An aggregate import demand function for Turkey:
The bounds testing approach

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Abstract

This study investigates the aggregate import demand behavior for Turkey using the bounds test procedure by Pesaran et. al. (2001) which is based on the estimate of an Unrestricted Error Correction Model (UECM). This technique generates robust short and long run estimates in small samples, where the integration of the variables are unknown. Using annual data over the period 1982-2002, the results of the bounds test indicate that there is a long run relationship among import demand, real income and relative prices for Turkey. Moreover, the dummy variable employed to investigate the effect of Turkey's European Customs Union membership on import demand. The results showed the dummy variable is statistically significant and positive. The findings suggest that Customs Union has increased the import demand of Turkey.

1. Introduction

Empirical investigation of the import demand function has been one of the most researched areas in international literature since Polak(1950) and Orcutt (1950). For policy purposes such as the balance of payment problem, it is important to know the determinants of import demand. By the estimation of the import demand function, it is possible to predict whether the balance of payment is going to get worse or not. International economists have long been concerned with the estimation of elasticities of the determination of trade flows in this

context. According to Marshall-Lerner condition, a well-known statement in the trade literature, a devaluation of a country's currency will improve the current account balance if the sums of the absolute values of the price elasticities of import and export demand of a country are greater than unity.

After Turkey changed its economic policies, shifting from the import substitution program to the export promotion program under the auspices of the World Bank and the International Monetary Fund in 1980, the share of exports and imports within the gross national product (GNP) has increased in time. However, this increase is more rapid in the ratio of imports/GNP, because the development of Turkish economy has depended heavily on import since nearly 70 % of total imports consist of intermediate manufactured inputs and raw materials. Thus, like many other developing countries, Turkey has consistently faced a negative balance of trade.

The purpose of this paper is to investigate the determinants of Turkish import demand model by using some latest advances in econometric time series modeling to make a contribution to the related empirical literature. Moreover, this study asses the effect of Turkey's European Customs Union membership in 1996 by using a dummy variable.

Erlat and Erlat(1991) estimated export supply, export demand and import demand model using OLS method with annual data over the period 1967-1987. They used relative prices, domestic real income, real international reserves and one period lagged value of the import as explanatory variables to estimate the import demand model. In addition to these, two dummy variables were used to explain the structural shift. Their results indicate that international reserves are most important variable, and relative prices do not have significance.

Kotan and Saygılı(1999) used Engle-Granger two step cointegration procedure and Bernanke-Sims structural VAR method to estimate Turkish import for the period 1987Q1-1999Q1. They used non oil imports as oil imports, nominal rate of depreciation and CPI inflation as relative import prices in their analysis. International reserves that are similar to Erlat and Erlat(1991), income, nominal deprecation rate and inflation were used in the import demand model. According to the results of this paper, although the short run dynamic equation of Engle-Granger and VAR results are compatible, Engle Granger long run equation and accumulated responses of VAR give different results. While exchange rate was found to be the most effective policy tool that had the greatest effect on import demand in

the short run, domestic demand and stock of international reserves were the main determinants of import demand.

Aydın et.al.(2004) analyzed(investigated) import demand model as well as export supply model for Turkish economy using both single equation and VAR frameworks .The sample period covered quarterly data from 1987 to 2003. They used real GDP and real exchange rate to explain Turkish import demand. In addition, a set of dummy variable for seasonal variations was used in the models. The Engle-Granger test results showed that quantity of import, domestic income and relative prices were cointegrated. According to the estimated cointegration relations, the long run income and relative price elasticity were 2.0 and 0.4, respectively. While the short run elasticity of imports with respect to domestic income was 1.2, the short run elasticity of real exchange rate(0.5) was a bit higher than the long run elasticity. According to VAR result, real exchange rate was significant in determining the extents of import and the trade deficit.

