ECONOMETRIC MODELLING OF IMPORT DEMAND AND EXPORT SUPPLY IN TURKEY

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SAYGIN ÇEVİK

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Economics.

Assist. Prof. Kıvılcım Metin
Supervisor

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Economics.

Assist. Prof. Fatma Taşkın
Examining Comitee Member

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Economics.

Assist. Prof. Nazmi Demir
Examining Comitee Member

Approval of the Institute of Economics and Social Sciences

Prof. Kürşat Aydoğan
Director

ABSTRACT

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Çevik, Saygın

Master of Economics

Supervisor: Assist. Prof. Kıvılcım Metin

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In this thesis, I estimate the export supply and import demand equations for Turkey using quarterly data over the period 1989-2000. Unlike the previous studies done for Turkey, in this study the sub-items of the total import demand, namely, intermediate, capital and consumption goods import demand equations are estimated. In empirical analysis, first the cointegration is tested by using two different approaches: Engle-Granger (1987) and Johansen (1991) approach. After finding long-run relationships, error correction models are specified and estimated for export supply and import demand equations respectively. The main conclusion that emerges from empirical results is that foreign trade developments in Turkey are highly dependent on the economic activity and the effects of exchange rate policy on imports and exports appear to be fairly limited.

Key Words: Import, Export, Cointegration, Error Correction Model

ÖZET

TÜRKİYE'DEKİ İHRACAT ARZI VE İTHALAT TALEBİ

DAVRANIŞLARININ EKONOMETRİK OLARAK İNCELENMESİ

Çevik, Saygın

Yüksek Lisans, İktisat Bölümü

Tez Yöneticisi: Yrd. Doç. Kıvılcım Metin

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Bu tez ihracat arz ve ithalat talep denklemlerini, 1989-2000 tarihleri arasındaki üç aylık veriler kullanılarak, Türkiye ekonomisi için modellemeye çalışmaktadır. Bu çalışmanın bugüne kadar Türkiye için yapılmış diğer çalışmalardan farkı ithalat talebinin hem toplam hem de alt kalemler itibariyle, yani ara malı, sermaye malı ve tüketim malı ithalat taleplerinin de modellenmesidir. Türkiye'nin uzun dönemli ihracat ve ithalat analizi için Engle-Granger yöntemi ve Johansen yöntemi olmak üzere iki ayrı koentegrasyon yöntemi kullanılmıştır. Uzun dönem ilişkileri bulunduktan sonra, kısa dönem modellemesinde hata düzeltme modelleri kullanılmıştır. Bu çalışmadaki uygulama sonuçlarından, Türkiye'deki dış ticaret gelişmelerinin çoğunlukla ülkedeki ekonomik faaliyetlere bağlı olduğu ve döviz kuru politikalarının ithalat ve ihracat üzerindeki etkisinin sınırlı olduğu sonucuna varılmıştır.

Anahtar Kelimeler: İthalat, İhracat, Koentegrasyon, Hata Düzeltme Modeli

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CHAPTER 1: INTRODUCTION

Outward oriented growth policies were initiated in Turkey in the 1980s and in the subsequent years, Turkish economy has gone through various experiences in terms of foreign trade policies, export performance and growth. As a result of this policy changes, openness of the economy has increased. Import plus export as a percentage of GDP has increased from 15 percent in 1980 to 40 percent in 2000.

Expansion and diversification of exports are generally considered necessary for developing countries to achieve higher and sustainable growth. Over the past few decades, exports have played a critical role in the economic growth of Turkey and policies to increase them have often been employed as an instrument to deal with balance of payment diffuculties. Several sets of policy instruments were used, such as an export tax rebate system, cash premiums, export credits, exemptions from import taxes for main inputs and the exchange rate policy. Thus, the importance of the development of exports for Turkish macroeconomic development is vital.

On the other hand, imports of intermediate and capital goods are critical inputs in the production of exports in Turkey and the share of intermediate goods and capital goods imports is approximately 90 percent in total imports. So, the development of imports is also important for Turkish macroeconomic development.

In this respect, the primary purpose of this study is to carry out an econometric investigation of Turkey's import and export performance for the period 1989-2000. In the earlier literature, numerous studies have examined the foreign trade performance of Turkey. They are generally concentrated on the formulation and estimation of aggregate export and import functions. However, to our knowledge, there are no studies reporting estimations of export and import flows at any level of disaggregation. Since a model for total imports may mask important differences in the effect of income and price for sub-categories of imports and the imports of intermediate and capital goods are critical inputs in the production in Turkey, unlike the previous studies done for Turkey, we also estimate the intermediate, consumption and capital goods import demand equations.

In the empirical form of the import demand and export supply functions, we follow "imperfect substitutes" model (Goldstein and Khan (1985)) in which the key assumption is that neither imports nor exports are perfect substitutes for domestic goods. In this model, import demand depends positively on domestic income and negatively on the relative price of imported goods vis-à-vis domestic goods and export supply depends positively on productive capacity and export prices and negatively on domestic costs.

There is substantial empirical literature on the estimation of import demand and export supply functions and the respective income and price elasticities. Deyak, *et al*. (1989) studied the structural stability of aggregate and disaggregated US import demand, Dwyer and Kent (1993) tested the cointegration relationship between import volumes of Australia and its explanators, Giorgianni and Milesi-Ferretti (1997) estimated Korean aggregate export and import equations and Beko (1998) estimated export supply and import demand functions for Slovene economy.

If we look at the studies done for Turkey, Uygur (1997) estimated long and short run export supply functions, Şahinbeyoğlu and Ulaşan (1999) estimated export supply and export demand equations, Kotan and Saygılı (1999) and Ghosh (2000) estimated an import demand function and Özatay (2000) estimated aggregate export and import equations in a quarterly macroeconometric model.

Having motivated from the previous literature, in this thesis we aim to estimate aggregate export supply and aggregate and disaggregated import demand functions for Turkey. Firstly, we intend to determine whether there exist a long run relationship between the (aggregate and disaggregated) import demand and its major determinants and also between the export supply function and its major determinants. The hypothesis of the existence of a cointegrated relationship is tested using the cointegration techniques developed by Engle and Granger (1987) and Johansen (1991). Secondly, we attempt to estimate error correction models to integrate the short-run with long-run adjustment processes.

Accordingly, the rest of this thesis is organized as follows. In Chapter 2, the historical background of the Turkish foreign trade since 1980 is discussed. In Chapter 3, the studies that are related to my thesis are analyzed. In Chapter 4, a theoretical framework of export supply and import demand functions are developed.

In Chapter 5, the econometric theory used in this study is explained. In Chapter 6, the data set is described, the results of unit root tests and cointegration tests are examined; and depending on these results, error correction models are developed and estimated. Finally in Chapter 7, the concluding remarks that can be drawn from the empirical results are discussed. The related tables are reported in Appendix A.

CHAPTER 2: HISTORICAL BACKGROUND

From early 1930s to 1980s, Turkey followed an inward oriented development strategy called import substitution industrialization which was carried out successfully until 1970s. But at the end of 1970s, as a result of several external and internal shocks; trade and current account deficits reached at its zenith point, economic growth slowed, the inflation rate accelerated, external debt increased sharply and Turkish economy faced a heavy balance of payment crisis.

