(REFEREED RESEARCH)

ARMINGTON ELASTICITY OF TURKEY'S IMPORT DEMAND FOR COTTON

TÜRKİYE'NİN PAMUK İTHALATININ ARMINGTON ESNEKLİĞİ

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ÖZET

This study estimates Armington elasticity of Turkey's import demand for cotton by using Autoregressive Distributed Lag (ARDL) method. The estimated long-run elasticity of demand shows that policies on cotton prices might have important economic impacts on domestic production and trade in Turkey. According to the results and based on 2014/15 season figures, a subsidy which decreases the ratio of domestic prices to import prices of cottons by 1 per cent would cost an additional 240 thousand US dollars for the budget and lead some 24 million US dollars decline in the value of imported cotton. On the other hand, an import tax which increases import prices at the same level would have the same effect on imports, while raising an amount of 12 million US dollars tariff revenue.

Keywords: Armington elasticity, cotton, import demand, agricultural trade, ARDL method.

ÖZET

Bu çalışmada, Türkiye'nin pamuk ithalatı talebinin Armington esnekliği Sınır Testi Yaklaşımı (ARDL) kullanılarak tahmin edilmiştir. Uzun dönem talep esnekliği pamuk fiyatlarına yönelik politikaların Türkiye'nin üretim ve ticareti üzerinde önemli ekonomik etkileri olacağını göstermektedir. Çalışma bulguları, yerli/ithal fiyat oranını yüzde 1 oranında düşüren bir destek politikasının bütçeye yaklaşık 240 bin ABD dolarlık ek bir maliyete neden olurken, aynı zamanda Türkiye'nin pamuk ithalatını neredeyse 24 milyon ABD doları azaltacağını göstermektedir. Bununla beraber, yerli/ithal pamuk fiyat oranında aynı seviyede düşüşe sebep olacak bir gümrük vergisinin ithalatı aynı miktarda azaltacağı, diğer yandan 12 milyon ABD dolarlık vergi geliri sağlayacağı beklenmektedir.

Anahtar Kelimeler: Armington esnekliği, pamuk, ithalat talebi, tarımsal ticaret, ARDL yöntemi.

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1. INTRODUCTION

The concept of price elasticity of demand is important for formulating trade policies, particularly the agricultural products. Cotton, for example, requires Turkey's special consideration since it is one of the major players in the world cotton industry as producer, consumer and importer. It is also primary input for the production of textiles and clothing constituting still a central industry in Turkish economy and trade. The economy's dependence on cotton and the fact that cotton imports have turned out to be a growing necessity to meet the increased domestic demand urged Turkish government to set priorities for larger output and higher yields (1). However, import demand elasticity of cotton for Turkey has not been studied widely in the literature. There are very few individual studies using alternative methods showed different results.

The purpose of this paper is to estimate Armington elasticity of Turkey's import demand for cotton. For this aim, we firstly investigate co-integration relationship between relevant variables by using the Bound Testing approach introduced by Pesaran at al. (2). Then, Autoregressive Distributed Lag (ARDL) approach is employed in order to determine the short and long-run static relationships between the ratio of imports to domestic demand for cotton and their relative prices.

The paper is organized as follows. The first section provides the methodology and the data for the estimation. The following section presents regression results regarding the import elasticities of cotton for Turkey. In the next section, we briefly discuss the policy implications for Turkey's cotton trade and production. The last section concludes.

2. METHODOLOGY AND DATA

The assumption developed by Armington (3) suggests that internationally traded products are differentiated by place of origin and kind. For instance, Turkish cotton and Brazilian cotton would be two different products as imperfect substitutes, rather than perfect substitutes in the market (4). This approach is mostly used in applied models of international trade and represents the elasticity of substitution between products of different countries (5). Therefore, the Armington elasticity is assumed as an economic parameter defining the quantitative and sometimes qualitative outcomes that policy makers apply (6). It has also become a standard component of partial and general equilibrium models since they could generate more realistic reactions to trade policy changes than in the case of homogeneous products (7 and 8).