In addition, Thomakos and Ulubaşoğlu(2002) empirically analyzed the effects of trade reforms on import demand of Turkey. Import demand elasticities of the 26 product groups were estimated for this analysis. They found that the trade reforms in the 1980s had a significant impact on the imports of several products.

In contrary with above studies, we follow the cointegration technique known as the bounds testing approach, which is based on the unrestricted error correction model (UECM), developed by Pesaran, Shin and Smith (2001). Using this approach, we re-assess the question of whether import and predict variables are cointegrated. Bounds test differs from the traditional cointegration approaches such as Engle-Granger(1987) two-step residual based procedure for testing the null of no cointegration, and Johansen (1991,1995) the system-based reduced rank regression approach . A potential weakness of these techniques is all these methods concentrate on the case in which the underlying variables are integrated of order one. But, it is well known that unit root tests which indicate the presence of a unit root in the time serieshave low power and sometimes inconsistent with each other. Hallam and Zanoli(1993) indicate that Phillips-Perron (1988) is more powerful over Dickey-Fuller(1979) test for testing order of integration especially in small samples. Bounds test technique allows both short and long run relationships to be consistently estimated without knowing precisely the integration properties of the time series appearing in the model.

Other advantage of bounds testing is that the method can be applied in case in which data set is of small sample size, such as in the present study. Pesaran and Shin(1999) show that the OLS estimates of the short-run parameters are super-consistent with $\sqrt{T}$ (T is observation number); and the ARDL based estimates of the long-run coefficient are consistent in small sample sizes. Mah (2000) also shows that the conventionally used cointegration tests such as Engle-Granger(1987) or Johansen-Juselius(1990) are not reliable for small samples. Wadud-Nair (2003) and Narayan and Narayan (2004) employed the bounds test in their studies with small samples.

In addition to the above advantages and simplicity of employing the bounds test, the unrestricted error correction model does not push the short dynamics into residual terms. Thus, UECM has better statistical properties than the Engle-Granger cointegration test (Banerjee et al., 1998). The bounds testing approach is used in the recent researches of the literature on import demand, that have been made by Mah(2000), Bahmani-Oskooee and Goswami(2004), Tang(2002), Tang(2003a), Tang (2003b), Narayan and Narayan(2004). This test has also been employed in the researches other than import demand in the literature of economics[1]. The another difference of this study from the previous studies which are briefly mentioned above, is the inclusion of Turkey's European Customs Union membership in 1996 into the import demand model by using a dummy variable. Thus, the effect of Turkey's European Customs Union membership on import demand will be investigated.

The structure of the paper is organized as follows. Section 2 summarizes the basic import demand function. The econometric methodology is given in Section 3. Empirical results are reported in section 4. Finally, concluding remarks are given in the Section 5.

2. Model specification

The traditional import demand function is widely used to estimate an aggregate import demand behavior in the field of applied econometrics (see Bahmani-Oskooee and Niroomand 1998, Mah 2000, Masih and Masih 2000, Hamori and Matsubayashi 2001, Tang 2002, Tang 2003a, Tang 2003b, Narayan and Narayan 2004). According to the traditional import demand function, import demand

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[1] Among them are Mills and Pentecost (2001), Coe and Serletis (2002), De Vita and Abbott (2002), Atkins and Coe (2002), Wadud and Nair (2003), Tang (2003c), Faria and Leon-Ledesma (2003), Narayan (2004).

is determined by domestic income and the relative import price. Thus, a general function for import demand can be specified as following:

