simply large number of observations (Hakkio and Rush, 1991b). We investigate the long-run relationship between total exports,  $X$ , and total imports,  $M$ , both expressed in US dollars using annual data for the period 1950-1996.<sup>3</sup>

When exports are the dependent variable in the cointegrating regression, the positive slope coefficient suggests that an increase in imports results in an increase in exports. This is due to the presence of imports of raw materials that are essential for the production of exportables as well as non-traded goods (for the same point, see Bahmani-Oskooee and Domac, 1995). Similarly, when imports are the dependent variable in the cointegrating regression, the positive slope coefficient implies that an increase in exports results in an increase in imports since export earnings are used to finance imports. If export earnings decline, this will then results in a shortage of foreign currency which in the end may force policy makers to restrict imports.

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<sup>2</sup> Haug (1993) compares seven different residual-based tests for cointegration with the Monte Carlo method. Among the tests considered, Engle-Granger's residual-based ADF test shows the least size distortion.

<sup>3</sup> Note that results with real exports and real imports were not different than those reported in the paper. Results are available on request.

Figure 1 also shows that both variables are clearly nonstationary in levels as they are both subject to a positive trend. Results in Table 1 suggest that both variables are integrated of order two;  $X \sim I(2)$  and  $M \sim I(2)$ . This may be due to spurious roots created by the possible structural break in the series.<sup>4</sup> A brief description of the AOM (additive outlier model) version of the Perron test for integration level for structural break is as follows. This is a two-step procedure (Perron, 1990, 1994; Perron and Vogelsang, 1992):

**1<sup>st</sup> step:** let  $y_t$  be the residuals from a regression (by employing OLS method of estimation) of  $Y_t$  on an intercept term, time trend and  $DU_t$  where  $DU_t = 1$  if  $t > T_b$  and 0 otherwise.

**2<sup>nd</sup> step:** run the following modified regression (by OLS) and test the negativity of  $\alpha$  by using appropriate critical values in Perron (1990, Table 4).

$$\Delta y_t = \alpha y_{t-1} + \sum_{j=0}^k d_j D(TB)_{t-j} + \sum_{i=1}^k a_i \Delta y_{t-i} + u_t \quad (4)$$

where  $D(TB)_t = 1$  if  $t = T_b + 1$  and 0 otherwise.  $T_b$  is the break year.

Our Perron unit root test (*additive outlier model*, AOM version is preferred) results for structural break suggest that (see Table 2), when breaks in the early

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<sup>4</sup> It has recently been argued (esp. Perron, 1989, 1990, 1994) that structural breaks can change the order of integration of the series by, i.e., creating spurious unit roots. In short, a structural break in the mean level is a sort of exogenous intervention to the series. Perron (1990) argues that ignoring these effects can lead to inadequate model specifications, spurious unit roots, poor forecasts and improper policy implications. Perron (1990, 1994) and Perron and Vogelsang (1992), in the same direction, propose a test for integration level for structural break known the ‘Perron test’ (hereafter) and provide the appropriate critical values. What the test does is that it removes a particular break from the noise function and add it to the deterministic part of the series. The noise function is then analysed without the effect of the break (i.e. application of the standard unit root testing). The test should be seen as an improvement in the direction of searching and creating more informative economic time-series. In fact, by employing the Perron test, one is not testing the presence of a structural break. Instead, whether or not the integration level of the series is changed by the structural change, is tested. In contrast to Christiano (1992), the Perron method determines the break data exogenously. For a recent application of the test to some Turkish macroeconomic data, see Utkulu (1997).

### *External Deficits Sustainability*

1980s are taken into account<sup>5</sup>, both series are integrated of order one. To ensure that our hypothesised break year is correctly chosen, we also calculate the split-sample ADF statistics. Our split-sample ADF test results confirm the validity of our choice for break year (available on request).

Table 3 shows the results of the residual-based ADF cointegration test. It is clear from the evidence that the null hypothesis of no cointegration cannot be rejected at 5% significance level, i.e. the estimated residuals are nonstationary. According to this evidence, one is able to conclude that the Turkish exports and imports variables are not cointegrated, which implies that the external deficits in the long-run do grow without bound. Given the size of the  $R^2$  and highly significant slope coefficients one wonders why there is lack of long-run relationship between exports and imports. One possibility is that this is due to a structural change in the mean level in the series involved.