Based on Armington approach, Gallaway et al. (9) specify a demand function of a composite good (Q) in a specific industry in terms of domestic (D) and foreign (M) goods:

$$Q = \left[\beta M^{\frac{(\sigma-1)}{\sigma}} + (1-\beta) D^{\frac{(\sigma-1)}{\sigma}}\right]^{\frac{\sigma}{(\sigma-1)}} \qquad (1)$$

In this equation, M and D are the quantity of the imported goods and production of domestic goods respectively. The parameter of β shows the proportion of the quantity demanded for foreign good to the domestic good in total consumption, while σ is the constant elasticity of substitution between the domestic and imported cotton. Then, the first order condition for the consumer's maximization problem based on this demand function would ensure the optimum combination of quantity demanded for domestic and imported goods:

$$\frac{M}{D} = \left[\left(\frac{\beta}{(1-\beta)}\right)\left(\frac{PD}{PM}\right)\right]^{\sigma} \qquad (2)$$

This equation, which shows simply the relationship between the rates of substitution and the relative prices of domestic and imported goods, allows estimating the Armington elasticities for disaggregated industries. Finally, we just take natural logarithms of both sides of the equation in order to make econometric estimation:

$$Q = \alpha_0 + \alpha_1 P \qquad (3)$$

where $Q = ln\left(\frac{M}{D}\right)$, $\alpha_0 = \sigma ln\left[\frac{\beta}{1-\beta}\right]$ and $P = ln\left(\frac{PD}{PM}\right)$.

In this simple expression, α_0 is constant while α_1 is the Armington elasticity of substitution between domestic and imported goods. Equation 3 implies that the ratio of imports to domestic goods (*Q*) is a function of the ratio of domestic prices to import prices (*P*).

The study is based on annually time series data over a time period from 1981 to 2014. The reason for using lower frequency data is that they could truly reflect long-run responses to trade-price changes (9). The other reason is the problem of obtaining high frequency data (monthly or quarterly) on cotton production because of the picking season which generally is spread over a period of about three months. Furthermore, a year in the series implies the crop season which starts in August and ends in July of the following year. Accordingly, the data on imports for 1981 represents the quantity of imports from the rest of the world in the cotton season of August 1981 through July 1982. Harmonized Commodity Description and Coding System (HS) 6-digit level of aggregated data is used in order to generate the trade data series.

This study uses different sources in order to obtain the data series required for the estimation. Turkish Statistical Institute provides the real quantity (i.e. measured in metric tons) of imported and exported cotton. The source of the yearly domestic cotton production in terms of metric tons is from Izmir Commodity Exchange. However, the quantity of exports is subtracted from the quantity of production to obtain the data series on domestic supply which will be used for the estimation.

Domestic cotton prices are crop year averages which are calculated from the monthly closing prices in Turkish Lira released by Izmir Commodity Exchange and then they are converted into US dollars by using exchange rates from the relevant periods determined by the Central Bank of the Republic of Turkey. Lastly, "A Index" is used for the prices of imported cotton. It is an average of the cheapest five quotations from a selection of the principal upland cottons traded internationally and that's why "A Index" is a proxy for the world price of cotton. Foreign prices are crop year averages and in US dollars terms.

In our empirical modeling, the first step is to explore stationarity properties of the variables. For this purpose, most commonly used unit root tests in the literature, namely Augmented Dickey–Fuller (ADF), Phillips–Perron (PP) and Ng-Perron tests, are employed. Subsequently, the Bound Testing procedure developed by Peseran et al. (2) is applied in order to analyze the long-run co-integration relationship between the variables. This approach has several advantages over the conventional co-integration models such as Engle-Granger and Johansen tests. First of all, it can be employed irrespective of whether the variables are I(0) or I(1). Secondly, it has robust properties in small sample sizes than other conventional co-integration approaches (2 and 10). If it is found co-integration relationship between the variables, then the final step is to estimate short and long-run Armington elasticities of Turkey's import demand for cotton by employing an ARDL model.

3. RESULTS

Firstly, stationarity properties of the variables are examined by applying the ADF (11), PP (12) and Ng-Perron (13) tests[2]. The unit root test results of the variables obtained from ADF and Ng-Perron tests did not reveal consistency with PP test. The ADF and Ng-Perron test results indicate that the variables are I(1) whereas PP test shows that they are I(0). In small samples, Ng-Perron test has more power against any other alternative tests including ADF and PP. Therefore, we can accept the Ng-Perron (13) test results assuming all the variables are I(1).