$M_t = f(Y_t, RP_t)$

where at period t, M_t is the volume of real import demand that is nominal import divided by import price deflator; Y_t is real domestic income as measure of economic activity by proposed Goldstein and Khan (1985) ; RP is the relative price of import which is defined as the ratio of import prices to the domestic prices in case of assuming homogeneous responses. The log- linear form of aggregate import demand equation is below:

$$lnM_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 lnRP_t + u_t \qquad (1)$$

where u_t is a random error assumed to satisfy classical assumptions, ln is natural logarithmic transformation. Estimation of Eq.1 will provide long-run estimates of the income (α_1) and relative price (α_2) elasticities. According to economic theory, an increase in the domestic income will increase the country's import. An increase in import price relative to domestic price level reduces demand for import, because imported goods become more expensive. Thus, income and price elasticties are expected to have positive and negative signs, respectively. However, Bahmani-Oskooee and Niroomand (1998) stated that domestic income can increase due to an increase in the production of import substitutes. In this state, the estimation of α_1 will be negative sign. Goldstein and Khan (1976) implied that if import represents the difference between domestic consumption and domestic production of imported goods, domestic production may rise faster than domestic consumption because of a rise in real income. Therefore, import could fall and then estimation of α_1 will be negative. Narayan and Narayan (2004) also noted that the sign on the income coefficient is a priori indeterminate. Thus, we can say that the sign of the income elasticity could be either positive or negative.

3. Econometric methodology

To examine the long-run relationship between quantity of import and explanatory variables, as stated in earlier, we employ the bounds testing approach to cointegration, within an autoregressive distributed lag (ARDL) framework. In this section, we present a brief outline of bounds test procedure proposed by Pesaran et. al.(2001).

Bounds test analysis starts from the unrestricted VAR model of order p (VAR(p)) of the following form:

$$z_t = \mu + \gamma t + \sum_{i=1}^{p} \phi_i z_{t-i} + \varepsilon_t \qquad t=1,2,...., \qquad (2)$$

where $z_t = \left[y_t x_t^{'} \right]^{'}$, y_t is the dependent variable, x_t is a k- vector of explanatory variables. These series, y_t and x_t ,can be either $I(0)$ or $I(1)$; in this paper $Z_t = \left[\ln M_t, \ln Y_t, \ln RP_t \right]^{'} = \left[\ln M_t, X' \right]^{'}$; μ is the vector of constant term, $\mu = \left[\mu_y \mu_x \right]^{'}$; t is a linear trend, $\gamma = \left[\gamma_y, \gamma_x \right]^{'}$ and ϕ_i is a matrix of VAR parameters for lag i. The vector error terms $\varepsilon_t = \left[\varepsilon_{yt}, \varepsilon_{xt} \right]^{'}$ is $N\sim(0,\Omega)$ where Ω is positive definite.

The variance matrix (Ω) of error term (ε_t) as below

$$\Omega = \begin{vmatrix} \omega_{yy} & \omega_{yx} \\ \omega_{yx} & \omega_{xx} \end{vmatrix}$$

Given this, ε_{yt} can be expressed conditionally in terms of ε_{xt} as

$$\varepsilon_{yt} = \omega_{yx} \omega_{xx}^{-1} \varepsilon_{xt} + u_t \qquad (3)$$

where $u_t \sim N(0, \omega_{uu})$, $\omega_{uu} = \omega_{yy} - \omega_{yx} \omega_{xx}^{-1} \omega_{xy}$ and u_t is independent of ε_{xt} .

Using the equation 3, VAR(p) may be rewritten in vector error correction model form (VECM), as follows:

$$\Delta z_t = a_0 + a_1 t + \Pi z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta z_{t-i} + \varepsilon_t \qquad t=1,2,......, \qquad (4)$$

where $\Delta=1-L$ is the difference operator and L is the lag operator .Γ and Π are the short-run response matrix and the long run multiplier matrix respectively, and are as follows;

$$\Gamma_i = \begin{vmatrix} r_{yy} & r_{yx} \\ r_{xy} & r_{xx} \end{vmatrix} = -\sum_{j=i+1}^{p} \phi_j$$

$$\Pi_j = \begin{vmatrix} \pi_{yy} & \pi_{yx} \\ \pi_{xy} & \pi_{xx} \end{vmatrix} = -\left(I - \sum_{i=1}^{p} \phi_i \right)$$

where I is an identity matrix. The diagonal elements of the Π matrix are left unrestricted. This allows for the possibility that each of the series can be $I(0)$ or $I(1)$. $\pi_{yy} =0$ implies that dependent variable is $I(1)$, and $\pi_{yy} <0$ implies that is $I(0)$. There is a zero restriction on one

of the off diagonals of the Π matrix, in other words one of π_{xy} and π_{yx} can be zero. Thus, this technique allows for the testing of the existence of a single long run relationship between related variables.