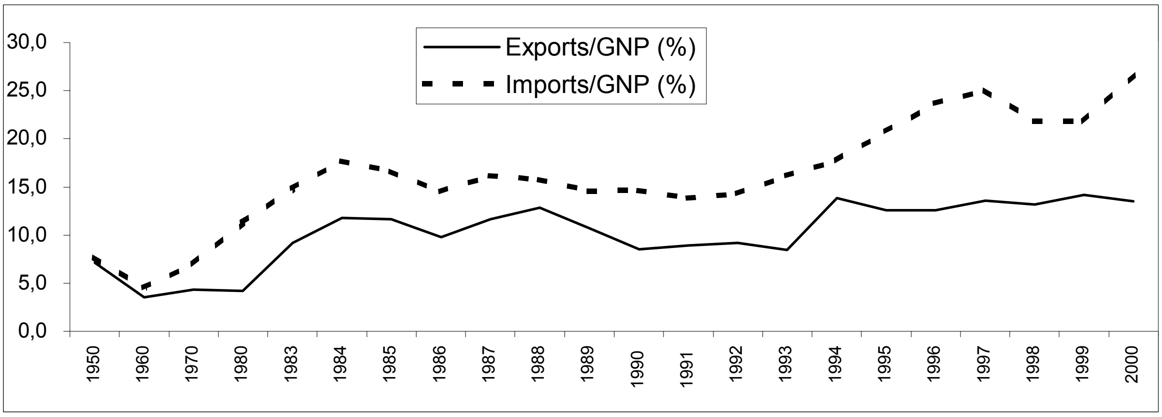
The problems lived in Turkish economy made the government put into practice, a stabilization and adjustment program called "January 24 Decisions" in January 1980. This program was supported by multilateral organizations, including IMF and the World Bank, and by bilateral creditors, the major OECD countries. The most important objectives of this program were to reduce the share of the public sector in the economy and to provide free market mechanism conditions. In this respect, the promotion of exports through continuous adjustments of the exchange rate and by export incentives and subsequently liberalization of imports were set as essential targets. Other important objectives were to realize financial liberalization, take measures towards improving capital markets, liberalize foreign capital movements and reduce the rate of inflation. In the implementation of this policy, export promotion policy through export incentives, especially devaluations, was pursued in this period. In this respect, multiple exchange rates were eliminated and a uniform rate was established with a large devaluation at a rate of 100 percent. This was followed by several other devaluations in the same year.

In this policy, liberalization of imports was more gradual and cautious due to balance of payment problems. In particular, tariffs on raw materials, intermediate goods and certain capital goods imports were decreased. In 1981, there are two main sets of reforms. First, quota lists were abolished. Second some administrative reforms were put into effect, such as lowering the stamp duty and guarantee deposits. In 1984, import regime was altered; tariff barriers were redefined, a list of items, the importation of which was prohibited or subject to prior approval, was introduced and special levies were introduced on a limited number of commodities at marginal rates. The most important result of the stabilization program was the reduction in domestic demand. In the context of this program, the real wage declined continuously and in mid-1980s, it reached levels which was only half of what it had been in the late 1970s. At the same time, agriculture trade terms decreased in this period as compared to the 1970s, which led to further contraction in domestic demand. The contraction of domestic demand promoted exports. In addition, the decline in real wages and large devaluations improved the competitiveness in international trade. At the same time, export incentives, such as tax rebate schemes, payment of cash premiums and subsidized export credits affected exports, especially manufacturing exports, in increasing terms.

The Turkish economy had export-led growth during the 1980-1988 period. In other words, export growth until 1988 was the most important achievement of the adjustment program. The share of exports and imports in GNP are shown in Graph 1.

From the graph, we can see that the share of exports in GNP is more than tripled during the 1980-1988 period.

Graph 1



The economy entered a recession in mid-1988, imports stagnated, current account showed surpluses, investment and consumption expenditures were reduced. 1989 can be assessed as a turning point for the Turkish economy. Firstly, the controls on foreign capital movements were removed and major changes were introduced. Turkish securities as well as foreign securities could be traded freely, Turkish banks could extend foreign currency credit to foreign trade companies, all barriers on the foreign borrowing of domestic firms were removed and foreigners could open Turkish lira accounts convertible to foreign exchange. Secondly economic policies became expansionary. Real wages in manufacturing industry increased sharply and agricultural subsidies accelerated. These developments made it easier for Turkish corporations to borrow from abroad and for foreign capital to benefit from the arbitrage opportunities caused by interest rate differentials. As a consequence of capital inflows, the Turkish lira appreciated in real terms during the 1989-1993 period. On the other hand, expansionary policies, especially increasing real wages, increased the domestic demand considerably. During the 1989-1993 period, export performance slowed significantly due to domestic demand expansion and real appreciation of the Turkish lira; and the share of exports in GNP decreased to the levels of the early 1980s as it can be seen from Graph 1. At the same time, export incentives, which had a strong impact on export performance, were removed to a large extent by the end of 1988 because of budgetary constraints. As a consequence of these developments, trade and current account deficits increased. Then international rating institutions decreased the credit rates of Turkey. To circumvent panic and keep the exchange rate within certain limits, the Central Bank intervened in the foreign exchange market at the cost of decreasing reserves. However, the demand for foreign exchange continued resulting a substantial amount of capital outflow. This financial crisis affected the real sector to a large extent leading to negative growth rates in 1994. These developments caused sharp rises in inflation and interest rates, whereas real wages declined significantly.

A stabilization program, similar to January 24 Decisions, was announced by government on April 5, 1994. This stabilization program was intended to reduce the domestic demand and increase exports via the real depreciation of the Turkish lira. Therefore, exports expanded substantially in 1994. This policy continued until the end of 1994 and expansionary measures were pursued with an expansion in domestic activity in 1995, especially in 1996-1997 period. This growth tendency continued until the first quarter of 1998 but started to decline afterwards because of the crisis in Southeast Asia which affected the developing countries in 1997, the measures that were taken for inflation targeting and the financial crisis that started in Russian Federation in 1998. Those developments affected the financial and real sector of Turkey negatively and increased trade deficit substantially. The economic contraction that started at the second quarter of 1998 became deeper in 1999 because of the world stagnation and the earthquakes occurred at August and November of 1999. In late 1999, in order to improve economy, “The Disinflation and Fiscal Adjustment” program was initiated by the government. This program was intended to increase economic activity by consumer spending and to decrease inflation rate. But the increasing domestic demand and the rise in international oil prices has led to sharp increase in imports and the share of imports in GNP reached its zenith point in 2000 as it can be seen from Graph 1.

To sum up, the increase in exports achieved in 1980-1989 can be attributed to the policies summarized as devaluations of Turkish lira, export incentive schemes and reduction in domestic demand. This episode ended by reverse trends in mentioned policies and a sharp reduction in exports was realized between 1989 and 1993. On the other hand, after 1992 an increasing trend can be observed in imports. The major step in the liberalization of imports was the acceptance of Turkey into the European Customs Union in 1996. After the financial crisis occurred in April 1994, as we can see from the Graph 1, the share of exports in the GNP expanded notably relative to the previous episodes and it keeps this level up to 2000.

On the other hand, another important development, observable in Table 1, was that sectoral decomposition of exports changed considerably from 1980 onwards. In 1980, the shares of agricultural and manufacturing exports were 57.4 % and 36 % respectively. The share of agricultural exports declined to 18.2 % in 1980 and 7.2 % in 2000 and the share of manufacturing exports reached 78.2 % in 1980 and 91.2 % in 2000. The tax rebate system, the export credit scheme, the assignment of foreign exchange funds to exporters and other export promotion measures all favoured the manufacturing exports during this period. Thus a significant role could be attributed to these measures in the growth of manufacturing exports.

