In this study, imports and export demand functions for Turkey between 1950 and 2003 are estimated using annual data. Contrary to the usual elasticities models in the economic literature, time series properties of the variables have been examined and tests of cointegration have been applied to import and export demand models. Existence of cointegration is rejected among exports/imports, price and income variables, under different specifications for import and export models. Given the frequent changes in the foreign trade regimes both before and after 1980, a long-term equilibrium relationship may not exist for such a long period from 1950 to 2003. It is well known that for a long period before 1980, Turkey implemented import substitution industrialization, which rests on substantial controls and interventions in foreign trade and, after 1980, the Turkish foreign trade was liberalized followed by the liberalization of capital movements in 1990s. In this respect, the existence of such breaks and the stability of the equations will be tested in this study through various structural break tests and, finally, the structural equations will be re-estimated by recursive least squares. Through this analysis, whether the model coefficients are stable or volatile and, if a shift or volatility in parameters exists during the period of investigation, and which specific period accounted for the volatility or shifts in the model parameters will be examined.

Keywords: Exports, Imports, Structural Break, Economic Growth, Terms of Trade, Foreign Financing Constraint, Import Substitution Industrialization, Liberalization, Turkey.
JEL Classification Numbers: F14, F32, F43, N75

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1. INTRODUCTION

In Turkey, the period from 1950 to 2003 is characterized by various economic difficulties, adaptations to and recovery from the crises. Although there was a major break in the economic policies in the early 1980s due to a shift to more liberal trade and finance policies, there were different shocks and economic policy responses either under import substitution industrialization (ISI) or liberalization period. In this study, Turkey’s foreign trade equations will be estimated for the 1950-2003 period, in the light of these changes in the economic policies. The primary objective of the study is to make an analytical survey on the Turkish economic history, covering a period as long as the data availability allows. In contrast to limited periods investigated in the previous research about Turkish foreign trade, this study tries to present a historical evolution of Turkish foreign trade under different economic policies. Given that the period of the study involves various instabilities and changes in economic policies, the estimated foreign trade equations will be inspected for the existence of structural breaks and change points by various tests of parameter stability.

Consequently, this study discloses the impact of some particular policy choices on Turkish foreign trade such as import substitution industrialization, foreign exchange controls and devaluations. In this respect, the structural transformation between the ISI and liberalization periods, as well as the impact of some of the economic turmoil periods will be presented through the estimated foreign trade equations. The impact of policy choices or crisis periods can be directly observed in the form of dummies or it can be indirect and gradual, which is captured through the changing magnitude or the instability in the parameter coefficients in those periods. Thirdly, this study also shows the evolution of the relative weights of the determinants of Turkish foreign trade in the 1950-2003 period and the changes over time in the relation between trade flows and their determinants. Consequently, the study aims at drawing attention to the importance of data reliability and the existence of structural breaks when dealing with historical data and compares the key variables in foreign trade under both ISI and liberalization strategies.

The organization of the study is as follows: The following section reviews shortly the existing economic literature and the previous studies on Turkish foreign trade.

In the next section, Turkish foreign trade equations will be estimated from 1950 to 2003. Along with the recent developments in the econometric literature, the existence of a long-term stable relationship between exports/imports and other variables will be tested using the cointegration tests. However, given that the period under consideration entails serious breaks and major policy changes, it is more plausible not to find a long-term equilibrium relationship in the foreign trade equations because the structural breaks are likely to lead to parameter instability. Therefore, while estimating the import and export demand equations for Turkey using price and income variables, this study will try to display some features and particularities of foreign trade in different periods, under different economic strategies.

In this context, in the third section, breaks and structural change points that seem most likely, as suggested in the economic literature will be questioned and it will be verified that some particular policies such as import substitution industrialization, foreign exchange stringencies and some major devaluations did have an impact on the export and import demand equations. Identifying these variables among the determinants of Turkish foreign trade, in fact, is one of the contributions of this study in the sense that historical information is embedded into the foreign trade equations.
Obviously, it is beyond the scope of single-equation models to display all the major policy changes or the historical evolution. Especially, due to the unavailability of the statistics, annual data has been used in this study, which may conceal and smooth out many changes. Therefore, given this limitation, as a second step in the analysis of the existence of breakpoints, formal structural break test developed by Andrews (1993) testing the probable change point at an unknown point will be implemented in the fourth section. However, such tests usually fail to address a structural break in the case of Turkey, as it considers only one particular unknown point.

Therefore, in the fifth and sixth sections, diagnostic recursive methods will be implemented. More specifically, recursive least squares coefficients for each of the export and import equations will be examined to see whether the coefficients display instability, a shift in level or a shift in the trend over the investigation period.

Estimation results indicate that the structural transformation between pre- and post-1980, between the ISI and liberalization periods is quite evident, as can be followed from the change in the relationship between some determinants of foreign trade in the two specific economic models.

Besides, it will be shown that there are considerable instabilities in the relation of some variables to either exports or imports during the 1970s, especially towards the end of the decade. Consequently, the 1970s were especially crucial in the Turkish economic history as a period of economic turbulence. That the relationship between the variables and the trade flows weakens and becomes unstable in this period is quite obvious. Therefore, any study focusing on those years should be very cautious about the analytical relationships and estimations.

Furthermore, foreign exchange constraint is found to be one of the important binding factors for both exports and imports. Finally, economic growth is found to be one of the key determinants of the import equation either under the ISI or liberalization strategies. This relationship has straightforward implications for foreign trade balance and balance of payments developments in Turkey. To put it differently, Turkey’s economic growth has resulted in the expansion in foreign trade and current account deficits under both economic strategies. Therefore, any growth strategy should take into account the implications for external balance of Turkey.

2. EMPIRICAL LITERATURE IN BRIEF RELATED TO TURKISH FOREIGN TRADE

Turkey initiated financial and foreign trade liberalization starting from 1980 and, following a classical sequence; capital movements were later liberalized in 1990s. Before 1980, for a long period, ISI became the dominant economic model, through which domestic industrialization was aimed to be fostered by heavy controls on foreign trade, subsidies and tax exemptions to the industry. The primary objective was to attain sustainable economic growth and this was believed to be achieved by self-sufficiency and strong industrial base.

However, during the 1950-1979 period, when ISI was predominantly implemented, Turkey often found herself in recursive economic crises, in the form of foreign exchange crises,
production bottlenecks and shortages. In the early 1980s, based on the view that trade and financial liberalization fosters economic growth, a shift in the economic regime took place. Financial liberalization was expected to increase savings through positive real market interest rates and a deeper financial system, providing the sufficient base for investment. Foreign trade liberalization along with export promotion schemes, on the other hand, would enhance export revenues and would make the necessary inputs for production available. Finally, liberalization of capital movements would attract foreign investment and allow for the maintenance of sufficient financing for sustainable growth. Nevertheless, this economic model had its own fragilities and the period from 1980 to 2001 was also characterized by frequent economic crises especially in the 1990s that were mostly in the form of capital outflows, leading to sharp devaluation of the domestic currency, contraction of economic output and rise in unemployment. Besides, the transfer of external shocks to domestic economy relatively easily was another source of volatility in this period.

At the core of both economic models, foreign trade policies assumed a major role. Consequently, examining Turkey’s foreign trade figures and estimating foreign trade equations have always been interesting topics for economic researchers. There is plenty of research about the topic, using different methodologies and examining different periods. Generally, these studies have focused on the liberalization period, or more specifically on the post-1990 period following the completion of the capital liberalization. In those studies, recent techniques have been applied considering the time series properties of the data and the unavailability of long-term time series data has been one of the factors limiting the research period. Therefore, studies investigated mostly the performance under free market conditions after 1990s, trying to abstain from frequent policy changes and external shocks.

In the empirical economic literature, the general approach to the estimation of import and export demand functions is based on “elasticities approach”, where real imports and real exports are determined by price and income variables. These variables involve various measures for nominal or real effective exchange rate, relative export and import prices, world and domestic real income. The variables are expressed in logarithmic form so that the estimated coefficients account for elasticities with respect to price and income. There is a vast literature on the topic and the equations presented in those studies are often single equation models, estimated particularly for a group of countries using OLS or 2SLS.