For cointegration analysis, it is essential that Eq. 2 be modeled as the conditional ECM

$$\Delta y_t = c_0 + c_1 t + \pi_{yy} y_{t-1} + \pi_{yx.x} x_{t-1} + \sum_{i=1}^{p-1} \psi_i' \Delta z_{t-i} + \omega' \Delta x_t + u_t \quad (5)$$

In Eq. 5, π_{yy} and $\pi_{yx.x}$ are long run multipliers. Lagged values of Δy_t and current and lagged values of Δx_t are used to show the short run dynamic structure. Eq. 5 can also be interpreted as an ARDL, and it is estimated using the ordinary least squares (OLS) method.

In order to test for the existence of a long run relationship, Pesaran et. al.(2001) consider two alternatives. The first is Wald test (*F*- statistic) for cointegration analysis under the null hypothesis of no cointegration relationship between the examined variables.

$$H_0: \pi_{yy} = 0, \pi_{yx.x} = 0',$$

$$H_1: \pi_{yy} \neq 0, \pi_{yx.x} \neq 0' \quad or \quad \pi_{yy} \neq 0, \pi_{yx.x} = 0' \quad or \quad \pi_{yy} = 0, \pi_{yx.x} \neq 0'$$

Pesaran et al.(2001) generated two sets of critical values assuming that both regressors are $I(1)$ and both are $I(0)$. The *F* statistic that has a non-standart distribution, depends upon; (i)whether the ARDL model contains an intercept and/or a trend, (ii)the number of regressors, (iii)whether variables included in the ARDL model are $I(1)$ or $I(0)$. If the calculated *F* statistic is higher than the upper critical value, $I(1)$, the null hypothesis of no long-run relationship can be rejected without knowing the order of integration of the regressors. Alternatively, if calculated *F* statistic is smaller than the lower critical value, $I(0)$, the null hypothesis is accepted without knowing the order of integration of the regressors. When the test statistic falls inside the upper and lower critical value, a conclusive inference cannot be made. Then, we must know the order of integration of variables, $I(d)$, for any conclusion can be drawn.

Second is *t*- statistic used to test of the significance of the coefficient of the lagged dependent variable originally proposed by Banerjee et al.(1998).

$$H_0 : \pi_{yy} = 0$$

$$H_1 : \pi_{yy} \neq 0$$

Pesaran et al.(2001) showed that results of both tests are consistent.

The UECM for equation (1) can be written as below:

$$\Delta \ln M_t = a_0 + \sum_{i=1}^{n} a_{1i} \Delta \ln M_{t-i} + \sum_{i=0}^{n} a_{2i} \Delta \ln Y_{t-i} + \sum_{i=0}^{n} a_{3i} \Delta \ln RP_{t-i} + a_4 \ln M_{t-1} \quad (6)$$
$$+ a_5 \ln Y_{t-1} + a_6 \ln RP_{t-1} + a_7 DUM + e_t$$

where $\Delta \ln M$, $\Delta \ln Y$, $\Delta \ln RP$ are first difference of the logarithms of import demand ($\ln M$), real domestic income ($\ln Y$), and relative price ($\ln RP$) respectively. We have also used dummy variable for considering structural break. *DUM* is dummy variable that indicates the acceptance of Turkey into the European Customs Union in 1996.

$$DUM = \begin{cases} 0 & for \quad 1982 - 1995 \\ 1 & for \quad 1996 - 2002 \end{cases}$$

e is a disturbance term assuming white noise and normal distributed.