Table 1: Shares of Exports by Sectors (%)

Years	Agriculture and Forestry	Mining and Quarrying	Manufacturing
1980	57.4	6.6	36.0
1989	18.2	3.6	78.2
1994	13.6	1.5	84.9
2000	7.2	1.5	91.2

From Table 2, we can see that the sectoral decomposition of imports changed slightly from 1980 onwards. In 1980, the shares of intermediate goods and consumption goods imports were 77.9 % and 2.1 % respectively. But the share of consumption goods imports reached 8.7 % in 1989 and 13.3 % in 2000 while the share of intermediate goods imports declined to 66.8 % in 1989 and 65.4 % in 2000.

Table 2: Shares of Imports by Commodity Groups (%)

Years	Intermediate goods	Capital goods	Consumption goods
1980	77.9	20.0	2.1
1989	66.8	24.3	8.7
1994	58.4	29.9	11.7
2000	65.4	20.8	13.3

CHAPTER 3: LITERATURE SURVEY

In international trade theory, there is substantial amount of study concerning the estimation of import demand and export supply functions and the respective income and price elasticities. In this chapter, the empirical studies that are related to my thesis will be analyzed briefly.

In the study by Deyak, *et al.* (1989), the structural stability of aggregate and disaggregated import demand functions were estimated for US economy by using OLS estimation techniques. In this study, import demand is disaggregated by economic class: crude foods, crude materials, manufactured foods, semi-manufactured foods and finished manufactures. It has been discussed that trends in the price and income elasticities are not smoothly continuous over time and that the values can vary considerably from one period to the next. For each import demand function the evidence of structural instability is tested and when instability is detected, the demand equations are reestimated along the lines suggested by the stability tests. Estimated price and income elasticities have the correct sign except for the crude materials and are higher in finished manufactures import demand function.

Dwyer and Kent (1993), tested the cointegration relationship between import volumes of Australia and its explanators using the Phillips and Hansen fully modified OLS estimator. Import volumes are considered as a function of gross domestic product and relative price of importable goods. The import equation is also estimated for the sub-items. (imports of consumption, intermediate and capital goods) For the aggregate import demand, it is found that the income elasticity is higher than the price elasticity. For the sub-items, the income elasticity is higher for capital goods import and the price elasticity is lower for the intermediate goods import.

Giorgianni and Milesi-Ferretti (1997), investigates the behaviour of Korean trade flows and presents estimates of export demand and supply and import demand equations. Equations are estimated by using a simultaneous structural model in which the long and short run dynamics properties of the data are fully specified. Estimation results indicate that real consumption and investment are important determinants of aggregate imports and the demand for exports exhibits high elasticity with respect to foreign income and relative prices.

Beko (1998), examined the determinants of Slovenian exports and imports by estimating short run export supply and import demand functions for Slovene economy using quarterly data. Total exports are considered as a function of real exchange rate, import demand and export price index whereas total imports are considered as a function of real exchange rate, gross domestic product and import price index. The estimation results show that export supply is price inelastic but income sensitive, whereas import demand is price elastic but insensitive to changes in domestic income. It is also shown that depreciation of exchange rate have an inflation-enhancing and growth-damaging effect in a small, open economy like Slovenia.

Uygur (1997) estimated long and short run export supply functions for Turkey using quarterly data and evaluated the export policies on the basis of the estimation results. Long run estimation is done by Johansen's multivariate cointegration methodology and the short run estimation is done by taking into account an error correction term. In the short run estimation, real exchange rate, investment, excess demand and export subsidies significantly affect export supply with correct signs. But the export subsidies turn out to have a negative effect on export supply in the long run.

Erlat and Erlat (1997), econometrically examined the foreign trade performance of Turkey within the context of a three equation model consisting of export supply, export demand and import demand. It is found that relative prices have no explanatory power in modeling import demand and international reserves appear to be the most important variable in explaining import demand. Also, it is found that the volume of imports is an important variable and prices become significant only after 1980 in explaining export supply.

Kotan and Saygılı (1999), estimated an import demand function for Turkey by using two different model specifications, Engle and Granger approach and Bernanke-Sims structural VAR approach. It is found that in the long run, income level, nominal depreciation rate, inflation rate and international reserves significantly affect imports. But in the short run, inflation growth and the growth of international reserves loose their significant impact on imports and income elasticity improves. In addition, it is also found that, export growth and a dummy that captures the crisis in 1998 have significant effects on import growth in the short run.

Şahinbeyoğlu and Ulaşan (1999), estimated export supply and export demand functions for Turkey using quarterly data. Export supply is considered as a function of real domestic income and real exchange rate while export demand is considered as a function of real foreign income and real exchange rate. The estimation results indicate that, in analyzing exports for the period after 1994, traditional export equations are not sufficient for forecasting and policy simulations. Variables such as uncertainty indicators or investment have crucial roles in explaining exports.

Özatay (2000), construct a quarterly macroeconometric model that describes the functioning of the Turkish economy. In the balance of payments block of the model, total exports are described as a function of real exchange rate and foreign income and total imports are considered as a function of real income and real exchange rate. The Engle and Granger two step procedure is used in the estimation of the models and the short run dynamics is modelled as an adjustment to long run relationships. There is a correction to the long run equilibrium every period in the short run. Estimation results indicate that real exchange rate affects the total imports significantly both in the long and short run, but income is significant only in the long run.

Ghosh (2000), estimated an import demand function for Turkey by using quarterly data. Import demand is considered as a function of gross national income and real exchange rates. Johansen estimation procedure is employed in the long run relationship. For the long run, income elasticities vary from 2.5 to 2.8 and the price elasticities vary from 0.05 to 0.5. An autoregressive distributed lag representation is employed to find the short run dynamics. In the short run dynamic model, the income elasticities vary from 0.6 to 1.7 and the price elasticities are around 0.7.

Table 3 : Summary of Literature Survey

Study	Country	Data	Estimation notes	Findings
Deyak, *et al.*(1989)	US	1958-83 quarterly data	Aggregate and disaggregated import demand functions	Estimated price and income elasticities have the correct sign except for the crude materials and higher in finished-manufactures import demand function.
Dwyer and Kent (1993)	Australia	1974-93 quarterly data	Aggregate and disaggregated import demand functions	For aggregate import demand, income elasticity is higher than the price elasticity. For the sub-items, income elasticity is higher for capital goods import and price elasticity is lower for intermediate goods import.
Giorgianni and Milesi-Ferretti (1997)	Korea	1973-95 quarterly data	Import demand and export demand and supply functions	It is found that real consumption and investment are important determinants of aggregate imports and the demand for exports exhibits high elasticity with respect to foreign income and relative prices.
Uygur (1997)	Turkey	1977-95 quarterly data	Export supply function	Export subsidies turn out to have a negative effect on export supply in the long run.
Erlat and Erlat (1997)	Turkey	1967-87 annual data	Import demand and export demand and supply functions	It is found that international reserves are the most important variable in explaining import demand and the volume of imports is an important variable in explaining export supply.
Beko (1998)	Slovenia	1992-97 quarterly data	Import demand and export supply functions	Export supply is found to be price inelastic but income sensitive whereas import demand is found to be price elastic but income insensitive.
Kotan and Saygılı (1999)	Turkey	1987-99 quarterly data	Import demand function	In the short run, it is found that inflation and international reserves loose their significant impact on imports and income elasticity improves.
Şahinbeyoğlu and Ulaşan (1999)	Turkey	1987-98 quarterly data	Export supply and demand functions	In explaining exports, it is found that variables such as uncertainty indicators or investment have crucial roles.
Özatay (2000)	Turkey	1977-96 quarterly data	Import demand and export supply functions	In the long run income is found to be significant but it loses its significance in the short run.
Ghosh (2000)	Turkey	1987-99 quarterly data	Import demand function	The income elasticities are higher in the long run and price elasticities are higher in the short run.