Kreinin (1967), Goldstein and Khan (1976), Warner and Kreinin (1983), Bahmani-Oskooee (1985), Srivastava and Green (1986) and Marquez (1990) are examples from this literature.
which either estimate aggregate, disaggregate or bilateral trade equations, regressing the
dependent variables on price and income variables. Besides estimating the price and income
elasticities, Warner and Kreinin (1983) evaluate the impact of fixed versus floating exchange
rate on trade flows between 1957-1970 (fixed exchange rate years) and 1972-1980 (floating
exchange rate years). Bahmani-Oskooee (1985) estimates a trade balance equation for four
developing countries specifically to measure the J-curve effect of devaluation and to see
whether the Marshall-Lerner conditions are met. Marquez (1990) estimates bilateral trade
elasticities and also evaluates the implications of those elasticities for Marshall-Lerner
condition, as well as the debt servicing potential of the developing countries. Besides price
and income variables, Srivastava and Green (1986) incorporates into their bilateral trade
model other factors such as political instability, engagements in specific economic unions and
cultural factors, namely, religion and culture.  

In the 1990s, developments in econometric literature necessitated the pre-investigation of time
series properties of the macro data for the existence of non-stationarity before constructing
econometric models. Upon this literature, cointegration techniques developed, which
examined stable long-run relationships among the variables of import and export demand
functions. Furthermore, along with cointegrated variables, the short-run dynamics of the trade
equations were estimated through the error correction models.  

This approach allowed a more
dynamic analysis of foreign trade equations, which presumed that short-run deviations from
the equilibrium would be corrected in the short-run through the error correction mechanism.

The topics in this recent strand in the empirical trade literature are quite similar to the issues
in the elasticities approach. Mostly, long-run and short-run estimates of price and income
elasticities are compared with the previous empirical research (Clarida, 1994; Senhadji, 1998)
or the impact of devaluation and relative prices on trade flows as well as the validity of
Marshall-Lerner condition are investigated (Reinhart, 1995; Bahmani-Oskooee, 1998;
Bahmani-Oskooee and Niroomand, 1998). In addition to the traditional determinants of
international trade, Prasad and Gable (1998) incorporate in their study the volatility in
macroeconomic variables to show the relationship between business cycles and trade
balance. 

Among other things, coefficient stability of the foreign trade models and the question of
whether any structural change existed in the export and import demands (whether aggregate
or disaggregate) is another central issue that attracted considerable attention in the economic
literature as well. Traditional structural break tests such as CUSUM, Quandt’s Log-likelihood
ratio, Chow tests and recursive least squares are applied in those studies; however, in some of
them with no consideration about the existence of unit-roots in the data as they precede the
developments in time-series literature. (Stern et.al., 1979; Deyak et. al 1989; Ceglowski,
1997; Marquez, 1990; Warner and Kreinin, 1983).  

1 In another study related to the elasticities approach, Thursby (1988) estimates a loss function for import demand
models to highlight the impact of misspecification errors. Using the expected loss for the price and income
variables, the author finds evidence about the common observation that estimates of income elasticity tend to
vary less with respect to price elasticity, which imply that estimated price elasticities are less reliable.
2 Among the foreign trade models examined through cointegration and error correction mechanism, Deyak et. al
3 Authors identify three different types of shocks, namely, supply, demand and nominal shocks and show that
country-specific shocks are more effective in the trade balance than global shocks and more specifically,
country-specific demand shocks are more important than country-specific supply shocks in trade dynamics.
Recent studies on the estimation of Turkish foreign trade flows are in line with the cointegration and error correction framework. Uygur (1996) focuses on the period from end-1977 to mid-1990s and estimates an export supply function for Turkey where exports are determined by real exchange rate, fixed investment, domestic demand and export subsidies in the short-term. The study differentiates between long- and short-term effects of the export policies, showing that export subsidies have a negative effect on exports in the long-term. Export demand and supply functions for Turkey are estimated in another study by Şahinbeyoğlu and Ulaşan (1999) via Engle-Granger two-step cointegration procedure for the 1988-1998 period using quarterly data. A cointegrating relation is found between real export supply, real domestic activity and real effective exchange rate, at the same time as a cointegrating relation is found between real export demand, real foreign demand and real effective exchange rate. Following the estimation of the short-run export functions, the study goes further to question the parameter stability of income and price elasticities and Chow breakpoint tests are applied for the known breakpoint 1994, the most significant economic crisis of the research period. However, test results do not suggest a break at that date, implying parameter stability.

Kotan and Saygılı (1999) estimate both the short- and long-term import function via Engle-Granger two-step cointegration procedure for the period 1987-1999 using quarterly data and evaluates short-run impulse response functions through the vector auto regression (VAR) framework. The study reveals a long-run equilibrium relation between nominal imports, domestic income, nominal depreciation rate, consumer price inflation and international reserves. In the short-run, exchange rate is found to be the most effective determinant of imports while in the long-run domestic demand and international reserves turn out to be the major sources. Aydn et. al. (2004) estimate export supply and import demand functions for Turkey with a relatively update data from 1987 to 2003. In addition to the single equation models estimated via Engle-Granger’s cointegration approach, VAR specifications for exports and imports are also inspected to evaluate the dynamic responses of each variable to other variables. The determinants of exports and imports were in line with the previous empirical research, with import demand determined mainly by real exchange rate and national income and export supply determined mainly by export prices, unit labor cost and national income.

Generally, the findings regarding the impact of real exchange rate on exports and imports, hence, the trade balance are mixed. In many studies, real exchange rate is found to be an effective determinant of both exports and imports, whereas in some of the studies (such as Aydn et. al., 2004) effects of real exchange rate on trade balance is realized through imports, as the impact of real exchange rate on exports is statistically not significant. The mixed results about the impact of the real exchange rate are addressed in Bostancı (2002), where she estimates a trade balance model in terms of domestic income, foreign income and real exchange rate. The data covers the period from 1987 to 2000 and Johansen’s cointegration procedure is applied. Basic results show that there is a stable long-run relationship between trade balance and the real exchange rate in line with the economic theory, verifying that devaluation leads to improvement in the trade balance.

Among the literature focusing on Turkish foreign trade, Pamukçu and Boer’s study (2000) is worth to mention, as they estimate the determinants of import growth through structural decomposition analysis and assess how the relative importance of these factors changed during two different economic strategies, namely, inward-oriented (1968-1979) and outward-oriented development strategies (1979-1990). Pamukçu and Boer (2000) have a similar approach used in this study in the sense that both studies deal with the changing response of imports to its
determinants during different development schemes. Although the findings of that paper are compatible with the results in this study, the period of analysis in Pamukçu and Boer (2000) is comparably shorter. Moreover, there are some differences in the above mentioned study in terms of the identification of sources of imports, which are mainly domestic demand and technological change during the ISI period and export expansion during the liberalization period.

Finally, aggregate and disaggregate export and import equations have been a building block of macroeconometric models of the Turkish economy, which are used by institutions such as the Turkish Treasury (2001) and Yapı Kredi Bank. In these models, too, exports are related to world demand for exports, price competitiveness and imports are estimated in relation to domestic demand and price competitiveness.  

3. ESTIMATION OF EXPORT AND IMPORT DEMAND FUNCTIONS

3.1. The Data and the Unit Root Tests:

In this study, export and import demand functions for Turkey have been analyzed through respective price and income variables suggested by the traditional elasticity models as well as through some different variables recently used in the economic literature, such as the foreign exchange constraint and the output gap. The period covers annual observations from 1950 to 2003.

Real exports are nominal exports deflated by non-oil developing country export unit value index. As for price of exports, non-oil developing country export unit value index from the International Financial Statistics (IFS) has been used due to the unavailability of time series data for Turkey’s own export prices. The strong correlation between Turkish export prices and non-oil developing country export unit value index for 1968-2003 suggested that the latter could be used as a proxy for the former.

World price of exports is the industrial countries’ export unit value index from the IFS. This variable has been chosen to reflect the relative prices in the international markets.

As for the demand from the major export markets of Turkey, imports of 14 major export markets of Turkey and industrial production index of industrialized countries have been tried in the estimations. Only the production index of industrialized countries has been found to be significant in the equations. The latter index is also from the IFS.

Output gap is defined as the difference between the long-term trend of real GDP and the real GDP. In the estimation of the export equation, this variable has been incorporated as an indicator for domestic demand. Assuming that the potential output does not change in the short-term, a decrease in the output gap can be interpreted as a proxy for increasing domestic demand, which will lead to an increase in domestic absorption, and hence, a decline in exports.

Real imports are nominal imports deflated by the US wholesale price index. Real imports also have been deflated by non-oil developing country import unit value index but this variable did not fit well into the model specifications so the former definition of real imports have been used.\textsuperscript{5}

Nominal and real GDP, as well as nominal imports and exports are from the State Institute of Statistics (SIS).

Real exchange rate is the nominal effective exchange rate weighted by the US producer prices, German wholesale prices and Turkish wholesale prices.

