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TURKISH TWIN DEFICITS: AN ERROR CORRECTION MODEL OF TRADE BALANCE

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Abstract

Twin deficit hypothesis mainly states that government budget deficits will cause trade deficits. However, this is not the only theoretically possible relationship between the budget deficit and the trade deficit. On the other extreme if Ricardian equivalence hypothesis holds it is also possible that two deficits are not related at all. In this study these hypotheses between the budget deficit and trade deficit for Turkey between 1987 – 2001 period are examined by using the cointegration methodology and by estimating an error correction model. This enabled us to search the relationship between the internal and external deficits both in the short-run and in the long-run. Our analysis showed that there is a long-run relationship between the two deficits. Also the short-run model yielded that worsening of the budget balance worsens the trade balance. Therefore we have concluded that the twin deficit hypothesis holds, and Ricardian equivalence hypothesis is not valid for Turkey during the study period.

Keywords: Twin deficits, trade deficit, budget deficit, Ricardian equivalence, cointegration, error correction models, unit roots, Turkey.

JEL Classification: F30, F32, F41

I. INTRODUCTION

The simultaneous upsurge of the budget deficits and trade deficits of the U.S. economy in the 1980's, aroused attention to the relationship between budget deficits and trade deficits. The close correlation observed between these two deficits does not imply any causal relation between the two. Therefore, identifying the causal relation between these deficits is important and would have different policy implications. Theoretically, there are four possibilities about the relationship between budget and trade deficits: The first one is called the Twin Deficit Hypothesis. According to this, budget deficit has positive and significant effect on trade deficit or the main cause of trade deficit is the excessive budget deficit. Even though theoretically not very well explained reverse of this relationship is also possible i.e. trade deficits might cause budget deficits, and a natural deduction from this is that two deficits might also be mutually interdependent. Finally the alternative to all these three possibilities is that there exists no relationship between the two deficits; they are independent.

Existing body of literature in this area mainly explores the US data, and the empirical results often yield conflicting conclusions. Enders and Lee (1990) test a two-country model and could not reject the independence of federal and current account deficits for the US economy. On the other hand Bachman (1992), by using the VAR approach and testing for Granger causality between federal deficits, current account deficit and other variables, find evidence for the twin deficit hypothesis. Rosenweigh and Tallman (1993) also look at the relationship between federal and trade deficits and the exchange rate, and find some evidence for twin deficit hypothesis. Similarly Dibooğlu (1997) uses a VAR that consists of an extensive set of macroeconomic variables and his results provide support for the twin deficit hypothesis. In an earlier study Darrat (1988) also by looking at Granger causality between the two deficits, finds that the causality runs both ways, i.e. there is feedback between the twins.

There are also some empirical applications of twin deficits to other countries. Winner (1993) finds out that the Australian data doesn't support the twin deficit hypothesis. Vamvoukas (1999) finds that Greek data supports the twin deficits. In a multicountry analysis Peeters (1999) criticizes the literature for using a partial modeling approach and compares the results of partial modeling with the full modeling approach by using the Global Economic Model for US, Japan, Germany and UK. While the partial modeling approach is more supportive of the twin deficits, the macro model results show that private savings largely offset public saving in the short-run.

In this study, our aim is to test the relationship between budget deficit and trade deficit both in the short-run and in the long-run for the Turkish economy for 1987 - 2001 period with quarterly data, by using the cointegration methodology and an error correction

model. The public sector in the Turkish economy has an important place both as a producer and as a consumer since the 1930's. The stabilization program in 1980 was a significant attempt to reduce the role of the public sector in the economy and the share of the budget deficit in GNP, also to reduce the inflation[1]. Despite all measures, Turkish economy continued to run high budget deficits hand in hand with trade deficits for long periods as seen in Figure 1, where bbal and trbal refer to the budget and trade deficits as percentages of GDP. Thus Turkish data provide a good test case for the twin deficit hypothesis. Though there are some studies that search the link between budget deficits and inflation (Metin (1998), Özatay (1997), Özmen and Koğar (1998)), crowding out (Özmen and Saygılı (1999)) and interest rates (Berüment and Güner (1997), Selçuk (1996)) for Turkish economy, studies about the link between the budget deficit and the external sector deficit are rare.[2]