Having motivated from the earlier literature, this study is concerned with the estimation of Turkish export supply and import demand equations over the period 1989-2000. Previous studies of the foreign trade of Turkey have generally concentrated on the formulation and estimation of aggregate export and import functions. But in Turkey, intermediate and capital goods imports are critical inputs in the production and a model for aggregate imports may mask important differences in the effect of income and price for sub-categories of imports. Unlike the previous studies done for Turkey, in this study we also estimate the intermediate goods import, capital goods import and consumption goods import demand functions. This enable us to estimate the price and income elasticities of subitems of imports and further discuss the policy implications of these estimates.

CHAPTER 4: ECONOMIC MODELLING

The theoretical foundation of export and import equations can be found in the "imperfect substitutes" model (Goldstein and Khan (1985)). This model is based on the simple observation that imported goods are imperfect substitutes for domestically produced goods and that exported goods are imperfect substitutes for other countries' domestically produced goods, or for third countries' exports. The demand functions can be thought of as being derived from a consumer utility maximization problem. The consumer is assumed to maximize utility subject to a budget constraint on the demand side. The resulting demand function for imports depends positively on domestic income and negatively on the relative price of imported goods vis-à-vis domestic goods. On the supply side, the producer is assumed to maximize profits subject to a cost constraint. This yields an export supply function that depends positively on productive capacity and export prices, and negatively on domestic costs.

Following the Goldstein and Khan (1985) model, we consider the following specifications for import demand and export supply:

$$RM = f\,(Y, P_m / P_d) \tag{1}$$

$$RX = g\,(Y, P_x / P_d) \tag{2}$$

Where RM is the real quantity of imports, RX is the real quantity of exports, Y is the real domestic income or a variable that represents productive capacity, P_d, P_m and P_x are the domestic price, import price and export price respectively. The use of relative price ratio, instead of two separate price terms, stems from the assumption of homogeneity and it also conveniently reduces the collinearity that may occur between the price terms

Empirical implementation of (1) and (2) requires decisions with respect to functional form and variable decisions. We use Gross Domestic Product (GDP) as a variable that represents domestic income and productive capacity and Real Effective Exchange Rate (REER) as a variable that represents the relative price ratio.

Two different real effective exchange rate indices are used in this study. The first real effective exchange rate is calculated by using the definition $REER_1 = \frac{P_d}{e.P_f}$ for exports and the second one is calculated by using the definition $REER_2 = \frac{eP_f}{P_d}$ for imports. In these definitions, P_f indicates the foreign prices, P_d indicates the domestic prices and e indicates the domestic currency price of foreign exchange. If we assume barter in international trade, i.e. acquiring goods by means of exchange with other goods, rather than with money; in the case Turkey exports to USA, $REER_1$ implies the quantity of USA goods that a firm in USA have to give in return of Turkish goods and in the case USA exports to Turkey, $REER_2$ implies the quantity of Turkish goods that a firm in Turkey have to give in return of USA goods. So, it should be more meaningful to use $REER_1$ for exports and $REER_2$ for imports.(Atuk and Öğünç, 2001)

There are no clear-cut criteria that can be relied on in choosing a functional form. The choice of the form is usually based on practical considerations and intuition. For both export supply and import demand equations, we utilize the standard log-log specification. After the linearization, the equations of import demand and export supply are:

$$RM = a_0 + a_1 GDP + a_2 REER_2 + \varepsilon \quad (3)$$

$$RX = b_0 + b_1 GDP + b_2 REER_1 + \upsilon \quad (4)$$

The import demand equation implies that import increases as the domestic purchasing power increases (GDP). On the contrary, when import prices increase, or when the real effective exchange rate increases ($REER_2$), demand of import become less profitable and, hence, importers will supply less. From equation (3) we expect a_1 to be positive and a_2 to be negative.

The export supply equation implies that supply of exports increases as the prices of exports increase, as the real effective exchange rate ($REER_1$) decreases and also when there is an increase in production (GDP). Therefore, we expect b_1 to be positive and b_2 to be negative in equation (4).

The analysis is based on small country assumption. Since Turkey's exports and imports represent a small fraction of total world exports and imports, her international price system is fully reflected by world market prices and therefore foreign trade prices are assumed to be exogenous. In the empirical part of this study, we will use the export supply and import demand equations specified in (3) and (4) to estimate aggregate export supply and aggregate and disaggregated import demand.

CHAPTER 5: ECONOMETRIC THEORY

In this chapter, the econometric theory used in the thesis is discussed.

5.1 Stationarity

Let $\{y_t(w),\ t \in T, w \in \Omega\}$ be a stochastic process and let the distribution function of $\{y_t\}$ is denoted by $D_y(\cdot)$. $\{y_t\}$ is said to be *strictly stationary* if for a time period $(t_1,\ldots,t_k)$;

$$D_y(y_{t1},\ldots,y_{tk}) = D_y(y_{t1+h},\ldots,y_{tk})\ \forall h,k \quad (1)$$

that is, the joint distribution of all collections $\{y_{t1},\ldots,y_{tk}\}$ is unaltered by 'translation' h- periods along the time axis.

A strictly stationary process need not to have a finite mean and/or variance so in practice it is more usual to deal with weak stationarity. $\{y_t\}$ is said to be *weakly stationary* if for all t and t-s;

$$E[y_t(w)] = E[y_{t-s}(w)] = \mu \quad (2)$$

$$E[(y_t(w)-\mu)^2] = E[(y_{t-s}(w)-\mu)^2] = \sigma^2_y \quad (3)$$

$$[Var[y_t(w)] = Var[y_{t-s}(w)] = \sigma^2_y] \quad (4)$$

$$E[(y_t(w)-\mu)(y_{t-s}(w)-\mu)] = E[(y_{t-j}(w)-\mu)(y_{t-j-s}(w)-\mu)] = \gamma_s \quad (5)$$

$$[Cov[y_t(w)\ y_{t-s}(w)] = Cov[y_{t-j}(w)\ y_{t-j-s}(w)] = \gamma_s] \quad (6)$$

where μ, σ^2_y and all γ_s are constants. Simply a time series is weakly stationary if its mean and all autocovariances are unaffected by a change of time origin. In the literature, a weakly stationary process is also referred to as a covariance stationary, second-order stationary or wide-sense stationary process.

If one or more of the conditions above are not fullfilled, the process is nonstationary. Nonstationarity seems a natural feature of economic life. Nonstationarity can be due to the evolution of economy, legislative changes and technological change. Nonstationarity of a time series is a problem in econometric analysis because when data means and variances are non-constant, observations come from different distributions over time, posing difficult problems for empirical modelling. Since almost all economic data series are nonstationary, inorder to make sensible regression analysis, these series have to be made stationary. In many cases nonstationarity of a series can be eliminated by simple differencing. If a series must be differenced d times to make stationary, it is said to be *integrated of order d*. This is denoted as $y_t \sim I(d)$. (Granger and Newbold, 1974)

5.2 Unit Root Test

Before any sensible regression analysis can be performed, it is essential to identify the order of integration of each variable. The general way of identifying the order of integration is testing for a unit root. An appropriate method of testing for a unit root has been proposed by Dickey and Fuller (1979), which is called Dickey-Fuller (DF) test.