Import duty is used as an indicator for the tariff policy, which is defined as the ratio of taxes on imports (in the national income accounts) to total imports.

Several measures of foreign exchange constraint have been tried, two of which have been found to be significant in import equation. These are the ratio of (GDP+imports-exports) to foreign exchange reserves (details of which will be explained in the following sections), ratio of imports minus exports to foreign exchange reserves and the ratio of current account balance to foreign exchange reserves. Current account data is from the Central Bank of Turkey (CBRT). Foreign exchange reserves of CBRT have been obtained from the IFS.

All variables are in logarithmic form except for output gap and foreign exchange constraint.

As a first step, the variables have been checked for stationarity using Augmented Dickey-Fuller (ADF) unit root test. The results of the unit root tests for the variables in question are as follows:

Table 1. Results of ADF Unit Root Tests

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>First Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADF Test</td>
<td>Lags</td>
</tr>
<tr>
<td></td>
<td>Statistics</td>
<td></td>
</tr>
<tr>
<td>Real Exports</td>
<td>-2.155</td>
<td>0</td>
</tr>
<tr>
<td>Export prices of Turkey</td>
<td>1.151</td>
<td>0</td>
</tr>
<tr>
<td>World export prices</td>
<td>-2.007</td>
<td>1</td>
</tr>
<tr>
<td>Developed country output</td>
<td>-2.740</td>
<td>0</td>
</tr>
<tr>
<td>Output gap</td>
<td>-5.931*</td>
<td>0</td>
</tr>
<tr>
<td>Real Imports</td>
<td>-2.769</td>
<td>0</td>
</tr>
<tr>
<td>Real GDP</td>
<td>-3.075</td>
<td>0</td>
</tr>
<tr>
<td>Real Exchange Rate</td>
<td>-3.173</td>
<td>0</td>
</tr>
<tr>
<td>Import Duties</td>
<td>-3.154</td>
<td>0</td>
</tr>
<tr>
<td>Foreign exchange constraint</td>
<td>-6.335*</td>
<td>0</td>
</tr>
<tr>
<td>Import prices of Turkey</td>
<td>1.443</td>
<td>4</td>
</tr>
<tr>
<td>Wholesale prices of Turkey</td>
<td>-0.818</td>
<td>1</td>
</tr>
</tbody>
</table>

*The hypothesis of a unit root in series is rejected at 1% level.

\textsuperscript{5} In contrast to the strong correlation between Turkish export prices and non-oil developing country export unit value index for 1969-2003, Turkish import prices (released by the SIS) and non-oil developing country import unit value index (from the IFS) diverges considerably in the 1969-2003 period. The insignificance of the latter in the import equation suggests that the two series might differ substantially before 1980. One explanation for this divergence may be that the composition of Turkish imports and the non-oil developing countries as a whole might not overlap to a great extent.
Accordingly, all variables but output gap and foreign exchange constraint contain unit root in levels, while tests do not point at the existence of a unit root at the first difference levels.

3.2. Cointegration Tests:

Until the 1990s, it was not common in the foreign trade literature to check whether the variables in the equations were stationary and whether the variables had common trend and the residuals are stationary. The idea of cointegration developed upon the view that, if the variables had a common trend and the residuals were stationary, then the variables were said to be integrated in a similar way. This helps to interpret the equation as a long-run stable equilibrium relationship. More explicitly, if the variables that are non-stationary are difference stationary, then a linear combination of the variables that eliminates their similar trend may exist. For example, if both the series X and Y are integrated of order one, they can be cointegrated, in which case the regression on the levels of the two variables is not spurious and the ordinary least squares residuals are stationary. This enables the researcher with a valuable information, which would have been lost had the series were differenced to eliminate non-stationarity. Consequently, a regression between non-stationary variables, which are cointegrated, is interpreted as a long-run equilibrium relationship between the variables.  

In this study, using the variables that are integrated of order one, I(1), different specifications for export and import demand models suggested by the economic theory have been tested for the existence of cointegration. These involve the most widely used variables in the economic literature, namely the income and price variables. Two specifications were investigated for both exports and imports. One of the export equations tested the long-run equilibrium relationship between real exports, domestic and world average export prices and output of the developed countries (as a measure for the demand for Turkish exports) and the second equation replaced the price variables with the real exchange rate. Similarly, one of the import specifications involved the series of real imports, real GDP, import prices and wholesale prices, while the second one involved the same variables except that the import prices and the wholesale prices were replaced with the real exchange rate.

In order to test the existence of a cointegration, Johansen’s test (1991, 1995) provided in the EViews was applied, in which restrictions imposed by cointegration on the unrestricted VAR involving the series are tested. In order to determine the lag length of the VAR model in the test, the short length of available time series was considered and it was assumed that in the annual data the impact of more than two years is negligible. Accordingly, the lag length up to 2 years was tested and it is observed that the results did not change with respect to lag 1 or 2. In order to specify the assumptions of the model regarding whether the series and cointegration equations have non-zero means, deterministic trends and/or stochastic trends, five cases provided by EViews were evaluated on the basis of Akaike information and Schwarz criteria. In the choice of the deterministic trend assumptions, the signs of the long-run relationships, which were economically meaningful, also played a considerable role.


7 Goldstein and Khan (1976) discusses the adjustment period of the quantity of imports to changes in the explanatory variables such as real income and relative prices. Authors find out in their empirical study for the period 1955-1973 that the average lag did not surpassed the three quarters, which implies that delays stemming from delivery problems, decision processes and contracts were considerably shorter, more specifically, less than two or three years.
The following are the results of the cointegration tests for different import and export equation specifications:

\[ \ln(\text{real imports}) = \ln(\text{real gdp}) + \ln(\text{import prices}) + \ln(\text{domestic WPI}) \quad (1) \]

**Result of the Cointegration Test for Equation (1)**

<table>
<thead>
<tr>
<th>Series: LNR2IMPO LNRGDP LNPRIEIMP LNWIPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lags interval: 1 to 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood Ratio</th>
<th>5% Critical Value</th>
<th>1% Critical Value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.306755</td>
<td>43.0036</td>
<td>47.21</td>
<td>54.46</td>
<td>None</td>
</tr>
<tr>
<td>0.222783</td>
<td>23.95228</td>
<td>29.68</td>
<td>35.65</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.185341</td>
<td>10.84645</td>
<td>15.41</td>
<td>20.04</td>
<td>At most 2</td>
</tr>
<tr>
<td>0.003592</td>
<td>0.187225</td>
<td>3.76</td>
<td>6.65</td>
<td>At most 3</td>
</tr>
</tbody>
</table>

*(***) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. rejects any cointegration at 5% significance level

\[ \ln(\text{real imports}) = \ln(\text{real gdp}) + \ln(\text{real exch rate}) \quad (2) \]

**Result of the Cointegration Test for Equation (2)**

<table>
<thead>
<tr>
<th>Series: LNR2IMPO LNRGDP LNREXC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lags interval: 1 to 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood Ratio</th>
<th>5% Critical Value</th>
<th>1% Critical Value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.306237</td>
<td>27.98468</td>
<td>34.55</td>
<td>40.49</td>
<td>None</td>
</tr>
<tr>
<td>0.133708</td>
<td>8.972163</td>
<td>18.17</td>
<td>23.46</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.028592</td>
<td>1.508439</td>
<td>3.74</td>
<td>6.4</td>
<td>At most 2</td>
</tr>
</tbody>
</table>

*(***) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. rejects any cointegration at 5% significance level

\[ \ln(\text{real exports}) = \ln(\text{TR exp o price}) + \ln(\text{world exp o price}) + \ln(\text{dev.ed count output}) \quad (3) \]

**Result of the Cointegration Test for Equation (3)**

<table>
<thead>
<tr>
<th>Series: LNREXPO LNPRIEEX LNPRICEXWO1 LNDEVPRO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lags interval: 1 to 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood Ratio</th>
<th>5% Critical Value</th>
<th>1% Critical Value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.368753</td>
<td>43.64116</td>
<td>47.21</td>
<td>54.46</td>
<td>None</td>
</tr>
<tr>
<td>0.202997</td>
<td>19.25812</td>
<td>29.68</td>
<td>35.65</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.093895</td>
<td>7.232555</td>
<td>15.41</td>
<td>20.04</td>
<td>At most 2</td>
</tr>
<tr>
<td>0.037155</td>
<td>2.006745</td>
<td>3.76</td>
<td>6.65</td>
<td>At most 3</td>
</tr>
</tbody>
</table>

*(***) denotes rejection of the hypothesis at 5%(1%) significance level

L.R. rejects any cointegration at 5% significance level
\[
\ln(\text{real } \text{exports}) = \ln(\text{dev.ed } \text{count. } \text{output}) + \ln(\text{real } \text{exch } \text{rate}) \tag{4}
\]

### Result of the Cointegration Test for Equation (4)

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Likelihood Ratio</th>
<th>5% Critical Value</th>
<th>1% Critical Value</th>
<th>Hypothesized No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.303114</td>
<td>40.59207</td>
<td>42.44</td>
<td>48.45</td>
<td>None</td>
</tr>
<tr>
<td>0.233944</td>
<td>21.81316</td>
<td>25.32</td>
<td>30.45</td>
<td>At most 1</td>
</tr>
<tr>
<td>0.141856</td>
<td>7.955137</td>
<td>12.25</td>
<td>16.26</td>
<td>At most 2</td>
</tr>
</tbody>
</table>

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. rejects any cointegration at 5% significance level.