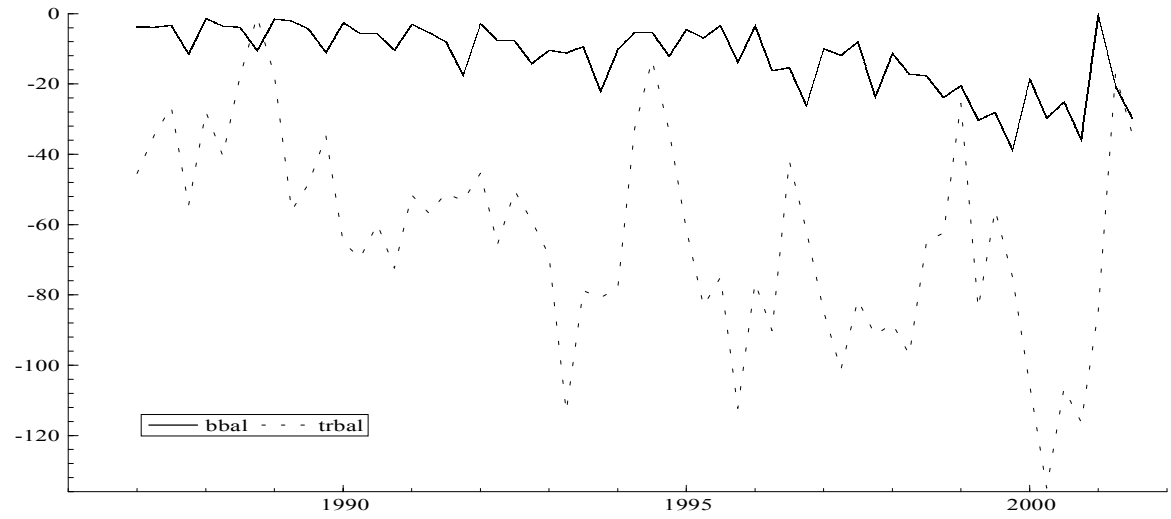

Figure 1. Turkish Twin Deficits

In the study the following plan is followed. In Section II, the theoretical grounds of the twin deficit hypothesis will be briefly discussed. In Section III, the data and the methodology used in this paper will be described. Section IV presents the long-run results and Section V presents the results of the error correction model, while Section VI concludes the paper.

II.THEORETICAL FRAMEWORK

The well-known saving-investment identity could be derived from the national income identity:

$$Y \equiv C + I + G + (X - M)$$

Here the national income; Y equals consumption; C, investment; I, government; G, expenditures plus the net exports; (X-M). One can easily rewrite this identity by using after tax (T) income equals consumption plus savings, S, relationship:

$$S + (T - G) \equiv I + (X - M)$$

This simply states that national savings, which is the sum of private and public savings, equals to private investment plus net exports. Another way of looking at this identity is:

$$(X - M) \equiv (S - I) + (T - G)$$

In this case net exports i.e. the trade balance simply equals to the private saving investment gap plus the budget balance. Thus assuming a stable saving investment gap, an increase in public sector deficit will directly increase the trade deficit, which is the traditional **twin deficit** relationship. But as Feldstein (1992) states it is not always inevitable that all the adjustment in the above identity will come from net exports, if for example investments fall then the adjustment in the trade balance that is required by the increased deficit would be smaller.

Theoretically the mechanism behind the twin deficits could simply be explained through the Keynesian income-expenditure approach. An increase in budget deficits will increase domestic absorption and, therefore the domestic income. Increased income will induce imports and eventually will reduce the surplus or increase the deficit in the trade balance. That is how the public sector and external sector deficits become twins.

In Keynesian open economy models with high capital mobility such as the Mundell-Fleming model, an additional linkage can explain the deterioration in the trade balance due to higher budget deficits. An increase in the budget deficit will cause an increase in the aggregate demand and domestic real interest rates. High interest rates will cause net capital inflow from abroad and result in appreciation of the domestic currency. This in turn will adversely affect net exports due to higher value of the domestic currency and thus there will be deterioration in the current account. It can be claimed that though the mechanisms differ slightly, this conclusion is valid both under fixed and flexible exchange rate regimes.

On the other hand, proponents of the Ricardian Equivalence Hypothesis (REH) claim that there is not a causal link between public sector deficit and external sector deficit; therefore the deficits are not twins. According to this hypothesis, the equilibrium levels of current account, interest rates, investment and consumption will not be affected by the changes in the level of budget deficit. This can be regarded as an extension of the Permanent Income-Life Cycle Hypothesis including government expenditure, taxes and debt. In this framework a change in the level of budget deficit will not change the lifetime budget constraint and real wealth of the consumer. If agents can borrow at a constant interest rate, a reduction in taxes will be regarded as an increase in the present value of future tax liabilities.