For a first order autoregressive process:

$$y_t = py_{t-1} + \varepsilon_t \qquad (7)$$

the DF test is a test of the null hypothesis $H_o : p = 1$ which means $\{y_t\}$ sequence contains a unit root. This test is based on the estimation of an equivalent regression equation to (7), namely:

$$\Delta y_t = \delta y_{t-1} + \varepsilon_t \qquad (8)$$

Equation (8) can be rewritten as:

$$y_t = (1+\delta)y_{t-1} + \varepsilon_t \qquad (9)$$

which is similar to (7) with $p = (1+\delta)$. The DF test consists of testing the negativity of δ in equation (8) where the null (H_o) and the alternative (H_1) hypothesis are:

$$H_0 : \delta = 0$$

$$H_1 : \delta < 0$$

The critical values tabulated in Fuller (1976) are used to evaluate the hypothesis because standard t-statistic does not have a limiting normal distribution under the null hypothesis.

If the null hypothesis (H_0) is rejected, it is concluded that y_t is stationary (i.e. $y_t \sim I(0)$). But if the null can not be rejected, the next step would be to test whether the order of integration is one (i.e. $\Delta y_t \sim I(0)$). The process of differencing continues until an order of integration is established or it is realized that series can not be made stationary by differencing.

The Dickey-Fuller test is weak because it assumes that the errors (ε_t) are independent and have a constant variance, and it does not take into account possible autocorrelation in the errors. If ε_t is autocorrelated then the ordinary least squares estimates of equation (8) are not efficient. The solution proposed by Dickey and Fuller (1981) is to add lags of the dependent variable to the right-hand side of the regression as additional explanatory variables in order to approximate the autocorrelation. This test is called Augmented Dickey-Fuller test and it is denoted by ADF. Among the alternative unit root tests, ADF test is found to be the most useful in practice by Dejong, et.al. (1992) and Schwert (1987) who study the operating characteristics of the unit root tests.

The ADF equivalent of equation (8) is the following:

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + \varepsilon_t \tag{10}$$

The practical rule for specifying the lag length k is that; it should be relatively small in order to save the degrees of freedom, but large enough to allow for the existence of autocorrelation in ε_t.

DF and ADF tests are similar tests in that they have the same structure, they test the same hypothesis and they use the same critical values. The only difference between the two tests is that the ADF test includes lagged values in order to eliminate possible autocorrelation.

5.3 Cointegration

If there exists a long run relationship between two (or more) nonstationary variables and the deviations from this long run equilibrium-called the equilibrium error- are stationary, then the variables of interest are said to be cointegrated. Intuitively, cointegration among a set of variables implies that there exist fundamental economic forces which make the variables move stochastically together over time.

Engle and Granger (1987) provide the following definition of cointegration. If time series x_t and y_t are integrated of order d and there exists a linear combination of these variables, say $\alpha_1 x_t + \alpha_2 y_t$, which is integrated of order d-b, where $d \geq b \geq 0$, then x_t and y_t are said to be cointegrated of order d,b and it is denoted as x_t, $y_t \sim CI(d,b)$. The vector $[\alpha_1, \alpha_2]$ is called the cointegrating vector. A generalization of this definition for the case of n variables is the following: If x_t denotes an n x 1 vector and each of series in x_t is I(d) and there exists an n x 1 vector α such that $x_t'\alpha \sim I(d-b)$, then $x_t'\alpha \sim CI(d,b)$.

Consider the following simple regression model called the cointegration regression:

$$\alpha' x_t = z_t \qquad (11)$$

where all components of x_t are I(1). Stock (1987) and Engle and Granger (1987) show that the OLS estimation of α yields an excellent approximation to the cointegrating vector, while Cochrane-Orcutt estimation does not. The OLS estimates of any cointegrating vector should converge to the true value extremely quickly (Stock, 1987), however its distribution is not asymptotically normal and the computed standard errors are meaningless. When x_t is a vector with more than two components, and if a cointegrating vector exists, it need not be unique; since for k components, there may be at most r (r < k-1) linearly independent cointegrating components. The uniqueness of the cointegrated vector between two series is shown by Stock (1987).

Even though, there are various frameworks suggested for the analysis of cointegration, by far the two most popular have been the Engle and Granger (1987) and Johansen (1991) VAR approaches.

5.3.1 Engle and Granger Two-step Approach

By Engle and Granger's definition, cointegration necessitates that the variables be integrated of the same order. Thus, firstly order of integration of each variable is determined. If both variables are integrated of the same order, then the long run relationship is estimated:

$$y_t = \beta x_t + u_t \tag{12}$$

After estimating the parameters of the regression (12), the residuals (u_t) of this long run relationship are estimated. If the cointegrating vector is known, the residuals are calculated from that known long run equation. Then we test whether the residuals are stationary (i.e. I(0)) or not. To test this, equation given below is used;

$$\Delta u_t = \delta u_{t-1} + \sum_{i=1}^{k} \delta_i \Delta u_{t-i} + \varepsilon_t \tag{13}$$

which is the Augmented Dickey Fuller equation. The null hypothesis is "ε_t is not stationary" which implies x_t and y_t are not cointegrated. So, if the null hypothesis of "ε_t is not stationary" is rejected we conclude that x_t and y_t are cointegrated. The critical values for ADF cointegration test given in Engle and Yoo (1987) for different sample sizes and number of observations are used to test the null hypothesis of "no cointegration".

5.3.2 Johansen's VAR approach

Johansen (1988) proposes a unified maximum-likelihood approach for the estimation and testing of the number of cointegrating relations This procedure, directly investigates cointegration in a vector autoregression (VAR) model and provides more robust results than that of Engle-Granger two-step procedure when there are more than two variables. (Gonzalo,1994)

Consider the unrestricted VAR model:

$$Z_t = \sum_{i=1}^{k} A_i Z_{t-i} + \varepsilon_t \tag{14}$$

where Z_t contains all n variables of the model and ε_t is a vector of random errors.

All the variables in Z_t will be assumed to be integrated of the same order and that this order of integration is either zero or one. The VAR model ignoring the deterministic part (intercepts, deterministic trends, seasonals, etc.), can be represented in the form (Johansen, 1988):

$$\Delta Z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-k} + \varepsilon_t \qquad (15)$$

where:

$\Gamma_i = -I + A_1 + ... + A_i$ (I is a unit matrix)

$\Pi = -(I - A_1 - ... - A_k)$

and ε_t are independent, n-dimensional, Gaussian, stationary variables with means zero and covariance matrix Σ. Since there are n variables which constitute the vector Z_t, the dimension of Π is n x n and its rank can be at most equal to n. If the rank of matrix Π is equal to r < n, there exists a representation of Π such that:

$$\Pi = \alpha\beta' \qquad (16)$$

where α and β are both n x r matrices.

Matrix β is called the *cointegrating matrix* and has the property that $\beta' Z_t \sim I(0)$, while $Z_t \sim I(1)$. The columns of β contain the coefficients in the r cointegrating vectors. The α matrix is called the adjustments matrix, which measures the speed of adjustment of particular variables with respect to a disturbance in the equilibrium relation.