In all of the above settings, the Johansen test procedure failed to detect a cointegration relationship between the variables. This suggests that a stable, long run relationship between exports/imports, a price and income variable does not exist for Turkey. This is not unexpected, however, given that in the period 1950-2003, Turkey faced many changes in its economic policies, small and serious economic crises, as well as several structural adjustment programs. These may have changed the nature of the relationship –permanently- between the trade flows and their determinants over time. In fact, some studies do find a cointegration relationship for exports/imports and other variables. However, it should be borne in mind that the period of research in those studies is limited to post-1980 and more specifically to the post-1990 period, minimizing the number of breaks in the economy. In this sense, the period examined in those studies is immune from the additional structural changes brought about by the ISI strategy. Furthermore, the data availability is another advantage in the post-1990 period, which allows for making more reliable estimations. Therefore, given the limitations of the data especially in the pre-1980 period and the substantial structural transformations during 1950-2003, it is plausible not to detect one particular long-run equilibrium relationship between exports/imports, price and income variables.

### 3.3. The Model:

Following the cointegration tests which could not provide satisfactory evidence in favor of a stable relationship between imports and exports and their determinants suggested by the economic theory, import and export equations for Turkey between 1950 and 2003 were estimated in this section, using the Ordinary Least Squares (OLS) and considering the time series properties of the data. In this respect, despite the loss of information, the first differences of the I(1) variables were used in both the export and import equations to eliminate unit root in the data.

Consequently, the following equation is estimated for export demand for 1951-2003:

---

8 Examples of the studies on Turkish foreign trade using cointegration and error correction are Uygur (1996), Şahinbeyoğlu and Ulaşan (1999), Kotan and Sayghi (1999) and Aydın et. al. (2004).
\[ d \log(\text{REXPORT}) = \alpha_1 + \alpha_2 d \log(\text{PRICEX}) + \alpha_3 d \log(\text{PRICEXWO1}) + \alpha_4 d \log(\text{DEVPRO}) + \alpha_5 \text{OUTPUTGAP}(-1) + \alpha_6 \text{FXSTR5359} + \alpha_7 \text{ISI1} + \alpha_8 D81 + \alpha_9 \text{POST} 2001 + \alpha_{10} AR(1) \]

where,

- \( d \log(\text{REXPORT}) \): real exports as logarithmic difference over previous year,
- \( d \log(\text{PRICEX}) \): export prices of Turkey as logarithmic difference over previous year,
- \( d \log(\text{PRICEXWO1}) \): world export prices as logarithmic difference over previous year,
- \( d \log(\text{DEVPRO}) \): industrial production of industrialized countries as logarithmic difference over previous year,
- \( \text{OUTPUTGAP}(-1) \): one period lagged difference between the long-term trend of real GDP and real GDP,
- \( \text{FXSTR5359} \): foreign exchange stringency in the 1953-59 period,
- \( \text{ISI1} \): dummy reflecting the first phase of import substitution industrialization between 1960 and 1969,
- \( D81 \): dummy reflecting a policy change in 1981,
- \( \text{POST}2001 \): dummy reflecting the floating exchange rate period in the aftermath of 2001 crisis.

The results of the OLS regression are presented in Table 2.

**Table 2. Determinants of Export Growth during 1951-2003**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.053</td>
<td>0.001</td>
</tr>
<tr>
<td>( d \log(\text{PRICEX}) )</td>
<td>-1.151</td>
<td>0.000</td>
</tr>
<tr>
<td>( d \log(\text{PRICEXWO1}) )</td>
<td>0.597</td>
<td>0.007</td>
</tr>
<tr>
<td>( d \log(\text{DEVPRO}) )</td>
<td>1.548</td>
<td>0.001</td>
</tr>
<tr>
<td>( \text{OUTPUTGAP}(-1) )</td>
<td>0.636</td>
<td>0.036</td>
</tr>
<tr>
<td>( \text{FXSTR5359} )</td>
<td>-0.106</td>
<td>0.011</td>
</tr>
<tr>
<td>( \text{ISI1} )</td>
<td>-0.107</td>
<td>0.000</td>
</tr>
<tr>
<td>( D81 )</td>
<td>0.553</td>
<td>0.000</td>
</tr>
<tr>
<td>( \text{POST}2001 )</td>
<td>0.091</td>
<td>0.000</td>
</tr>
<tr>
<td>( AR(1) )</td>
<td>-0.592</td>
<td>0.000</td>
</tr>
</tbody>
</table>

- R-squared: 0.759
- Adjusted R-squared: 0.709
- Log likelihood: 56.824
- Durbin-Watson stat: 2.186
- F-statistic: 15.079
- Prob(F-statistic): 0.000

* Diagnostic tests of Box-Pierce Q and Breusch-Godfrey test for serial correlation; Jaque-Bera test for normality; ARCH test and White heteroskedasticity test were checked.

According to the above estimation, the signs of the coefficients of income and price variables are in line with predictions. The export growth in Turkey is determined by the rate of growth of home export prices and world export prices, as well as industrialized country output growth and domestic demand.
The impact of home export price variable is negative while the coefficient of the world average price of export variable is positive. A rise in the home export price growth leads to a decline in price competitiveness and affects exports of Turkey negatively. The rise in the growth of the latter, however, increases the relative price competitiveness of Turkey’s products by reducing the relative price of Turkish exportables. In addition, more implicitly, rise in the prices of industrial countries’ exports increases the relative income in the industrial countries, which are already the major export markets of Turkey, hence, inducing a demand for Turkish exportable goods.

The growth in Turkey’s major export markets, which is reflected in this specification by the growth in the industrialized country output, is one of the major determinants of Turkey’s exports. Its coefficient is positive, implying that increase in the income growth in major export markets of Turkey accelerates growth of Turkish exports.

Furthermore, as mentioned already, an increase in the output gap implies weak domestic demand whereas the decline in the output gap implies a growing domestic demand. In this sense, the coefficient of the output gap can be interpreted in a way that higher absorption at home leads to a decline in growth of exports while lower domestic demand leads to the diversion of home production to exports. The impact of the domestic demand variable surface with one year lag, probably due to the fact that the exports are carried out through contracts and the realization of low domestic demand for home goods takes time.

In addition to these variables, various dummy variables to capture foreign trade policy and economic regime shifts have been tested in the export equation. The aim of using dummy variables is to see whether the export equation could reflect the numerous regime shifts and policy changes in the 1950-2003 period identified by the Turkish economic history literature. Level shift dummies regarding the export policy were tested as a first step and trend shift dummies were tested in the following sections where structural breaks in the equation is examined in more detail.

The following dummies were constructed and tested in the export equation: foreign exchange stringency in the 1953-1959 period, the step wise devaluation in the 1958-1959 period, import substitution industrialization between 1960 and 1979, the first stage and the second stage of the ISI between 1960-1969 and 1970-1979, respectively, foreign exchange stringency in 1978-1979, devaluations in 1981, recovery in exports due to foreign trade liberalization between 1980-1989, slowdown in exports between 1990-1993, devaluation in 1994, export recovery in the 1994-2000 period, Russian crisis in 1998, earthquake disaster in 1999, exchange rate based stabilization program in 2000 and the devaluation in 2001. Furthermore, to see whether there was a structural change in levels at some particular dates, dummies which takes a value of 0 until the break point and then takes a value of 1 after the possible break point, were also constructed and tested: These were dummies for the post-1960 period, liberalization in the post-1980 period, the aftermath of capital account liberalization which was initiated in 1989 and completed in 1992, and the post-2001 floating exchange rate period.