The consumers will adjust their savings to the change in the budget deficit and therefore, the amount of desired national savings will not differ. In this model, it is assumed that consumers have infinite horizons and altruistic bequest motives. Also there are no liquidity constraints and there is no uncertainty about the public sector behavior[3].

As a consequence of intertemporal consumption behavior, according to the REH, temporary changes in the level of government expenditures and marginal tax rates are much more important than the ways of financing it. REH proposes that to explain the balance of payments deficit, interest rate, productivity differentials, and temporary increases in the public sector spending could be considered as alternative explanatory variables besides budget deficits.

III. DATA AND METHODOLOGY

In this study general to specific modeling approach is used. This technique makes it possible to deal with non-stationary variables by first analyzing the long-run properties of the model, and including this information from the long-run into the dynamic short-run model explicitly. The long-run properties are analyzed using the cointegration technique developed by Johansen in a series of papers between 1988 and 1995 (Johansen, 1995).

Failure to establish cointegration between non-stationary variables can lead to spurious regressions, which do not reflect long-run equilibrium relationships but rather reflect common trends. In spurious regressions, the results suggest that there are statistically significant relationships among the variables of the model when in fact they are just contemporaneous correlations, not meaningful causal relations. This problem can be overcome by using error correction models, which provide a useful link between the long-run equilibrium relationships and short-run disequilibrium dynamics. When the model involves non-stationary variables; equilibrium is contained in the cointegration relations, i.e., cointegrating relations between the non-stationary variables imply a stationary long-run equilibrium relationship.

The error correction model, which will be estimated, can be represented as follows:

$$\Delta X_t = \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \mu + \varepsilon_t \qquad \textbf{(1)}$$

$$\Pi = \alpha\beta' \qquad \textbf{(2)}$$

where X_t is a px1 vector of stochastic variables, which are I(1), μ represents the intercept term, and the error term ε_t is assumed to be white noise. Since X_t is I(1), if a linear combination of these I(1) variables exists that is stationary then these variables are said to be

cointegrated. If cointegration exists then Engle and Granger (1987) showed that an error correction representation like equation (1) exists for these variables. In equation (1) $\Pi=\alpha\beta'$ is the impact matrix where α is the vector of adjustment coefficients and β is the vector of cointegrating relations and both are pxr matrices. Since the existence of error correction form depends on the cointegrating relations we will first search for the long-run cointegrating relations between the variables of the model and then estimate equation (1) and look at the short-run dynamics between these variables of the model.

The variables of the model consist of the budget balance as a percentage of GDP, **bbal**; trade balance as percentage of GDP, **trbal**; industrial production index, **ipi**; and narrow money as a percentage of GDP, **mon**. The model includes an output term, *ipi* and a monetary term, *mon*, to account for different channels of interaction between the budget deficit and current account deficit. In the Mundell-Fleming model there are two possible channels as explained in section II. One directly works over the domestic absorption and the other through the monetary channels. So the *ipi* and *mon* variables are included as proxies for these channels. [4]

The data set consists of quarterly variables between 1987.Q1-2001.Q3. Budget and trade balances, and GDP are taken from Central Bank of the Republic of Turkey database, and industrial production index and money are taken from IMF-IFS database.

By using this data set we will focus on testing two hypotheses both in the short-run and in the long-run. These hypotheses are:

I. The twin deficit hypothesis: Budget deficit causes trade deficit.

II. Ricardian equivalence hypothesis: There is no link between the two deficits.

The first hypothesis comes from the Mundell-Fleming type models, and work through domestic absorption and capital inflows as explained in section II. Second hypothesis is the alternative to hypothesis I, and is a conclusion of the Ricardian Equivalence hypothesis as explained in section II.

IV. COINTEGRATION ANALYSIS

Initially, stationarity of the data set is checked by using the augmented Dickey-Fuller (ADF) unit root tests (Dickey and Fuller, 1981). Table 1 and 2 [5] summarize these tests. These indicate that all variables are I(1) except *trbal*, which is trend stationary. From Table 2 it is also concluded that all variables are difference stationary.