By regressing ΔZ_t and Z_{t-k} on $\Delta Z_{t-1}, \Delta Z_{t-2}, \ldots, \Delta Z_{t-k+1}$, we obtain residuals R_{ot} and R_{kt}. The residual product moment matrices are:

$$S_{ij} = T^{-1} \sum_{t=1}^{T} R_{it} R'_{jt} \;, \quad \text{i, j = 0, T = sample size} \tag{17}$$

Solving for eigenvalues,

$$\left| \mu S_{kk} - S_{ko} S_{oo}{}^{-1} S_{ok} \right| = 0 \tag{18}$$

yields the eigenvalues $\hat{\mu}_1 > \hat{\mu}_2 > \ldots > \hat{\mu}_n$ (ordered from largest to smallest) and associated eigenvectors $\hat{v}_i$ which may be arranged in the matrix $\hat{V} = [\hat{v}_1, \hat{v}_2, \ldots, \hat{v}_n]$. The eigenvectors are normalized such that $\hat{V}' S_{kk} \hat{V} = I$. If the cointegrating matrix β is of rank r < n, the first r eigenvectors are the cointegrating vectors, that is they are the columns of matrix β. Using the above eigenvalues, the null hypothesis that there are at most r cointegrating vectors can be tested by calculating the loglikelihood ratio statistic:

$$LR = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\mu}_i) \tag{19}$$

which is called as the trace statistic (Johansen and Juselius, 1990). Normally testing starts from the hypothesis that there are no cointegrating vectors in a VAR model, i.e. r = 0. If this hypothesis can not be rejected, the procedure stops. If it is rejected, it is possible to examine sequentially the hypothesis that r≤1, r≤2 and so on.

There is also a likelihood ratio test known as the *maximum eigenvalue* test in which the null hypothesis of r cointegrated vectors is tested against the alternative of r+1 cointegrating vectors. The corresponding test statistic is:

$$LR = -T\ln(1-\hat{\mu}_r) \tag{20}$$

The critical values of these tests are tabulated in Johansen and Juselius (1990)and Osterwald-Lenum (1992).

In empirical applications of the Johansen method, a major problem can be met when establishing the lag length, that is k in equation (14). If the empirical analysis is concerned exclusively with the estimation and identification of a cointegrating vector, the usual practice is to allow for relatively long lags. Because, long lags might approximate the possible autocorrelation structure of the error terms. However, if the aim is to use the estimated cointegrating vector(s) for further analysis of the VAR model, using long lags may be inconsistent with economic sense. In our empirical work, we will use the Schwarz criteria to choose the optimal lag length (see Hendry (1989) for details).

Testing and analyzing cointegration by Johansen's VAR approach is considered superior to the Engle and Granger method due to the following reasons: first, if a multiple cointegrating vector exists, the use of Engle-Granger method may simply produce a complex linear combination of all the distinct cointegrating vectors that can not be sensibly interpreted. On the other hand, Johansen's method provides a unified framework for the estimation and testing of cointegrating relations in the context of VAR error correction models. Secondly, the Engle-Granger method relies on a super convergence result and applies OLS in order to obtain parameter estimates of the cointegrating vector. However, OLS parameter estimates may vary with the arbitrary normalization implicit in the selection of the left hand side variable for the OLS regression. In contrast, the Johansen's method does not rely on an arbitrary normalization. Finally, the Johansen's procedure allows for testing certain restrictions suggested by economic theory, such as the sign and size of the elasticity estimates.

5.4 Error Correction Model

In an error correction model the dynamics of both short-run (changes) and long-run (levels) adjustment processes are modelled simultaneously. This idea of incorporating the dynamic adjustment to steady-state targets in the form of error-correction terms, suggested by Sargan(1964) and developed by Hendry and Anderson (1977) and Davidson et al. (1978), offers the possibility of revealing information about both short-run and long-run relationships.

Granger (1981), Granger and Weiss (1983) and Engle and Granger (1987) have established the connection and even the equivalence between error correction and the concept of cointegration through the Granger representation theorem, i.e., if a set of variables are cointegrated, then there exists a valid error correction representation, and conversely. Cointegration thus provides a formal statistical support for the use of ECM.

The n x 1 vector $x_t = (x_{1t}, x_{2t},..., x_{nt})'$ has an error correction representation if it can be expressed in the form:

$$\Delta x_t = \pi_0 + \pi x_{t-1} + \pi_1 \Delta x_{t-1} + \pi_2 \Delta x_{t-2} + ... + \pi_p \Delta x_{t-p} + \varepsilon_t \qquad (21)$$

where

π_0 = an (n x1) vector of intercept terms with elements π_{io}

π_i = (n x n) coefficient matrices with elements $\pi_{jk}(i)$

π = is a matrix with elements π_{jk} such that one or more of the $\pi_{jk} \neq 0$

ε_t = an (n x 1) vector with elements ε_{it}

The disturbance terms are such that ε_{it}'s are white noise and may be correlated with ε_{jt}.

Let all variables in x_t be I(1). Now, if there is an error-correction representation of these variables in (21), there is an linear combination of the I(1) variables that is stationary. Solving (21) for πx_{t-1} yields:

$$\pi x_{t-1} = \Delta x_t - \pi_0 - \sum \pi_i \Delta x_{t-i} - \varepsilon_t \qquad (22)$$

Since each expression on the right-hand side is stationary, πx_{t-1} must also be stationary. Since π contains only constants, each row of π is a cointegrating vector of x_t. The first row can be written as $(\pi_{11}x_{1t-1} + \pi_{12}x_{2t-1} + \ldots + \pi_{1n}x_{nt-1})$. Since each series x_{it-1} is I(1), $(\pi_{11}, \pi_{12}, \ldots, \pi_{1n})$ must be a cointegrating vector of x_t.

If all elements of π equal to zero, (21) is a traditional VAR in first differences. In such circumstances, there is no error-correction representation since Δx_t does not respond to the previous period's deviation from long-run equilibrium.

If one or more of the π_{jk} differs from zero, Δx_t responds to the previous period's deviation from long-run equilibrium. Hence, estimating x_t as a VAR in the first difference is inappropriate if x_t has an error-correction representation. The omission of the expression πx_{t-1} entails a misspecification error if x_t has an error-correction representation as in (21).

CHAPTER 6: EMPIRICAL RESULTS

In the first section of this chapter, information about the data set is provided. Then in the following sections, the empirical results of testing stationarity and cointegration will be presented. Finally in the last section the empirical models are estimated.

6.1 The Data Set

The data set consists of quarterly observations for the variables of interest over the period 1989(Q1)-2000(Q4).

Turkey is an oil importing country so, due to the fact that oil imports depend strongly on world oil prices and the changes in oil prices are considered as exogenous shocks, the crude oil imports are excluded from total imports and intermediate goods imports to eliminate the effects of changes in oil prices.

The nominal values for total import and its sub-items (expressed in terms of million US dollars) have been deflated by total import price index (MPI) in order to obtain real imports. Similarly, the nominal values for total export (expressed in terms of million US dollars) have been deflated by total export price index (XPI) in order to obtain real exports. The GDP data is utilized in real constant (1987) prices (expressed in terms of billion TL).

Two different real effective exchange rate indices are used in this study. The first one is calculated by using the definition $REER_1 = \frac{P_d}{e.P_f}$. In this definition, P_f indicates the foreign prices, P_d indicates the domestic prices and e indicates the domestic currency price of foreign exchange. While calculating this real effective exchange rate, producer price indices of Germany and USA, the private manufacturing price index of Turkey and the exchange rate basket which is weighted by an average of US dollar and German mark with weights 1 and 1.5 respectively are used. An increase in $REER_1$ refers to an appreciation of Turkish Lira against the mentioned foreign currencies. The second real effective exchange rate is calculated by using the definition $REER_2 = \frac{eP_f}{P_d}$. While calculating this, for the foreign prices (P_f) consumer price indices of Germany and USA and for the domestic prices (P_d) consumer price index of Turkey is used. The exchange rate basket employed is the same basket that is used in the $REER_1$. An increase in $REER_2$ refers to an appreciation of mentioned foreign currencies against Turkish Lira.