4. The empirical results

This section reports the empirical results. The empirical work in this study is based on annual time series data covering from 1982 to 2002. The annual data are obtained from the Central Bank of the Republic of Turkey (CBRT). Because a pre-test for unit root of the interested series is not necessary in applying the bounds test for cointegration analysis[2], the first step is to specify an optimum lag length for UECM. Even though three-year lag length is recommended by Charemza and Deadman (1992), we did not use three-year lag length. Due to 21 annual observations, the lag length kept as short as possible.

We tested UECM with lag length of two and one. As a result, a lag length with 2 year, $n=2$ is preferred which minimized Akaike information criterion (AIC) and Schwartz criterion (SC). The estimated UECM for the demand of Turkey import is given in Table 1.

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[2] DeVita - Abbott (2002) and Narayan(2004) used the Augmented Dickey-Fuller(ADF) and the Phillips-Perron(PP) tests to confirm the the stationary level of each variables. Tang (2003) who used bounds test for cointegration relationship test reported the results of ADF and PP tests in Appendix. Also see Tang (2002) and Wadud- Nair (2003) who used PP unit root test; and Faria and Leon-Ledesma(2003) who used ADF unit root test.

Table 1
The Estimated UECM for Turkey Import Demand Function (1982-2002)

Dependent variable: $\Delta \ln M_t$

Variable	Coefficient	t-Statistic
Constant[***]	-18.010	-1.971
$\Delta \ln M_{t-1}$ [***]	0.492	2.218
$\Delta \ln M_{t-2}$	0.357	1.301
$\Delta \ln Y_t$ [**]	1.346	3.380
$\Delta \ln Y_{t-1}$ [**]	-2.294	-3.719
$\Delta \ln Y_{t-2}$ [***]	-1.865	-2.426
$\Delta \ln RP_t$ [**]	-0.634	-3.827
$\Delta \ln RP_{t-1}$ [***]	0.539	2.492
$\Delta \ln RP_{t-2}$	-0.086	-0.585
$\ln M_{t-1}$ [*]	-1.608	-4.233
$\ln Y_{t-1}$ [**]	2.211	3.167
$\ln RP_{t-1}$ [**]	-1.470	-3.449
DUM [**]	*0.543*	*2.971*

[*], [**], [***] Significant at 1%, 5%, 10 % level, respectively.
R^2 : 0.973, Adjusted R^2: 0.911, *F*- statistic: 15.51 (Prob:0.003), Sum Squared Residual: 0.014, D-W:2.144 ,
Jarque-Bera:3.63 (Prob:0.16), Ramsey Reset[1]: 2.58 (Prob:0.10), Breusch-Godfrey, LM test[1]: 2.16 (Prob:0.14), ARCH test[1]:0.03 (Prob:0.84), ARCH test[2]:0.09 (Prob:0.95) ARCH test[3]:0.54 (Prob:0.90).

The estimated UECM with $n=2$ passes a battery of diagnostic tests. The test results show that (1) the model passes the Jarque-Bera normality test suggesting that the errors are normally distributed, (2) Ramsey RESET test rejects the presence of functional mis-specification (3) Breusch-Godfrey LM statistic rejects the present of autocorrelation in the disturbance of the error term, (4) ARCH test rejects the heteroscedasticity in the disturbance of error term. Hence, we can say that the model is well behaved.

Table 2
Bounds Test Results for the Existence of Cointegration

Computed *F*- statistic (Wald test) = 11.5945		H_0: $a_4 = a_5 = a_6 =0$	
Critical value bounds of the *F*-statistic[*]:intercept and no trend			
	k[**]	Lower value	Upper value
1%	2	5.15	6.36

*From Table C1.iii of Pesaran et al. (2001).
**k is the number of regressor.