Table 1 ADF Tests

Vars.	Lags	η_μ	lags	η_τ
bbal	**4**	**-1.713**	**4**	**-2.963**
trbal	**5**	**-2.596**	**4**	**-5.592****
mon	**3**	**-2.339**	**3**	**-0.648**
ıpı	**6**	**-1.326**	**4**	**-2.682**

* significance at 95% ** significance at 99%

Table 2 ADF Tests of the first differences

Vars.	Lags	η_μ	lags	η_τ
dbbal	**3**	**-3.152***	**3**	**-3.054**
dtrbal	**4**	**-4.948****	**4**	**-4.842****
dmon	**3**	**-4.689****	**2**	**-22.10****
dipı	**5**	**-3.767****	**6**	**-4.216****

* significance at 95% ** significance at 99%

Next we determine the long-run properties of the VAR model. Table 3 reports the results of the cointegration analysis for the VAR model with 4 lags [6]. The table includes Johansen's trace statistic that is used to determine the cointegration rank, which involves finding the number of linearly independent columns of Π. The test is a standard likelihood ratio test with non-standard distribution [7]. It tests the null of r=k (k=1,2, ... , n-1) against the alternative of unrestricted r. Results of trace test given in table 3 suggest that the rank is one, since the null of r=1 is not rejected but null of r=0 is rejected at 99%. By looking at these results we will use a single cointegration relationship during the rest of the analysis.

Table 3 Rank Determination for Π

Ho: rank = r	Trace stat.	p value
r = 0	**77.677****	**0.002**
r = 1	**41.316**	**0.070**
r = 2	**19.927**	**0.234**
r = 3	**8.4612**	**0.223**

** significance at 99%

After deciding on the cointegration rank we have tested linear restrictions on α and β. For this model with rank =1, α and β vectors are as given below [7]:

$$\alpha = \begin{bmatrix} \theta_0 \\ \theta_1 \\ \theta_2 \\ \theta_3 \end{bmatrix} \begin{matrix} bbal \\ trbal \\ mon \\ ipi \end{matrix} \quad \beta' = \begin{bmatrix} \overset{bbal}{\theta_4} & \overset{trbal}{\theta_5} & \overset{mon}{\theta_6} & \overset{ipi}{\theta_7} \end{bmatrix}$$

First set of linear tests is weak exogeneity tests, which are linear restrictions on α. The condition for X_{it} in equation (1) to be weakly exogenous for β is that ΔX_{it} does not contain information about the long-run parameters β, and this is achieved if rows of α corresponding to that variable are equal to zero. If a variable is weakly exogenous it means that it is possible to condition the short-run model on that variable without any loss of information. Results of weak exogeneity tests are given in Table 4. The table states that except for *trbal*, weak exogeneity is not rejected with high confidence. Simultaneously exclusion of some of the variables are also tested, exclusion of *mon* and *ipi* together and *mon*, *ipi* and *bbal* altogether are not rejected either. Therefore, we conclude that *mon*, *ipi* and *bbal* are weakly exogenous and that it is possible to condition the short-run model on these three variables.

Table 4 Weak Exogeneity Tests (Linear restrictions on α)

Variables	β unrestricted, rank = 1
bbal	**χ^2 (1) = 1.0435 [0.3070]**
trbal	**χ^2 (1) = 11.810 [0.0006] ****
mon	**χ^2 (1) = 0.0850 [0.7706]**
ipi	**χ^2 (1) = 2.2936 [0.1299]**
mon & ipi	**χ^2 (2) = 2.8597 [0.2393]**
bbal & mon & ipi	**χ^2 (3) = 6.2806 [0.0987]**

* significance at 95% ** significance at 99%

Other types of restrictions that are tested include the linear restrictions on β. By using these restrictions it is possible to test the validity of the twin deficit hypothesis in the long-run. The cointegration vector is restricted by imposing zero coefficients. This way we have tested whether these variables lie in the long-run relationship. So for example to test whether *bbal* lies in the cointegration vector its coefficient is restricted to zero, and tested. Results of these tests are summarized in Table 5.