The data are collected from the Central Bank of Turkey, The State Institute of Statistics and International Financial Statistics. The data sources for all series are given in Table 1.1 in Appendix A. The base year for all the indices is 1987 . The data set is presented in Table 1.2 in Appendix A.

The following abbreviations are used from this part onwards:

RX: Total real export

RM: Total real non-oil import

RINT: Real non-oil intermediate goods import

RCAP: Real capital goods import

RCONS: Real consumption goods import

GDP: Real gross domestic product

$REER_1$: Real effective exchange rate index calculated by using the definition

$$REER_1 = \frac{P_d}{e.P_f}$$

$REER_2$: Real effective exchange rate index calculated by using the definition

$$REER_2 = \frac{eP_f}{P_d}$$

Where L represents the logarithm, D represents the first difference

6.2 Results of Unit Root Tests

Before starting the cointegration analysis, the integration order of the series have to be determined. The order of integration of each series is identified with unit root test. ADF unit root tests are applied on both levels and first differences of all variables as discussed in subsection 5.2.

The ADF test results for the levels of the variables are presented in Table 2.1 and for the first difference of the variables are presented in Table 2.2. In both tables, the value of "k" corresponds to the highest order lag for which the t-statistic in the regression is significant, "C" denotes a significant intercept and "T" denotes a significant trend and intercept.

Test results show that, at 5 percent significance level, the hypothesis of a unit root in each series can not be rejected for the level of the variables but it is rejected for the first difference of all variables. Therefore, all variables appear to be integrated of order one (i.e. I(1)) and we have to take first difference of the variables to make them stationary.

6.3 Results of Cointegration Tests

This section reports the results of the Engle-Granger two-step cointegration tests (Engle and Granger, 1987) and Johansen type multivariate cointegration tests (Johansen, 1991) among the I(1) series (LRX, LGDP, $LREER_1$), (LRM, LGDP, $LREER_2$), (LRINT, LGDP, $LREER_2$), (LRCAP, LGDP, $LREER_2$), (LRCONS, LGDP, $LREER_2$)[i] .

6.3.1 Engle-Granger Cointegration Test Results

In the first step of Engle-Granger cointegration test, the long run equations are estimated by OLS and results are summarized in Table 3.1 through Table 3.5 in Appendix A. Import data and export data have a strong seasonal pattern, so the seasonal dummies (S_1, S_2, S_3) are included in the long run equations. The following long run relationships are obtained from OLS estimation:

[i] Cointegration analysis are performed systematically among (real total exports, real income, real exchange rate), (real total imports, real income, real exchange rate), (real intermediate goods imports,

$$LRX = -12.34 + 0.28S_1 - 0.05S_2 - 0.72S_3 - 0.78LREER_1 + 1.98LGDP \qquad R^2 = 0.90$$

$$LRM = -24.20 + 0.51S_1 + 0.17S_2 - 0.94S_3 - 0.32LREER_2 + 2.96LGDP \qquad R^2 = 0.97$$

$$LRINT = -21.94 + 0.51S_1 + 0.17S_2 - 0.81S_3 - 0.24LREER_2 + 2.66LGDP \qquad R^2 = 0.96$$

$$LRCAP = -30.02 + 0.42S_1 + 0.15S_2 - 1.13S_3 - 0.05LREER_2 + 3.29LGDP \qquad R^2 = 0.92$$

$$LRCONS = -34.27 + 0.79S_1 + 0.27S_2 - 1.28S_3 - 1.69LREER_2 + 4.33LGDP \qquad R^2 = 0.88$$

In these equations, all variables have the expected signs. Banerjee *et al.* (1986) have shown that there could be substantial small sample bias in the cointegrating vector estimates, and this bias declines more slowly than theoretically expected. Thus, as standard errors are biased downwards, t-statistics are to be interpreted more carefully. They show[ii] that $(1-R^2)$ is an indicator of the bias in the OLS estimator: the bias goes to zero as R^2 goes to 1. Thus, a high R^2 is a necessary condition for adopting the two-step procedure of the Engle-Granger test. Since the above long run equations have high R^2 s, we can proceed with the second step of the Engle-Granger test.

In the second step of the Engle-Granger cointegration test, the stationarity of the residuals of the estimated equations are tested by ADF test. The results are presented in Table 4.1 in Appendix A.

Critical values used in this test are taken from Engle and Yoo (1987) for 50 observations and given in Table 4.2 in Appendix A. According to these critical values, residuals of aggregate import demand equation are stationary at 1 % significance level, residuals of intermediate and capital goods import demand

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real income, real exchange rate), (real capital goods imports, real income, real exchange rate), (real consumption goods imports, real income, real exchange rate).

equations are stationary at 5 % significance level and residuals of export supply and consumption goods import demand equations are stationary at 10 % significance level. Thus, all five long-run equations provide evidence in favor of cointegration and can be used as cointegration regressions.

6.3.2 Johansen Cointegration Test Results

Johansen's (1991) method applies the maximum likelihood procedure to determine the presence of a cointegrating vector in a Vector Autoregression (VAR) model. Since the cointegration results are very sensitive to the lag length of VAR, first the optimum lag length of the cointegration analysis must be determined. We will base our selection of the lag length on Schwarz criteria.

We start with VAR(4) due to the data limitations and the maximum lag length is usually equal to four or five for quarterly data. The models are estimated with including unrestricted constant term and unrestricted seasonal dummies. Removing one lag of all the variables at a time, models are reestimated over the same sample until the models are reduced to VAR(1). The minimum of Schwarz criteria for each system gives the optimum lag length for the VAR models.

Schwarz test values for all models are reported in Table 5 in Appendix A. The values in Table 5 reveal that for each model, the minimum value of the test values are associated to VAR(1). Therefore, the optimum lag length for all models is considered to be 1.

[ii] Theorem 2 in Banerjee *et al.* (1986, pp. 274-75)

After finding the optimum lag lengths as one, the Johansen cointegration test is performed for each model. The test results are reported in Table 6.1 through 6.5 in Appendix A. Trace and maximum eigenvalue statistics together with their 5 % critical values are reported in the tables to decide on the number of cointegrating vectors. According to both trace statistics and the maximum eigenvalue statistics, the number of cointegrating vectors are one for export supply, aggregate import demand, intermediate goods import demand, capital goods import demand and consumption goods import demand.

Also, the normalized cointegrating coefficients are given in Table 6.1 through 6.5. According to these coefficients, the following long run relations are obtained:

$$LRX = -23.49 + 2.80\ LGDP + 0.06\ LREER_1$$

$$LRM = -25.93 + 3.13\ LGDP - 0.28\ LREER_2$$

$$LRINT = -23.90 + 2.83\ LGDP - 0.16\ LREER_2$$

$$LRCAP = -33.52 + 3.61\ LGDP + 0.06\ LREER_2$$

$$LRCONS = -34.81 + 4.63\ LGDP - 1.72\ LREER_2$$

According to these long run equations, real income enters with a positive coefficient in all equations as expected, but the real effective exchange rate enters with a wrong sign in export supply and capital goods import demand equations. Since these equations are not consistent with economic theory, we can not use this long run relations in the error correction modeling.

In order to conduct a reliable single equation analysis, weak exogeneity of the variables should be tested. But, since we made a small country assumption and we found one cointegrating vector for each equation, we did not test for weak exogeneity and proceed with single equation modelling.