Bahmani-Oskooee and Domac (1995) employs the F-Max test of Christiano (1992) to identify the year of structural break over the 1947-1990 period. Their results indicated that variables experienced a break in 1973. However, using annual data over 1950-1996 period, we failed to observe a break in 1973 when dummy included in the ADF testing procedure. Following the procedure in Bahmani-Oskooee and Domac (1995), we also tried including dummy for 1973 in the cointegrating regression. No significant t-values for the dummy were obtained. However, our search showed (statistically significant) breaks for exports and imports variables in 1980-1981, the year in which Turkey adopted trade liberalisation policies. Accordingly, we include only dummy variable DU for the year 1981 (where  $DU_t=1$  if  $t \geq 1981$  and 0 otherwise) in our cointegrating regressions and test for the stationarity of the residuals using the residual-based ADF test (see Table 4).

There is however a debate in the literature on what critical values should be used to judge the significance of the residual-based ADF test when a dummy variable is included in the cointegrating equations. To the best of our knowledge, there exists three paths. First, we can rely on critical values reported by Husted (1992). He reports critical values of -3.88 and -3.57 at the 5% and 10% significance levels, respectively, for 100 observations. Although, our sample size is 47, the calculated residual-based ADF statistics are much bigger than his critical values, showing that we cannot assume stationary residuals. Second, one can follow Ireland and Wren-Lewis (1992), argued that since the dummy is not stochastic, it could be interpreted as modification to the intercept term. This sort of explanation allows researchers not to regard the dummy as an extra variable and

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<sup>5</sup> Note that dummy for the year 1981 turn out to be the most significant one in the Perron equation for unit roots. We also checked for the early 1970s and 1995 but failed to observe a significant dummy variable in the Perron AOM testing procedure.

use the same critical values. The residual-based ADF statistics in Table 4 are all higher than the MacKinnon (1991) critical values reported in Table 3, providing evidence of no cointegration between relevant variables. Finally, by assuming that there are three variables in each cointegrating regression (exports, imports, DU), we use the MacKinnon critical values for cointegration among the three variables. Once again, there is evidence of no cointegration since we cannot reject the null.

#### **IV. CONCLUDING REMARKS**

The paper analyzes the long-run tendency of the Turkish exports and imports over 1950-1996 by using annual data. We have evidence of no cointegration between exports and imports implying that external deficits are not sustainable (violating its intertemporal budget constraint) in the long-run due to growing external deficits. This finding is not consistent with the evidence from Bahmani-Oskooee and Domac (1995), since they found evidence that Turkish exports and imports are cointegrated when only dummy variable is included in the cointegrating regression.

The empirical evidence provided shows that not only Turkey's exports and imports are not cointegrated, but the slope coefficient is not close to one. Following Bahmani-Oskooee (1994), one can interpret the findings not only as an indication of unsustainability of Turkey's trade balance in the long-run but also as an indication of the ineffectiveness of fiscal, monetary and exchange rate policies. Accordingly, Turkey's macroeconomic policies have been ineffective in making exports and imports converge toward an equilibrium in the long-run. Since it is clear from the evidence that Turkey cannot sustain its trade deficits in the long-run, measures, especially to promote exports to close the gap, are needed to change the current strategy.

#### **APPENDIX**

### *External Deficits Sustainability*

#### Data sources

The data used in this study are annual for the period of 1950-1996 and are taken from the State Institute of Statistics (SIS).

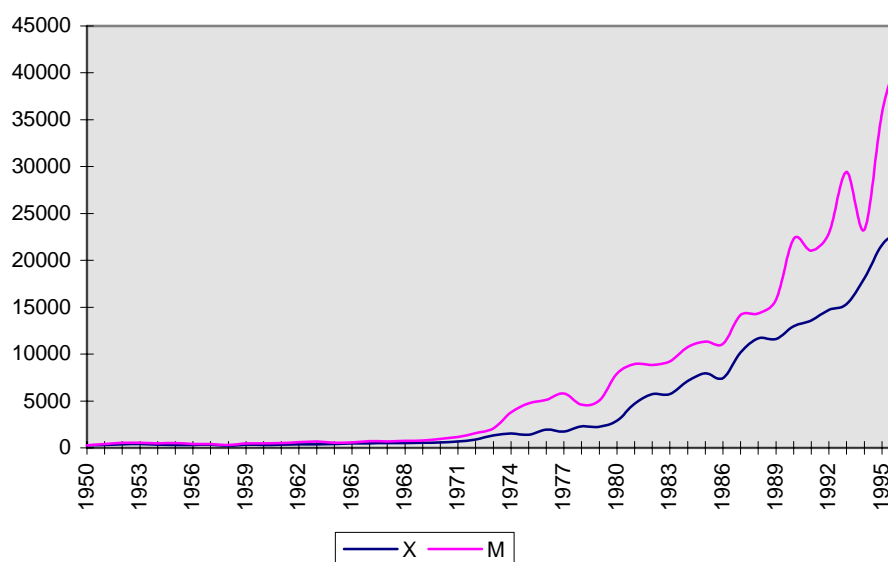
#### Definitions of the Variables

X: Turkish exports expressed in US dollars.