[2] Unit root test results are available from the authors upon request.

3.1. Bound Testing Approach for Co-Integration Analysis

Having checked the stationarity properties of the variables, we investigated the co-integration relationship between them by following the Bound Testing procedure developed by Pesaran et al. (2). For the Bound Test analysis, we started by forming the Unrestricted Error Correction Model (UECM)**.** Following the determination of the lag number of the UECM model, we could test for the presence of co-integration relationship. The calculated F-statistics from the UECM model have been compared with the lower and upper bound critical levels in Pesaran et al. (2). Table 1 reports the Bound Test results.

Table 1. Bound Test Results

K	F-statistics	Critical Value at 5 per cent Significance Level	
		Lower-Bound	**Upper-Bound**
1	12.82	4.94	5.73

Note: k is number of independent variable and critical values are obtained from Table C1 (iii) in Pesaran et. al. (2).

The F-statistics (12.82) in Table 1 are higher than the upper bound critical value of 5.73 at 5 per cent significance level. As a result, the null hypothesis of “no co-integration” is rejected, implying a significant long run co-integration relationship between the ratio of imports to domestic demand for cotton and the ratio of domestic prices to import prices.

3.2. ARDL Model

Once we have found the existence of co-integration relationship between the variables, their short and long-run relationships can be investigated by employing an ARDL model. The ARDL model specification for our study is presented in Equation 4.

$$Q_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i} Q_{t-i} + \sum_{i=0}^{n} \alpha_{2i} P_{t-i} + \mu_t \tag{4}$$

In order to find the optimal lag length in Equation 4, maximum lag number is taken 4 and ARDL (1,2) model is selected using the Schwarz Information Criterion. The estimated short and long-run coefficients by employing ARDL (1,2) model are presented in Table 2. According to diagnostic checks, there are no serial correlation, heteroscedasticity and misspecification problems in the error terms.

The long-run coefficient (3.773) obtained from ARDL (1,2) model concludes that the ratio of domestic prices to import prices (*P)* variable is statistically significant. In other words, the estimated coefficient of the long-run relationship reveals that relative prices (i.e. the ratio of domestic prices to import prices) have a significant impact on Turkey’s import demand for cotton. The long-run coefficient estimates suggest that 1 per cent increase in *P* will lead *ceteris paribus* to 3.773 per cent increase in the ratio of imports to domestic cottons (*Q*).

The error correction term which is ECT(-1) is the one period lagged value of the error terms obtained from the equilibrium relationship. It also shows the eliminated rate of the short run disequilibrium in the long run (2). This equilibrium correction coefficient is estimated as -0.14 and has the correct sign implying the quick adjustment to the long-run equilibrium after a shock. Nearly 14 per cent of the disequilibrium from the previous year’s shock is anticipated to eliminate in the current year.

4. POLICY IMPACTS ON TRADE AND PRODUCTION

The above findings indicate that any policy affecting the ratio of domestic prices to import prices would have significant impacts on Turkey’s cotton trade and production. The policies could be either in the form of direct subsidy of premium payment to farmers or introduction of an ad valorem tax for imported cotton into Turkey. Both policies would lead domestic producers to increase the land allocated for cotton production and hence a substantial decline in Turkey’s cotton imports. An additional subsidy can lower the price of domestic cotton, while an ad valorem tax can increase the price of imported cotton. According to the season 2014-2015 figures, Table 3 shows *ceteris paribus* the impacts of these policies on trade and production as a result of 1 per cent decline in the ratio of domestic prices to import prices which also causes a 3.773 per cent decrease in the ratio of imports to domestic cotton.