Among these dummy variables, foreign exchange rate stringency during the 1953-1959 period, the first stage of the ISI, series of devaluations and the change in economic policies in 1981, as well as the post-2001 recovery in exports were found to be significant. These show that the pressures in the economy during 1953-1959 which paved the way to the devaluation in 1958 led to the slackening in exports. Furthermore, during the first stage of the ISI between 1960 and 1969 when the controls on foreign trade increased substantially, the rate of growth
of exports fell. Furthermore, in 1981, the instant positive impact of the series of devaluations and daily adjustments in the exchange rate on exports is observed through the positive sign of the dummy variable. Finally, the considerable increase in the rate of growth of exports after the substantial devaluation during the economic crisis in 2001 is captured through the dummy variable taking the value of 1 in the floating exchange rate period following February 2001. Although the real exchange rate appreciated since 2003, the export growth remained robust due to the strong demand from abroad and the low unit production costs. The low production costs, on the other hand, stemmed from the reduced real wages and low costs of imported inputs due to the appreciated currency.

The following equation is estimated for import demand for 1952-2003:

$$d\log(RIMPORT) = \beta_1 + \beta_2 [0.75 \times d\log(RGDP)] + 0.25 \times d\log(RGDP(-1)) + \beta_3 d\log(REXCH) + \beta_4 d\log(IMPDUTY) + \beta_5 FXCONSTR3(-1) + \beta_6 DEV1958 + \beta_7 FXSTR5359 + \beta_8 ISI1 + \beta_9 STAB2000 + \beta_{10} AR(1)$$

where,
- $d\log(RIMPORT)$: real imports as logarithmic difference over previous year,
- $d\log(RGDP)$: real gross domestic product (GDP) as logarithmic difference over previous year,
- $d\log(REXCH)$: real exchange rate as logarithmic difference over previous year,
- $d\log(IMPDUTY)$: ratio of import duty to GDP, as logarithmic difference over previous year,
- $FXCONSTR3(-1)$: one period lagged value of foreign exchange constraint,
- $DEV1958$: dummy for the devaluation in the 1958-1960 period,
- $FXSTR5359$: foreign exchange stringency in the 1953-59 period,
- $ISI1$: dummy reflecting the first phase of import substitution industrialization between 1960 and 1969,

The results of the ordinary least squares (OLS) regression are presented in Table 3 below.

According to the OLS estimation, one of the major determinants of the import growth in Turkey is the economic growth reflected by the rate of increase in the GDP. This is in line with the predictions of economic theory. The variable is the weighted average of the two years, involving the impact of the previous year’s GDP growth as well.

In the import equation, as in the export equation, some price variables were tested. These price variables were the import unit value index of non-oil producing developing countries (as a proxy for Turkish import prices) and import unit value index of industrialized countries (for average international import prices), both from the IFS. However, these variables were not statistically significant in explaining the real import growth in Turkey. This may be because the import unit value index of non-oil producing developing countries might not have adequately reflected the import composition of Turkey. The import composition of developing countries might be diverse, especially in the period before 1980 and not as similar as in export bundles. The following figures which depict export and import prices of Turkey available from the SIS for 1969-2003 and the price indices of non-oil producing developing countries from the IFS suggest that the discrepancies between the indices are greater for import unit value than export unit value.
Table 3. Determinants of Import Growth during 1952-2003

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.021</td>
<td>0.331</td>
</tr>
<tr>
<td>0.75<em>dlog(RGDP)+0.25</em>dlog(RGDP(-1))</td>
<td>2.864</td>
<td>0.000</td>
</tr>
<tr>
<td>dlog (REXCH)</td>
<td>-0.341</td>
<td>0.004</td>
</tr>
<tr>
<td>dlog (IMPDUTY)</td>
<td>-0.555</td>
<td>0.000</td>
</tr>
<tr>
<td>FXCONST3(-1)</td>
<td>-0.029</td>
<td>0.002</td>
</tr>
<tr>
<td>DEV1958</td>
<td>0.194</td>
<td>0.003</td>
</tr>
<tr>
<td>FXSTR5359</td>
<td>-0.086</td>
<td>0.031</td>
</tr>
<tr>
<td>ISI</td>
<td>0.059</td>
<td>0.147</td>
</tr>
<tr>
<td>STAB2000</td>
<td>0.143</td>
<td>0.135</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.600</td>
<td>0.000</td>
</tr>
</tbody>
</table>

R-squared                        | 0.757       |
Adjusted R-squared               | 0.705       |
Log likelihood                   | 53.118      |
Durbin-Watson stat               | 1.992       |
F-statistic                      | 14.543      |
Prob(F-statistic)                | 0.000       |

* Diagnostic tests of Box-Pierce Q and Breusch-Godfrey test for serial correlation; Jaque-Bera test for normality; ARCH test and White heteroskedasticity test were checked.

Due to the poor results from the price variables, the real exchange rate was used to assess the relative purchasing power of the domestic currency in terms of foreign goods; and this had a satisfactory result, showing the negative relationship between the depreciation of the domestic currency and imports. One possible explanation why the real exchange rate worked better in the import equation than the price variable may be due to the fact that economic agents observed and evaluated the exchange rate relatively more easily.
In addition to the traditional income and price variables, a policy variable, the ratio of the import duties to the GDP which meant to capture the frequent changes in the import policies, especially in the controlled economy period before 1980 and in the early liberalization period until 1990, were added to the import equation. The coefficient of this variable is negative, pointing out that when import duties increased faster, the resulting impact is a decline in the rate of growth of imports. This variable is intended to reflect strengthening or loosening of the import controls.

Among the determinants of imports, the foreign exchange rate constraint variable deserves a special attention. In the conventional import demand models, a variable relating the foreign exchange rate availability to imports does not exist. This phenomenon is recently more often addressed in the empirical studies (Egwaikhide, 1999; Kotan and Saygılı, 1999; Emran and Shilpi, 2001) since, apart from price and income variables, foreign exchange availability becomes one of the major determinants of imports, especially if the economy is under strict foreign trade and capital controls or, in an open economy framework, if the economy is faced with frequent capital outflows. Based on this reasoning, a measure of foreign exchange constraint for Turkey was also incorporated into the import equation.

Regarding the choice of the FX constraint variable, several measures were derived. In fact, it is common to use the international reserves as an indicator of FX availability or scarcity in empirical studies (Warner and Kreinin, 1983; Kotan and Saygılı, 1999). However, this form was also subject to serious criticism since it suffered from the problem of “near-identity.” (Emran and Shilpi, 2001) To cope with this problem, parametrization of the variable to alternative variables is suggested so that the one-to-one relationship between imports and the FX availability is avoided.

In this respect, three measures of FX constraint were derived and tested in the equation. The first one is inspired from the one suggested by Emran and Shilpi (2001), which is the ratio of total domestic expenditure (GDP+import-export) to international reserves. This variable, however, did not satisfactorily explain the changes in import growth in Turkey and, thus, alternatively, ratio of net exports (imports-exports) to international reserves and ratio of current account deficit to international reserves were also tried. Both of these variables were significant; hence, the latter was chosen as the foreign exchange rate constraint variable in the model. Consequently, the negative coefficient of the regressor pointed out that the import growth declined as foreign exchange constraint increased.

Finally, as in export equation, several level shift dummy variables were tested. Accordingly, it is observed that during the devaluation in 1958, import growth rose, contrary to the expected decline. This may be due to the fact that despite the devaluation, selected imports to meet the import substitution industrialization requirements at that time might have offset the negative impact of the depreciation of the domestic currency. Furthermore, as in export equation, the economic problems during 1953-1959 and the resulting FX stringency led to the slowdown in the rate of growth of imports. This finding is the expected outcome based on

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9 In this respect, the study of Egwaikhide (1999) which estimates the determinants of imports and its components for 1953-1989 in Nigeria is quite relevant for Turkish case. Foreign exchange receipts is included in the import demand function based on the reasoning that in the most part of the research period, import substitution industrialization was pursued and foreign exchange constraints played an important role in the import behavior of developing countries.

10 Most of the dummies tested were the same as those that were tried in the export equation, since the dummy variables were basically chosen on the basis of a change in the economic policy that has direct consequences on foreign trade. Therefore, these dummy variables will not be re-addressed here.
prior information about the period. Furthermore, despite their low explanatory power, dummy variables for the first phase of the ISI and the exchange rate based stabilization period were also used in the import equation. The aim is to show that during both periods, the impact of those particular policies were to increase the rate of growth of imports. In the former, the motivation behind increasing imports were heavy industrialization during the ISI, whereas in the latter consumption good imports led to a surge in total imports.