M: Turkish imports expressed in US dollars.

#### Figures

*Figure 1. Exports (X) and Imports (M), 1950-1996*





Tables

Table 1. The ADF test for unit roots

VARIABLE	TEST STATISTIC			CRITICAL VALUE
	levels	1 <sup>st</sup> diff.	2 <sup>nd</sup> diff.	
X	5.07(2)	-1.02(2)	-4.70(5)	-2.94
M	6.87(4)	1.23(4)	-6.93(3)	-2.94

*Notes:* The reported critical values are obtained from MacKinnon (1991), and correspond to 45 number of observations at 5% significance level. The intercept term is included in the ADF equations. The time trend is not included since statistical insignificance. Numbers in parentheses show the order of augmentation sufficient to secure lack of autocorrelation of the error terms.

Table 2. The Perron test for unit roots with structural break: the AOM model

VARIABLE	TEST STATISTIC		CRITICAL VALUE	
	levels	1 <sup>st</sup> diff.	%5	%10
X	-0.78(1)	-3.24(0)	-3.39[0.7]	-3.05[0.7]
M	-0.02(1)	-7.69(0)	-3.39[0.7]	-3.05[0.7]

*Notes:* We use the original critical values for 50 number of observations reported by Perron (1990) and Perron and Vogelsang (1992). The corresponding break fractions are calculated as  $\delta = T_b/T$  where  $T_b$  and  $T$  represent the number of observations until the break year (inclusive) and the whole sample size respectively. Numbers in parentheses in the test statistic columns show the order of augmentation sufficient to secure lack of autocorrelation of the error terms while numbers in parentheses in the critical value column show the corresponding calculated *break fractions* for each variable.

*External Deficits Sustainability*

*Table 3. The residual-based ADF test for cointegration*

Cointegrating Equation	Constant	Slope	R <sup>2</sup>	ADF
X = f(M)	35.0 (0.17)	0.61 (36.1)	0.97	-2.40[3]
M = f(X)	196.4 (0.58)	1.59 (36.1)	0.97	-2.73[3]

*Notes:* The critical value of the ADF statistic for 45 observations is -3.49 at 5% significance level. This value is from MacKinnon (1991). Numbers in brackets show the order of augmentation sufficient to secure lack of autocorrelation of the error terms while numbers in parentheses are the corresponding t-statistics. It is important to note that all the estimated test statistics including the t-values have only a descriptive role since the variables in cointegrating regressions are nonstationary. High R<sup>2</sup> in a cointegrating regression implies that long-run OLS estimators are not substantially biased (see Banerjee *et al.*, 1993).

*Table 4. The residual-based ADF test for cointegration including the dummy variable (DU) in the cointegrating equation*

Cointegrating Equation	Constant	Slope	Dummy	R <sup>2</sup>	ADF
X = f(M, DU)	-55.2 (-0.33)	0.51 (22.4)	2645.0 (5.41)	0.98	-2.57[3]
M = f(X, DU)	258.0 (0.82)	1.82 (22.4)	-3378.9 (-3.13)	0.97	-2.91[3]

*Notes:* The critical value of the ADF statistic for 45 observations when there are three variables in the cointegrating equations is -3.95 at 5% significance level. This value is from MacKinnon (1991). Numbers in brackets show the order of augmentation sufficient to secure lack of autocorrelation of the error terms while numbers in parentheses are the corresponding t-statistics.

### ÖZET

Bu çalışma Türkiye'nin dış ticaret dengesizliklerinin uzun dönemli yapısını ele almaktadır. Özellikle doksanlı yıllarda dış açıkların ulaştığı boyut kamuoyunu, akademik ve politik çevreleri kaygılandırmaktadır. Çalışma, bu alandaki ekonometrik gelişmeleri dikkate almakta ve sözkonusu dış açıkların uzun dönemde sürdürülebilirliğini "Koentegrasyon analizi" çerçevesinde incelemektedir.

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*External Deficits Sustainability*

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*External Deficits Sustainability*

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