Table 5 General Restrictions on Π

Restrictions	LR-tests
$\theta_4 = 0$	$\chi^2(1) = 6.4780$ [0.0109]*
$\theta_5 = 0$	$\chi^2(1) = 12.191$ [0.0005]**
$\theta_6 = 0$	$\chi^2(1) = 8.8701$ [0.0029]**
$\theta_7 = 0$	$\chi^2(1) = 1.7956$ [0.1802]
$\theta_4 = \theta_5 = 0$	$\chi^2(1) = 28.298$ [0.0000]**
$\theta_4 = \theta_5 = 1$	$\chi^2(1) = 11.391$ [0.0007]**
$\theta_0 = \theta_2 = \theta_3 = \theta_7 = 0$	$\chi^2(4) = 7.5045$ [0.1115]
$\theta_0 = \theta_2 = \theta_3 = \theta_7 = 0$ & $\theta_4 = 1$	$\chi^2(4) = 7.5045$ [0.1115]

* significance at 95% ** significance at 99%

First the exclusion from the cointegration vector is tested individually for all the variables. These tests are rejected for *bbal* at 95% and for *trbal* and *mon* at 99%. Exclusion of the output term however is not rejected. Also simultaneous exclusion of both *bbal* and *trbal* is tested and rejected. These results first of all will indicate that the Ricardian equivalence does not hold in the long-run, since both *bbal* and *trbal* variables lie in the cointegration vector. These tests are all repeated under the weak exogeneity restrictions, and it doesn't seem to alter the previous results, only the exclusion of *ipi* with the weak exogeneity restrictions is reported as the final row of table 5, since it is the final specification of the cointegration vector that we will use. So the main result from these tests is that there exists a long-run relationship between the budget balance, trade balance and money terms.

Table 6 Restricted Long-run Matrices under $\theta_7 = \theta_0 = \theta_2 = \theta_3 = 0$

Standardized β' eigenvectors

bbal	trbal	mon	ipi
-1.340	**1.000**	**-2.354**	**0.000**

Standardized α coefficients

bbal	**0.000**
trbal	**-0.849**
mon	**0.000**
ipi	**0.000**

Restricted long-run matrix Π=αβ', rank 1

	bbal	trbal	mon	ipi
bbal	**0.0000**	**0.0000**	**0.0000**	**0.0000**
trbal	**1.1375**	**-0.8489**	**1.9987**	**0.0000**
mon	**0.0000**	**0.0000**	**0.0000**	**0.0000**
ipi	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Finally, standardized β eigenvector is given in Table 6, β is normalized over *trbal*. This table shows that in the long-run an increase in the budget deficit will increase the trade deficit or an increase in the budget surplus will increase the trade surplus, therefore the

relationship between the deficits are as indicated by the twin deficit hypothesis. The long-run relationship between the money and trade balance is negative, thus an increase in the money will reduce the trade deficit in the long-run. As a conclusion the cointegration relationship that is found in this section provides some evidence for the first hypothesis and it definitely rejects the second one.

V. ERROR CORRECTION MODEL

In this section we have estimated equation (1) by using our results from section IV. To estimate the error correction model we defined a new variable, **ci**, by using the cointegration vector estimated in the previous section:

$$\text{ci} = -1.34\ \text{bbal} + \text{trbal} - 2.354\ \text{mon} \qquad \textbf{(3)}$$

Figure 2 plots the cointegration relationship *ci*, which is stationary. So an error correction model is estimated by using variables *bbal*, *trbal*, *mon*, *ipi* and *ci*. The model is conditioned