Consequently, it is observed that both the export and import equations are primarily determined by price and income variables as in standard trade models. However, as the period in question, 1950-2003, is marked for many changes in economic policies and the data is only available in annual terms, new variables and dummy variables were introduced in the single equation framework in order to obtain a more complete view of the historical developments. In this sense, in both export and import equations, foreign exchange rate availabilities and import substitution industrialization strategy played a role, while the post-2001 period had a definite increasing effect on export growth. The exchange rate based stabilization program, on the other hand, seems to have some impact on the import growth.

However, it should be noted that a single equation framework itself, by no means suffices to explain all the shifts and changes in the economic structure. These equations can only be suggestive for the start of a more in depth analysis. In the following sections, these models will be subject to further examination through formal tests of stability to grab more intuition about the changes and breaks in the economic structure of Turkey between 1950 and 2003.

4. TESTING FOR STRUCTURAL CHANGE

In this section, the constancy of parameters when the structural change points are not known will be tested by the methodology derived by Andrews (1993). The null hypothesis of the test for parameter stability is \( H_0: \beta_t = \beta_0 \) for all \( t \) in the period in question, where the alternative hypothesis with a change point at an unknown time is \( H_1: \beta_s \neq \beta_t \) for some \( s, t \) in the same period. To decide on a potential break point, Andrews proposed to calculate the F statistics for each potential breakeven point and take the maximum among the potential change points, which is called the SupF statistics. Andrews tabulated in his paper the asymptotic critical values for the SupF statistics.

The structural equation for a break in the model is as follows:

\[
y_t = \beta_t x_t + e_t
\]

where \( \beta_t = (\beta, \text{ if } t < t_0 \) and \( \beta + \theta, \text{ if } t \geq t_0 \) and \( t_0 \) is the time when the shift took place. The test is whether \( H_0: \theta = 0 \) against the alternative \( H_1: \theta \neq 0 \).

In this context, for each export and import equation estimated in the previous section, F statistic has been calculated for each potential break year, among which the highest valued F statistics have been chosen. Results of the Andrews’ (1993) SupF test and the asymptotic critical values are presented below.

---

11 The well-known Chow (1960) tests is designed for the cases when the nuisance parameter, that is, the breakeven point is known and, therefore, it does not suffice to detect the change which is unknown at the beginning. In other words, the Chow’s critical points are quite low (naturally for it tests the particular known dates) and, therefore, when applied to unknown dates, one can easily accept the hypothesis of a change when it is in fact not.
Table 4. Export Equation: Test Results of Structural Break for 1951-2003

<table>
<thead>
<tr>
<th>Potential Structural Break</th>
<th>$F_0$</th>
<th>10% Critical Value</th>
<th>5% Critical Value</th>
<th>1% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t = 1958$</td>
<td>1.89</td>
<td>30.9</td>
<td>33.4</td>
<td>38.4</td>
</tr>
</tbody>
</table>

* Critical values are tabulated in Andrews (1993).

Table 5. Import Equation: Test Results of Structural Break for 1952-2003

<table>
<thead>
<tr>
<th>Potential Structural Break</th>
<th>$F_0$</th>
<th>10% Critical Value</th>
<th>5% Critical Value</th>
<th>1% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t = 1979$</td>
<td>5.07</td>
<td>23.31</td>
<td>25.95</td>
<td>31.62</td>
</tr>
</tbody>
</table>

* Critical values are tabulated in Andrews (1993).

Consequently, the test fails to detect a break in the suggested points, 1958 for exports and 1979 for imports and the existence of a structural break or a regime shift in the sample period is strongly rejected. There is considerable difference between the critical ratios and the estimated test statistics. This may be interpreted that the estimated coefficients seem stable during the period in question. However, such tests may also fail to detect a break as they consider only a single point, which may be misleading if the data does not exhibit a break at a single point. There may be multiple breaks or the impact of the parameters may be evolving through time gradually. This will be evaluated in the following sections through diagnostic recursive methods.

5. DIAGNOSTIC RECURSIVE METHODS: CUSUM TESTS

One of the diagnostic tools to detect the non-constancy over the sample period is the recursive estimation methods. In this section, the parameter instability in the export and import equations will be tested by using recursive techniques, given that several regime shifts were more likely to have occurred during 1950-2003 than a one-time shift. Besides, the change in the impact of the determinants of foreign trade flows might have taken place only gradually, which can more easily be detected by a visual inspection of the evolution of the coefficients of those variables through time.

In the general form of the recursive estimation, namely, the recursive least squares, the sample is split into a base period, $t = 1, 2, 3, \ldots, k$, and the model is estimated repeatedly adding one observation to the sample period until the sample period reaches $t = T$. In each estimation of the model, the model parameters are updated and the plots of the series of the coefficients of the parameters are obtained after all the possible estimations are worked out. This allows the evaluation of constancy problems through graphical representations. If the graphs of the

12 Chow tests for single and multiple break points have also been applied to the equations, omitting the dummy variables and the AR term. Given the limitation of the test that it is a methodology for the known break points, the test suggests break points for export equation in 1971, 1979 and 1987. For import equation, the suggested break points are 1959, 1970 and 1988. These points are suggestive but should be handled with caution due to the omission of the dummy variables and the low critical values of the Chow tests. Furthermore, import equation without the dummy variables and the AR term contains autocorrelation and serial correlation, which are by themselves the source of instabilities. Therefore, in this study, Chow test results are not displayed but are available from the author upon request.
coefficients display significant variation, the existence of a regime shift or instability in the period in question can be suspected.

Two specific forms of recursive methods are CUSUM (cumulative sum) test and CUSUM of squares test, both of which are based on recursive residuals. The one-step forecast error obtained by the recursive least squares is called recursive residual, \( w_t \), which is defined as follows:

\[
w_t = \frac{y_t - \hat{y}_t^{-1}}{\sqrt{1 + \hat{y}_t(X'_{t-1}X_{t-1})^{-1}x_t}}
\]

The residuals are computed for \( t = k+1, \ldots, T \). The CUSUM test looks at the cumulative sum of the residuals, which is given by the statistic,

\[
W_t = \frac{1}{s} \sum_{t=k+1}^{T} w_t, \quad t = k+1, \ldots, T
\]

where \( s \) is the standard error of the regression fitted to all \( T \) sample points. The cumulative sum is plotted against time and is expected to diverge from the zero mean value line, if the coefficient vector \( \beta \) changes from period to period. The significance of the parameter instability is determined by reference to 5% critical lines. Parameter instability is verified if the cumulative sum goes outside the area between the critical lines.

The idea behind the CUSUM of squares test is similar to the CUSUM test. The test statistic is given by

\[
s_t = \frac{\sum_{t=k+1}^{T} w_t^2}{\sum_{t=k+1}^{T} w_t^2}
\]

Similarly, the significance of the deviation of \( s_t \) from the expected line is determined by reference to 5% critical lines around the expected line. If the cumulative sum of squares remain within the band, this suggests stable residual variance.

In this study, recursive least squares as well CUSUM and CUSUM of squares will be implemented. CUSUM tests are applicable only to stable equations (which fulfill basic diagnostic tests) without dummy variables and the AR term. The export equation which is re-estimated using price variables, developed country output and the output gap satisfies the diagnostic tests; and, therefore, will be subject to CUSUM tests. Import equation without the dummies and the AR component, however, has serial correlation; so CUSUM tests cannot be applied. Besides, EViews provides critical values for OLS equations but not for AR equations.

Finally, the original equations of both exports and imports estimated in Section 3.3 will be tested through recursive least squares in Section 6.

The results of the CUSUM and CUSUM of squares test for export equation are as follows:
According to the CUSUM test, the recursive residuals are within the critical 5% lines. The picture suggests that in 1980, there is a clear structural change in the equation as can be followed from the shift of the recursive residuals to a new plateau. However, this change cannot be interpreted as parameter instability according to the test. CUSUM of squares, on the other hand, has produced similar results that there is a change in the economic regime in 1980. However, this test also suggests that parameter instability increased around 1980-1990 since the recursive residuals passes the critical lines in that period.

The date of 1980 and the period of 1980-1990 as change points in the Turkish economy are plausible since the change in the economic regime from ISI to trade and financial liberalization in the early 1980 is the most evident regime shift in the Turkish economy. The transformation of the economy during 1980-1990 might have led to considerable instability in the relationship between the macroeconomic variables and the transformation process seems to have been competed in the early 1990s. Whether these pieces of information will be verified through the recursive least squares will be examined below.