The calculated F- statistic (Wald test), that is necessary for testing the presence of a cointegration relation among the variables of import demand function, is 11.5945. This value exceeds the upper critical value of 6.36. Then, the null hypothesis of no long-run relationship can be rejected. These results support the findings of Aydın et.al(2004)., They found that the demand of import is cointegrated with its determinants, and these variables tend to move together in the long-run. In other words, there exist a stable long-run level relationship between import and its determinants namely real income and relative prices that can be described as follows:

$$lnM_t = \beta_0 + \beta_1 lnY_t + \beta_2 lnRP_t + \beta_3 DUM + v_t \qquad (7)$$

where β_1 and β_2 derived from the UECM that are the long-run income and relative price elasticity. Bardsen(1989) showed that the long run coefficient can be calculated from ECM, and the long-run income and relative price elasticity is equal to $-(\alpha_5/\alpha_4)$ and $-(\alpha_6/\alpha_4)$ respectively. Pesaran and Shin (1999) indicated that the short-run elasticities are captured by the estimated coefficients of the first-differenced variables in the UECM.

Table 3
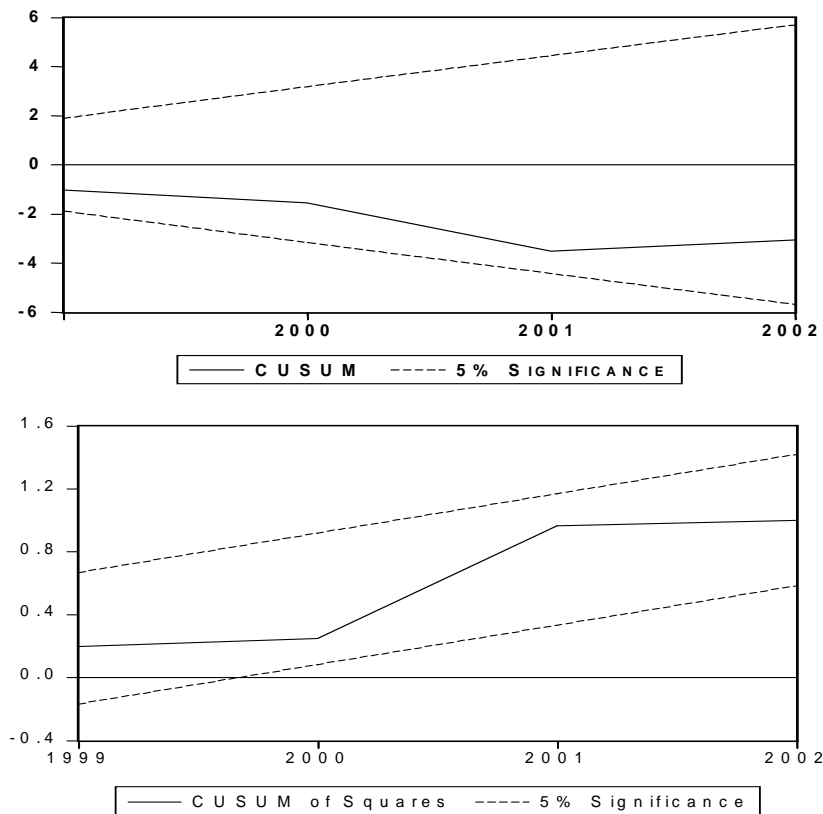Estimated Short-Run and Long-Run Clasticities of Turkey's Import Demand

	Short-run	Long-run
Income elasticities	1.34 (Prob: 0.0197)	1.37 (Prob: 0.0061)
Price elasticties	-0.63 (Prob: 0.0123)	-0.91 (Prob: 0.0013)

*The long run coeffecient of DUM variable is calculated to be 0.33 (Prob: 0.0081).