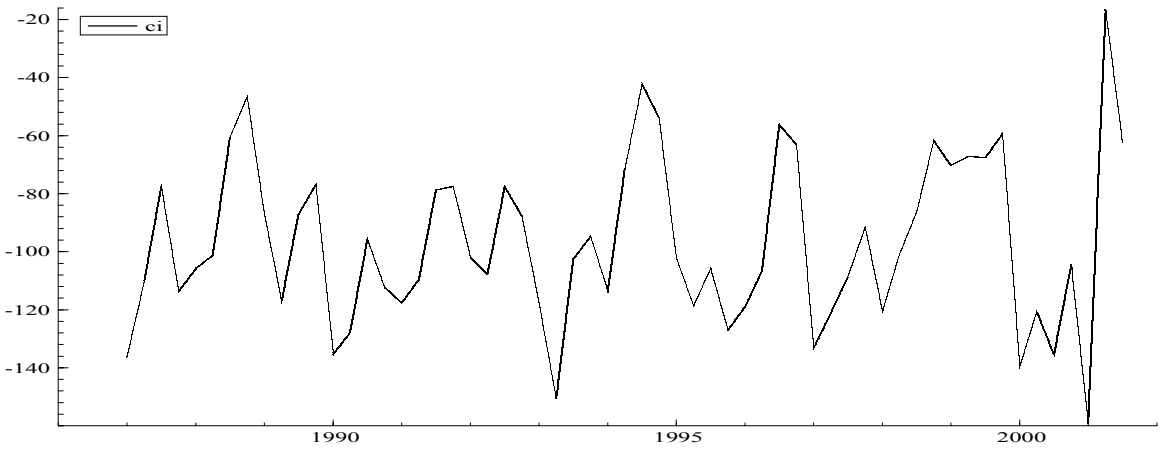

Figure 2. The cointegration vector, *ci*

on *bbal*, *mon* and *ipi* based on the weak exogeneity test results of the previous section. Furthermore, first differences of the variables are used so that all the variables of the model are stationary[9]. Therefore we run a single equation error correction model where *dtrbal* is the endogenous variable and *dbbal*, *dmon* and *dipi* are the exogenous variables and *ci* is the error correction term. The system is estimated by using three lags to be consistent with the long-run analysis since the variables are in first differences.

This short-run model is reduced to achieve parsimony by using sequential F-tests. The reduced short-run model is summarized in Table 7. In the table it is noted that the coefficient of the *ci* term is consistent with the α estimated in the long-run model. The error correction term is also less than zero as expected, suggesting that any movement away from

the long-run equilibrium will be corrected. In terms of the short-run model the relationship between the budget deficit and trade deficit justifies the twin deficit hypothesis; a worsening of the budget deficit will worsen the trade balance or vice versa. However this effect will be influential only after a couple of quarter lags. Also the output variable has the expected effect on the trade balance, an increase in the output will worsen the trade balance. A monetary expansion however will improve the trade balance according to the short-run model.

Table 7 Reduced ECM

Coefficients	dtrbal
dtrbal_1	**-0.5770 (-4.75)****
dtrbal_2	**-0.7129 (-5.56)****
dtrbal_3	**-0.4407 (-3.34)****
dbbal_2	**1.1635 (2.05)***
dbbal_3	**1.6131 (3.16)****
dmon	**0.9854 (2.19)***
dmon_3	**2.4464 (5.57)****
dipi	**-1.9804 (-4.56)****
dipi_1	**-1.8375 (-4.38)****
dipi_2	**-2.4063 (-5.47)****
ci_4	**-0.7837 (-5.56)****
Constant	**-70.717 (-5.02)****
Corr. of actual & fitted	**0.8747**

* significance at 95% ** significance at 99%

Further, the diagnostic tests of the reduced ECM that are given in Table 8 shows that there is not a diagnostic problem with the system. Normality is not rejected, and there are no problems regarding autocorrelation, and autoregressive conditional heteroscedasticity. Also the homoscedasticity of the residuals is not rejected either.

Table 8 Diagnostic Tests of the reduced model

Diagnostic Tests	
AR 1- 4 F(4, 38)	**1.0641 [0.3876]**
Normality $\chi 2$ (2)	**0.1741 [0.9166]**
ARCH 1-4 F(4, 34)	**0.5036 [0.7333]**
Xi2 F(22, 19)	**0.5250 [0.9260]**
Reset F(1,141)	**0.5536 [0.4611]**

In terms of parameter constancy figure 3 shows two graphs; 1-step residuals and break point Chow tests. From these the errors lie within the approximate 95% confidence