Table 2. ARDL (1,2) Model Short and Long-run Parameter Estimations

Estimated Long-run Coefficients Using ARDL(1,2) Model		
Variables	**Coefficient**	**t-statistics**
P	3.773	4.775*
C	-0.401	-0.436
Error Correction Representation for the ARDL(1,2) Model		
Variables	**Coefficient**	**t-statistics**
DQ	5.055	8.776*
DQ(-1)	2.049	3.596*
C	0.000	0.000
ECT(1)	-0.139	-3.326*
Diagnostic Checks		
Lagrange multiplier test of residual serial correlation	χ^2_{SC}	1.066 (0.359)
Based on a test of skewness and kurtosis of residuals	χ^2_{NORM}	0.569 (0.752)
Based on the regression of squared residuals on squared fitted values	χ^2_{WHITE}	1.721 (0.199)
Ramsey's RESET test using the square of the fitted values	χ^2_{RAMSEY}	0.166 (0.686)

*Note: * and ** denote significance at the 1 per cent and 5 per cent level respectively.*

Table 3. Policy Effects on Cotton Trade and Production in Turkey

Variables	Season 2014/2015	Premium Payment		Import Tariff	
		After the Policy	*Change*	*After the Policy*	*Change*
Domestic Prices (US dollars)	1,624.65	1,609.05	-15.60	1,624.65	0.00
Import Prices (US dollars)	1,560.43	1,560.43	0.00	1,575.56	15.13
Domestic/Import Prices Ratio	1.0412	1.0312	-1.000%	1.0312	-1.000%
Domestic Production (tons)	794,705	809,933	15,228	809,933	15,228
Imports (tons)	800,067	784,839	-15,228	784,839	-15,228
Domestic/Imports Ratio	1.0067	0.9690	-3.773%	0.9690	-3.773%
Imports (US dollars)	1,248,451,245	1,224,688,943	-23,762,301	1,224,688,943	-23,762,301
Tariff Revenue (US dollars)	0.00	0.00	0.00	11,876,865	11,876,865
Domestic Support (US dollars)	183.33	198.94	15.60	183.33	0.00
Total Support (US dollars)	145,696,052	161,126,320	237,622	145,696,052	0.00

Source: Authors' calculations based on the data obtained from Turkish Statistical Institute, Izmir Commodity Exchange, National Cotton Council of America and the Central Bank of the Republic of Turkey.

A 1 per cent of increase in the ratio of domestic prices to import prices is associated with an additional 15.60 US dollars[3] per metric ton of cotton to domestic farmers or an amount of 0.97[4] per cent duty on imports. The subsidy policy would reduce domestic prices from 1,624.65 US dollars to 1,609.65 US dollars per ton whereas the import tax would raise domestic prices from 1,560.43 US dollars to 1,575.56 US dollars per ton. Both measures would reduce the quantity of cotton imported into Turkey by some 15 thousand metric tons. Since it is assumed that Turkey's total consumption does not change under the Armington assumptions, the domestically produced output could also be expanded by the same amount. The increase in production support would cause additional costs of approximately 240 thousand US dollars for the government budget, whereas reducing the cotton imports by some 24 million US dollars. An import tariff raising the import prices is expected to have the same effect on the cotton imports, but in this case an amount of some 12 million US dollars tariff revenue could be raised for Turkey.

5. CONCLUSION

This study applies Autoregressive Distributed Lag (ARDL) method to Armington approach in order to estimate Turkey's import demand elasticity for cotton. The regression results indicate that substitution between the domestic and imported cotton is very elastic. A change in favour of domestic prices that would follow from rising Turkish subsidies or applying an import tariff on cotton would have a significant positive impact on the domestically produced cotton whereas reducing its imports substantially. A direct payment policy that would lower the ratio of imports to domestic cottons by 1 per cent costing approximately 240 thousand US dollars could lead to approximately 24 million US dollars decline in the value of imported cotton in the long-run. On the other hand, an import tax decreasing that ratio at the same level could have similar effect on imports, while raising an amount of some 12 million US dollars tariff revenue. Therefore, the policy makers in Turkey ought to be aware that policies on cotton prices might have important economic influences for traders and farmers in Turkey.

[3] The government announced that the premiums of 183.33 US dollars per ton (exchange rate is assumed 3 TL/US dollar) for the season 2014/15.

[4] It is calculated as ad valorem equivalent of 15.13 US dollars per ton of cotton. Cotton is exempt from import duty in Turkey.

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