As can be seen from the results presented in Table3, the estimated income and price elasticities of import are of the apriori expected sign, and are statistically significant. Unlike the findings of Erlat and Erlat(1991), Kotan and Saygılı(1999) and Aydın et.al.(2004), we find that both relative prices and income significantly affect the level of import demand in the short run and the long run. In this analysis, the estimated income elasticities are greater than unity both in long run and short run, and the values of this estimations are close to each other - a 1% increase in domestic income will increase import by 1.34% in short run and 1.37% in long run. According to this result, income-elastic of Turkish import, an increase in real income of Turkey has raised the aggregate import by a greater proportion than real income. Thus, other things being equal, the economic growth

have a negative impact on the trade balance. On the other hand, relative prices have an inelastic impact on import demand. Although the long run price elasticity is found to be inelastic, it is not too far from unity- a 1 % increase in relative prices induces approximately 1 % fall in the import demand-. This means that increase in price would keep the import bill unchanged in long run. Based on the estimated short run relative price elasticity(-0.63), we can say that changes in the relative price have little impact on import demand of Turkey .The dummy variable is statistically significant and has positive sign. This result indicates that joining of Turkey into the European Customs Union has increased import demand of Turkey.

Figure1
Plots of CUSUM and CUSUM of Squares tests for the Estimated
UECM

CUSUM and CUSUM of Squares tests proposed by Brown et al.(1975) are used in testing for constancy of the long-run parameters. As seen from Figure1, CUSUM and CUSUM of Squares tests statistics are inside the 95% confidence interval. Thus, applied CUSUM and CUSUM of Squares tests clearly indicate stability of the estimated parameters of the UECM during the sample period.

5. Conclusions

This paper has investigated the existence of a long-run equilibrium relationship between quantity of imports and its determinants (real income and relative prices term), by applying a new robust estimation method namely the UECM and the bounds test developed in a recent paper by Pesaran et al.(2001). The bounds test results suggest that there is a long run relationship among import demand, real income and relative prices for Turkey. The estimated coefficients from UECM indicate that import demand is relatively elastic in income and relatively inelastic in prices. This result is not surprising for Turkish economy. In order to facilitate its economic development, Turkey needs imported raw materials and intermediate manufactured inputs. Import demand appears to be less sensitive to import price changes than income changes.

This study provides empirical evidence that Customs Union with the European Union has increased import demand Turkey. Customs Union has a negative effect on the trade balance of Turkey. The test results, also clearly indicate that Turkey's import demand stable was during 1982-2002. According to Tang(2003b), this result indicates that stimulation of domestic business conditions in a country will necessarily link to the quantity of imports.

From our results, we deduce that exchange rate policy may be an appropriate tool to improve the trade account balance of Turkey. In addition, we can say that domestic inflation must be kept in check for the balance of payments to improve as domestic prices will increase the volume of imports.

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Özet

Türkiye'nin ithalat talep modeli: Sınırlar (bounds) testi yaklaşımı

Bu çalışmada Türkiye'nin ithalat talebi, Pesaran ve diğ. (2001) tarafından geliştirilen ve kısıtsız hata düzeltme modelinin tahminine dayanan sınırlar test yöntemi kullanılarak araştırılmıştır. Bu yöntem değişkenlerin durağanlık özelliği bilinmediği durumlarda, küçük örneklerde dayanıklı (robust) kısa ve uzun dönem tahminleri sağlamaktadır. 1982-2002 dönemi için yıllık verilerin kullanıldığı çalışmada, sınırlar testi sonuçları Türkiye için ithalat talebi, reel gelir ve nispi fiyatlar arasında uzun dönem ilişkisinin olduğunu göstermektedir. Ayrıca Türkiye'nin Avrupa Gümrük Birliğine üyeliğinin ithalat talebine etkisini araştırmak için dummy değişken kullanılmıştır. Bulgular Gümrük Birliğinin Türkiye'nin ithalat talebini arttırdığı yönündedir.