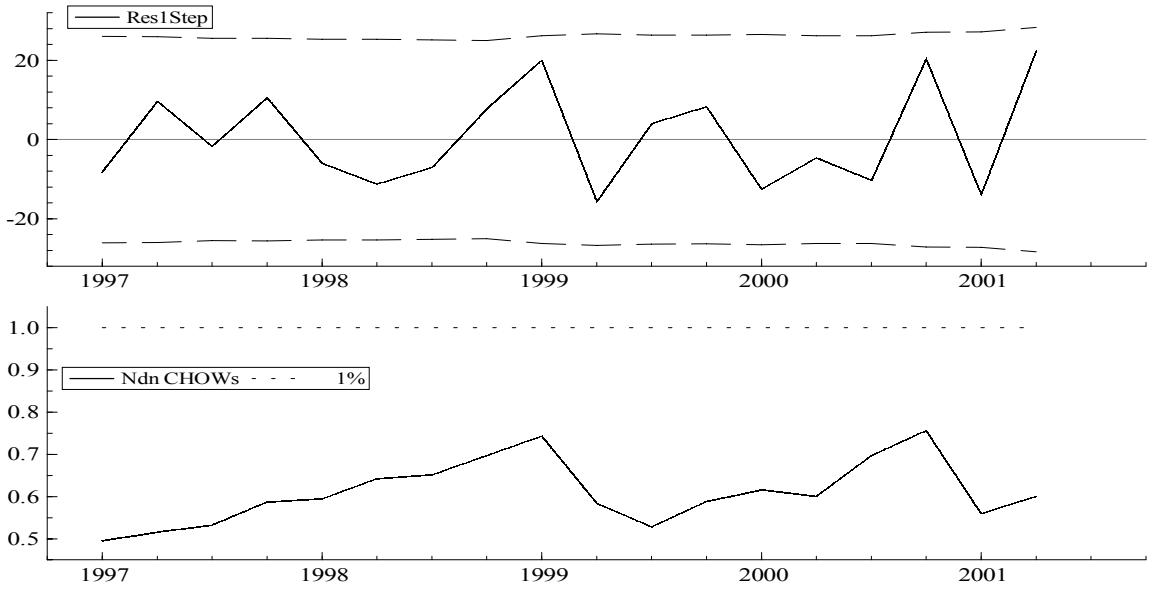

Figure 3. Parameter constancy; 1-step residuals and break-point Chow tests

band with constant standard errors, and all break-point Chow tests lie within the 1% band, and hence non of them are significant. Thus, constancy cannot be rejected.

VI. CONCLUSION

In this paper we have investigated the relationship between the budget deficit and foreign sector deficit for Turkey between 1987–2001 by using the cointegration methodology and by estimating an error correction model. This enabled us to search the relationship between the internal and external deficits both in the short-run and in the long-run. The relationship between the two deficits gives rise to the following hypothesis: The deficits could be twins as stated under Mundell-Fleming analysis; government budget deficits will cause trade deficits under both the flexible and fixed exchange rate regimes. It is also possible that, as Ricardian Equivalence hypothesis suggests these two deficits might not be related at all.

Our analysis showed that in the long-run there is cointegration between the budget deficit, current account deficit and the money term, which can be interpreted as a long-run equilibrium relationship. However, this analysis does not give a conclusive result in terms of the direction of the relationship, i.e. which deficit causes the other. In terms of our long-run analysis all we could say is that the Ricardian Equivalence hypothesis is not validated in the long-run.

The short-run analysis involved estimating an error correction model; our statistical analysis justifies reducing the VAR to a single equation ECM for trade balance. Looking at this model we have concluded that Ricardian Equivalence hypothesis again is not valid for

Turkey in the short-run during the study period. However the twin deficit hypothesis is justified, and budget deficits turns out to have an important influence over trade deficits in the Turkish case for the study period. Thus our study suggests that current attempts at reducing the budget deficit, if successful, would help improving the trade balance soon.

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FOOTNOTES

1 For a comprehensive analysis of Turkish experience, among others one can refer to Nas and Odekon (1988), Celasun and Rodrik (1989), Arıcanlı and Rodrik (1990) and Türel (1999)

2 The only study about the Turkish twin deficits to our knowledge is Kuştepeli and Wallace (1999), which found that both nominal and real government deficits appear to affect the current account deficit from different channels in opposite directions.

3 For a complete discussion of REH, see Seater(1993).

4 The second channel of the Mundell-Fleming model actually works through interest rates. We have also alternatively tried including a measure of short-term interest rates instead of the money variable. However due to heavy domestic borrowing of the public sector to finance large budget deficits during the period, there is a strong, dominant relationship between budget deficits and interest rate. Thus inclusion of the interest rate term dominates the model, and makes it impossible to work the relationship between budget and trade deficits.

5 Lag length for the ADF tests are selected by looking at the Akaike Information Criteria, and the sequential F-tests.

6 Lag length for the VAR system is determined by using sequential F-tests, which reduces the system from VAR(k) to VAR(k-1) starting from k=5. These tests strongly suggest k=4, and rejects further reduction to k=3.

7 Critical values are based on a response surface fitted to the results of Osterwald –Lenum (1992) for different specifications of trend and constant terms.

8 Originally a trend term is included in β vector. Significance of the trend term then tested by comparing the trended model with the non-trended model. The trend term turns out to be not significant as a result of this inquiry.

9 Variables dbbal, dtrbal, dmon and dipi are the first differences of the variables bbal, trbal, mon and ipi. The variable names are such that; dbbal_t shows t lags of the differenced variable.