6. DIAGNOSTIC RECURSIVE METHODS: RECURSIVE LEAST SQUARES

Recursive least squares (RLS) have been implemented in three steps: First, for each equation, a sample of 24 observations is chosen starting from the beginning of the period. Second, keeping the number of observations fixed, the sample is moved by dropping one observation from the beginning and adding one from the end of the sub-sample and the equation is re-estimated with each sub-sample. In the next step, in order to see whether the change in the coefficients emanates from including one observation, RLS estimations is repeated by keeping the starting point fixed and adding one observation each time the equation is re-estimated. Finally, to see whether the change in the coefficients is due to dropping one observation, the model is estimated this time for the whole period and one observation starting from the beginning of the period will be dropped in each estimation, keeping the end point

---

The sample size is arbitrarily chosen. The analysis has been applied to sample sizes of 20 and 30 to see whether results are robust to changes in the sample size. RLS with sample size of 20 has been omitted as it reflected more volatility due to lack of enough number of observations. Regression with sample size of 30, on the other hand, exhibited milder fluctuations, as can be expected, but the results are not different from the ones obtained from the 24-observation sample. Moreover, with the sample size of 30, one covers the period until 1980s and cannot evaluate the changes in the pre-1980 period. Accordingly, only the results of the sample size of 24 will be displayed in this study.
fixed. The result of the last two steps will be displayed in the graphs below. The graphs on the left and right side depict the RLS results with fixed starting point and the RLS results with fixed ending point, respectively. An arbitrary plus and minus 20% lines around the mean of the coefficients have been also drawn in the graphs in order to evaluate the extent of the fluctuations more clearly.

6.1. Import Equation:

The inspection of growth coefficient in the import equation through RLS with fixed starting point shows that coefficient remains relatively stable. There is, however, a moderate instability between 1978 and 1980. Furthermore, in the second graph where RLS coefficient with fixed ending point is displayed, dropping 1975-1977 creates volatility. This corresponds to the second phase of the ISI, when the economic problems mounted coupled with oil price shock at the end of the decade. The crisis of the ISI reveals itself as production bottlenecks and foreign exchange shortages at the end of 1970s. Later, when the sample consists of the post-1980 data, the growth coefficient declines moderately (from around 2.8 to 2.5) and remains stable afterwards, probably reflecting the structural change between the ISI and the liberalization period.

Real exchange rate coefficient in the import equation is also quite stable under three specifications of RLS with 24-observation sample. The only major change in the coefficient of the real exchange rate takes place in 1977 in the RLS with fixed ending point, however, when dropping the data at that date and its preceding period, the coefficient (in absolute value terms) increases sharply and remains stable after that date. This implies that the relationship between real exchange rate and imports changed in the post-1980 period in a way that the weight of real exchange rate among the determinants of imports increased. This is an expected result, since the exchange rate used in the equation is the official exchange rate before 1980, which was subject to heavy controls. There is strong evidence that the impact of blackmarket on foreign trade of Turkey was sizeable especially before 1980, which is verified by the huge gap between the blackmarket and official exchange rates. Therefore, official exchange rate had less explanatory power in the determination of imports in the closed economy period and the real exchange rate became more effective after the gradual deregulation of foreign exchange markets after 1980s.

The path of the coefficient of import duty in the import equation displays an important divide between pre- and post-1980. The coefficient moderately increases (in absolute value) between 1974 and 1978, while it decreases moderately in the 1979-1986, as can be followed through the RLS with fixed starting point. This may be interpreted as a distinction between the impact

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14 The RLS results with fixed sample period are not displayed here for two reasons. First, it is the combination of the other two steps; therefore, it is used as a guide in the interpretation of the second and third steps. Second, the fixed 24-observation sample is still a small sample size that may not produce reliable results and may overestimate fluctuations.

15 That the coefficient becomes stable around 2.5 is more clearly observable in the estimations done through RLS with fixed ending point dropping the data until 20-observations sample remains. This allows more observations for 1980-1984, albeit less reliable.

16 Similar to the growth coefficient, the stability of the real exchange rate coefficient is verified by the RLS with fixed ending point dropping the data until 1984 to obtain 20-observations sample.

17 Unfortunately, the blackmarket rates are not available in time series to allow for more reliable estimates for Turkish foreign trade. Only a limited number of data regarding the average monthly official and blackmarket US dollar exchange rates for 1967-1980 can be found in Pick’s Currency Yearbooks. For a discussion of the unofficial foreign exchange rate market and its impact on Turkish foreign trade, see Yücel (2003).
of tariff policy in the closed economy and open economy frameworks. During the ISI period, it is plausible to expect that tariff policy assumed a higher role in the determination of imports along with the increase in the controls on foreign trade, especially in the second half of 1970s. After 1980, as foreign trade was liberalized and the controls on foreign trade were lifted, the weight of the tariff policy in the determination of imports seems to have declined relatively and stabilized. The slightly increasing trend in the RLS coefficients with fixed ending points (implying a decline in the magnitude of the coefficient in absolute value) also supports this view.

The breakpoint in the late 1970s just preceding the introduction of economic liberalization is also worth of notice in the evolution of the coefficient of the foreign exchange constraint. In the cases of RLS with fixed length (which is not depicted here) and RLS with fixed ending point, dropping the observation at 1977 and the preceding period leads to insignificant coefficients. This implies that the foreign exchange constraint was effective on imports during the ISI period, as expected, while in the post-1980 period in the aftermath of liberalization, the foreign exchange constraint was no longer a valid determinant of imports due to the relaxation of foreign exchange restrictions and increase in the availability of foreign exchange. Moreover, the RLS with fixed starting point reveals another interesting feature that from 1994 onwards the impact of FX constraint declined gradually, which further supports the view that the importance of the foreign exchange constraint weakened especially in the second half of 1990s.

6.2. Export Equation:

Although the coefficient of home export prices is quite instable, it remains within the 20% band around its mean, which can be interpreted in a way that the fluctuations are more or less moderate. In the left panel with RLS with fixed starting point, it is observed that adding 1977-1985 increases the coefficient moderately in absolute value terms and observations after 1986 reduces the coefficient moderately. In the right panel with RLS with fixed ending point, the volatility in the coefficient is more visible, where the coefficient decreases sharply when the observations in the 1962-1964 period are dropped from the sample. The coefficient exhibits further volatility after dropping each observation in the 1972-1980 period.\(^{18}\)

The instability in the relationship between this variable and exports may be due to the foreign trade policy during the ISI. The most evident change in the magnitude of the coefficient is between 1962 and 1965, in the early years of the first phase of ISI and another notable change takes place during 1972-1980, which is the second phase. ISI rests on increased control on foreign exchange and trade flows and, therefore, the controls should have been relatively more dominant in export and import decisions than the price variables. Periods of economic turbulences such as the late 1970s should have also played a role in distorting the relationship of the macroeconomic variables.

Coefficient of average world export prices is relatively stable during 1950-2003. Major instability is between 1973 and 1979 according to the RLS with fixed starting point while the coefficient remains within the 20% lines around the mean after that date. In the RLS with fixed ending point, major change in the coefficient takes place after dropping 1962-1964, when the coefficient declines from a value around 0.6 to 0.4. Moreover, once again the distortions generated by the late-1970 economic crisis can be observed through the RLS with

\(^{18}\) In the 1981-2003, however, the coefficient returns to its level between 1965 and 1972. This can be seen if observations are continued to be dropped until 1984.
fixed ending point in the right panel. After dropping 1977-1979, however, the coefficient returns to its average level around 0.4.\(^{19}\) A decline in the magnitude of the coefficient in both of the specifications suggests that relative importance of this variable declined after mid-1960s.

The output growth of developed countries can also be considered as a relatively stable variable in the export equation. This is not surprising since the demand from major export markets have always been a very crucial determinant of Turkish exports. In the RLS with fixed starting point, there is some instability in the second half of 1970s when crisis conditions worsened. The fluctuations in the second phase of the ISI are also verified in the panel with RLS with fixed ending point, where volatility is more evident between 1973 and 1981. These fluctuations ended as of early 1980 when the coefficient of this variable returned to its mean value around 1.5 by 1982 in RLS with fixed starting point, following the liberalization practices.\(^{20}\) This implies that once the crisis conditions are over, the Turkish exporters quickly regained their access to foreign markets, assisted by the opening of the economy.

Output gap is almost zero until 1976 according to RLS with fixed starting point and coefficient of this variable increases after that date. In the early 1980s, following foreign trade liberalization it gained even further importance as can be followed through the increase in the coefficient. The coefficient of the variable can be regarded as relatively stable, reflecting the continuing importance of domestic demand conditions in the Turkish export performance.

\(^{19}\) This is observable if further observations until 1984 are dropped from the sample.

\(^{20}\) It should be recalled that the smallest sample of the regressions consists of 24 observations rather than 20, in order to allow for relatively more reliable results as well comparison with other regressions. But if one continues to drop the observations until 1984 (finally regressing the equation for 20 observations), the stability around the value of 1.5 can be easily seen in the coefficient of the output growth of the developed countries, as well.
6.3. Recursive Least Squares Panels: Import Equation

Elasticity with respect to GDP Growth - II
(Moving Windows with Fixed Starting Point)

Elasticity with respect to GDP Growth - III
(Moving Windows with Fixed Ending Point)

Elasticity with respect to Real Exchange Rate - II
(Moving Windows with Fixed Starting Point)

Elasticity with respect to Real Exchange Rate - III
(Moving Windows with Fixed Ending Point)

Elasticity with respect to Import Duty - II
(Moving Windows with Fixed Starting Point)

Elasticity with respect to Import Duty - III
(Moving Windows with Fixed Ending Point)
6.4. Recursive Least Squares Panels: Export Equation
7. CONCLUSION

In this study, various dimensions of Turkey’s foreign trade in the 1950-2003 period have been examined through the long-run export and import demand equations, which were not estimated for the period in question before. Apart from the unavailability of time series data since 1950s, the reliability of the existing statistics especially in the pre-1990 period makes research difficult in this period. However, even considering the limitations of the data, this study arrived at reasonable conclusions, which may give way to further debates and research on the topic.

At the first step, the existence of a stable long-run relationship between exports/imports, price and income variables were questioned. Had it existed, such relationship would have provided valuable information and the econometric estimations of export and import demand models would have non-spurious results. Through this equilibrium relationship, it would be easy to interpret the elasticity of export and imports with respect to income and price variables. However, cointegration tests did not support the existence of a stable long-run relationship in the 1950-2003 period. This is not unexpected, however, since factors such as the regime shifts, economic policy changes and various crises in the research period might have led to permanent deviation in the long-run equilibrium relationships. Indeed, considering the whole economic history since 1950s, it is observed that the Turkish economy is more marked for its boom-bust cycles than periods of medium-term stability. The intervention in and the control
over the economy were the main features of the period before 1980, when import substitution industrialization was predominantly implemented. From 1980 to early 1990s, liberalization of the economy was completed in terms of trade, finance and capital movements but this did not lead to sustainable growth path either. The economic growth was interrupted frequently by crises of various intensities in the 1990s and the early 2000s, among which the 1994, 1999 and 2001 crises ended up with considerable contraction of the economy. Following the worst economic crisis of Turkey ever recorded in 2001, further reforms regarding the public and financial sectors have been introduced, which have been continuing through the two consecutive stand-by arrangements with the IMF. Finally, since 2002, a relative stability in the economy has been established owing to those structural reforms.

Given this economic background, export and import equations were estimated in this study, taking into account the time series properties of the data. Despite some loss of information due to the required elimination of unit roots in the data, it has been shown that both the export and import equations are primarily determined by price and income variables as in conventional trade models. Exports are determined by export prices of Turkey, world average export prices and demand from the major export markets.

In addition to these variables, it is worth to mention that domestic demand also played a role in exports, while foreign exchange constraint affected exports negatively specifically in the 1953-1959 period and in the first phase of the ISI between 1960 and 1969. The 1953-1959 period was specific in the sense that the government was obliged to increase restrictions on foreign trade and foreign exchange transactions due to increasing current account deficit. One explanation of the negative impact of increased control of foreign trade on exports may partly be the probable rise in unregistered transactions in response to restrictions. In addition, the prolonged economic problems during that period might have also affected production and export decisions. This period was followed by a stabilization program, which involved devaluation of the domestic currency, as well as increasing discipline in public finances between 1958 and 1960. In the beginning of 1960s, ISI started to be implemented more formally through five-year development plans. Exports stagnated during 1960s, however, which received less concern from the officials, as the priority was given to the industrialization and the government did not face difficulties in financing the imports of raw materials and capital goods.

Finally, after the liberalization was launched in 1980, Turkey underwent a substantial transformation, which changed the nature of the relationship between the macroeconomic...
variables. Immediate impact of the shift was reflected as a rise in the rate of growth of exports. Moreover, the economic crisis in 2001 appeared to be a positive shock for exports, leading to higher export growth in the aftermath of the substantial contraction in domestic absorption and sharp devaluation.

Determinants of imports in Turkey, on the other hand, were found to be the real GDP growth and the real exchange rate, as well as the tariff policy and the foreign exchange constraint. Increasing controls on imports through tariff rates negatively affected imports, as expected. Among the determinants of imports, foreign exchange constraint is particularly important because this variable reflects the whole atmosphere of the ISI strategy based on controls of the foreign exchange and trade. Accordingly, the difficulties in obtaining foreign exchange obviously reduced import demand. This constraint was eliminated completely in the 1980s and, more specifically, after 1990s, following the completion of the liberalization of capital movements. Moreover, increased restrictions to curb current account deficit in the second half of 1950s were effective in reducing import growth, as can be followed from the negative coefficient of the FX stringency dummy for 1953-1959 period.

Analyzing export and import equations in the light of structural break and stability tests give more insight about the dynamics of foreign trade in Turkey. The structural transformation between pre- and post-1980, between the ISI and liberalization periods becomes even more obvious, as can be followed from the change in the relationship between the determinants of foreign trade in the two specific economic models. In import equation, the coefficients of all the major variables, namely, GDP growth, real exchange rate, import duty and foreign exchange constraint exhibits shifts in the late 1970s and in 1980 and stabilizes after that date.

Through the RLS of export equation, the breakpoint at 1980 is also evident preceded by the volatility in the late 1970s, when the economy was hit by the shortcomings of the ISI (such as stagnant exports, foreign exchange shortages and production bottlenecks) as well as oil price shocks. Although the economic turbulence in the 1970s can be felt in the RLS coefficients in the import equation, the volatility generated in those years is more obvious in the export equation, where the disturbing impact of the economic problems in the 1970s starts as early as 1972. However, in the import equation, the volatility is observed more in the second half of 1970s, and more specifically, in the years between 1977 and 1979.

This evidence, therefore, suggests that the shortcomings of the ISI and the adverse external conditions in the late 1970s affected exports and imports differently. Exports were more adversely affected but this development did not receive enough attention, since foreign exchange revenues in the form of workers remittances had started to increase during that time and this allowed the officials to neglect the stagnation in exports. The workers remittances became a perfect buffer for the oil price shock in 1974 and thanks to abundant foreign exchange from this source, Turkey could continue to implement ISI and sustain imports of raw materials and intermediate goods for industrial production. As a result, the crisis of the 1970s was only transmitted onto imports at the very end of the decade.

Following the launch of the liberalization program, the volatility seems to have lessened and the RLS coefficients maintained stability, which imply that a structural change in the economic perspective was a proper response to the crisis. Naturally, following the structural transformation, some factors, which had higher explanatory power in the pre-1980 period, had a declining explanatory power in the aftermath of liberalization or vice versa. Real exchange rate in the import equation is such a variable, whose weight in the determination of imports
increased after 1980. Along with the elimination of tariffs and the increase in the openness of the economy, the response of imports to tariff policy also declined in the post-1980, while the foreign exchange constraint was no longer a valid determinant of imports after the relaxation of foreign exchange restrictions and liberalization of capital movements especially in the second half of 1990s. Similarly, in the export equation, output gap (the domestic demand proxy) gained more importance in the early 1980s and the relative importance of world prices declined after mid-1960s.

Summing up shortly, this study concludes that any research focusing on Turkey since 1950s should be very cautious about the analytical relationships and estimations. Long-term studies on Turkish economic literature require sensitivity and questioning about data reliability and existence of structural breaks and change points.

Final point worth to mention among the conclusions in this study is that the economic growth is the key determinant of imports either under ISI or liberalization strategies. This implies that Turkey’s economic growth leads to expansion in foreign trade and current account deficits under either economic strategy. This is very much related to the nature of domestic production, which rests on high share of imported raw materials. Whether the production is oriented towards domestic consumption (as in the ISI period) or the production is triggered by strong export performance (as in the post-2001 period) the result is similar: rise in trade and current account deficits. Therefore, any policy directed at sustaining economic growth should take into account the relationship between growth, imports and current account deficit. Only a transformation, which allows the substitution of imported inputs with domestically produced raw materials and intermediate goods, may help reduce the elasticity of imports with respect to income.
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