6.4 Empirical Modelling

Since cointegration has been observed between variables of interest, we specify and estimate error correction models (ECM) including the error correction terms to investigate the dynamic behaviour of the models.

Models include the error correction terms, the residuals of the long run equations. Since, the sign of real effective exchange rate in the long run equations of export supply and capital goods import demand obtained in Johansen cointegration analysis is wrong; least squares residuals are estimated from long run equations obtained in Engle-Granger cointegration analysis. The general ECMs involve variables of interest transformed to the I(0) space and the lag error correction terms.

For quarterly data, the maximum lag length is usually equal to four or five on the hypothetical basis that economic agents are characterized by one-year planning horizons. Thus, we start with fourth order autoregressive distributed lag models (ADL) and develop these models using Hendry's (1988) general to specific methodology:

$$DLX_t = \alpha_0 + \alpha_1 S_1 + \alpha_2 S_2 + \alpha_3 S_3 + \sum_{i=0}^{4} \alpha_{4i} DLX_{t-i} + \sum_{i=0}^{4} \alpha_{5i} DLGDP_{t-i} + \sum_{i=0}^{4} \alpha_{6i} DLREER_{1,t-i} + \alpha_7 ECM_{X,t-1}$$

$$DLM_t = \beta_0 + \beta_1 S_1 + \beta_2 S_2 + \beta_3 S_3 + \sum_{i=0}^{4} \beta_{4i} DLM_{t-i} + \sum_{i=0}^{4} \beta_{5i} DLGDP_{t-i} + \sum_{i=0}^{4} \beta_{6i} DLREER_{2,t-i} + \beta_7 ECM_{M,t-1}$$

$$DLINT_t = \delta_0 + \delta_1 S_1 + \delta_2 S_2 + \delta_3 S_3 + \sum_{i=0}^{4} \delta_{4i} DLINT_{t-i} + \sum_{i=0}^{4} \delta_{5i} DLGDP_{t-i} + \sum_{i=0}^{4} \delta_{6i} DLREER_{2,t-i} + \delta_7 ECM_{INT,t-1}$$

$$DLCAP_t = \gamma_0 + \gamma_1 S_1 + \gamma_2 S_2 + \gamma_3 S_3 + \sum_{i=0}^{4} \gamma_{4i} DLCAP_{t-i} + \sum_{i=0}^{4} \gamma_{5i} DLGDP_{t-i} + \sum_{i=0}^{4} \gamma_{6i} DLREER_{2,t-i} + \gamma_7 ECM_{CAP,t-1}$$

$$DLCONS_t = \varphi_0 + \varphi_1 S_1 + \varphi_2 S_2 + \varphi_3 S_3 + \sum_{i=0}^{4} \varphi_{4i} DLCONS_{t-i} + \sum_{i=0}^{4} \varphi_{5i} DLGDP_{t-i} + \sum_{i=0}^{4} \varphi_{6i} DLREER_{2,t-i} + \varphi_7 ECM_{CONS,t-1}$$

where α_o, β_o, δ_o, γ_o, φ_o represent the constant term and S_1, S_2, S_3 represent the seasonal dummies.

From the results of the extensive literature that has estimated import demand and export supply, the signs of the coefficients are expected to be as follows:

$$\alpha_{5i}, \beta_{5i}, \delta_{5i}, \gamma_{5i}, \varphi_{5i} > 0, \qquad i = 1,\ldots,4$$

$$\alpha_{6i}, \beta_{6i}, \delta_{6i}, \gamma_{6i}, \varphi_{6i} < 0, \qquad i = 1,\ldots,4$$

$$-1 < \alpha_7, \beta_7, \delta_7, \gamma_7, \varphi_7 < 0, \qquad i = 1,\ldots,4$$

These expectations imply that import demand and export supply increases as real income increases and import demand increases and export supply decreases as Turkish Lira appreciates against the mentioned foreign currencies.

The models are estimated by OLS using the quarterly data over the period 1989(Q1)-2000(Q4). Then the reduction based on Hendry's (1988) general to specific simplification methodology is made by eliminating, step by step, the statistically most insignificant and economically not meaningful regressors. T-statistic is used for eliminating the insignificant regressors. The regressors that have a t-statistic lower than the critical one are considered to be insignificant. But eliminating the insignificant regressors with a higher lag length is preferable even if their t-statistics are higher than the insignificant regressors with a lower lag length. The reason is that the regressors which are nearer in time to the dependent variable are assumed to have a stronger impact that can be hidden by the presence of the other variables.

The final models and their diagnostic statistics are reported in Table 7.1 through 7.5 in Appendix A. The last remaining equations are:

$$DLRX = 0.30 - 0.31\ S1 - 0.32\ S2 - 0.49\ S3 - 0.41\ DLRX(-2) + 0.50\ DLGDP - 0.30\ ECMXS(-1) \quad \textbf{(1)}$$

$$DLRM = 0.69 - 0.40\ S1 - 0.87\ S2 - 1.53\ S3 + 0.26\ DLRM(-1) + 2.12\ DLGDP - 0.41 DLREER_2 - 0.72\ ECMID(-1) \quad \textbf{(2)}$$

$$DLRINT = 0.58 - 0.23\,S1 - 0.79\,S2 - 1.29\,S3 + 1.88\,DLGDP - 0.77\,DLREER_2 - 0.65\,ECMINT(-1) \quad \textbf{(3)}$$

$$DLRCAP = 0.28 + 0.05\,S1 - 0.05\,S2 - 1.10\,S3 + 1.66\,DLGDP + 1.11\,DLGDP(-1) - 0.62\,DLREER_2(-2) - 0.52\,ECMCAP(-1) \quad \textbf{(4)}$$

$$DLRCONS = 1.04 - 0.47\,S1 - 1.43\,S2 - 2.26\,S3 + 0.15\,DLRCONS(-1) + 0.19\,DLRCONS(-2) + 3.54\,DLGDP - 1.09\,DLREER_2 - 0.50\,ECMCONS(-1) \quad \textbf{(5)}$$

The diagnostic statistics reported in Table 6.1 through 6.5, show that the residuals obtained from these models do not show evidence of serial correlation, autoregressive conditional heteroscedasticity (ARCH) effects, nonnormality and heteroscedasticity. Thus, models are econometrically well specified.

Equation (1) shows that real export is negatively related to its own second lag and positively related to the gross domestic income (GDP). The real effective exchange rate lose its significance on export supply in the short run; it was eliminated in the reduction process because it turned out to be insignificant. The short run income elasticity of export supply is 0.50, somewhat smaller than the long run elasticity obtained from the cointegration regression. The estimated coefficient of ECMXS(-1) is statistically significant at an estimated value of 0.30 and with the appropriate(negative) sign. It suggests the validity of long run equilibrium relationship among the variables in Equation (1). The estimated value of the coefficient of ECMXS(-1) indicates that system corrects its previous period's level of disequilibrium by 30 % a quarter.

Equation (2) shows that real import is positively related to its own first lag and negatively related to gross domestic income and to real effective exchange rate. The short run elasticity of import demand with respect to income is 2.12 which is smaller than the long run elasticity, whereas the short-run elasticity of imports with respect to real effective exchange rate is 0.41 which is greater than the long run elasticity. The adjustment term ECMID(-1) has the expected negative sign and is significant at an estimated value of 0.72, implying a rapid adjustment towards the estimated equilibrium state.

In equation (3), real intermediate goods import is found to be positively related with gross domestic product and negatively related with real effective exchange rate. The short run income elasticity is 1.88 and real effective exchange rate elasticity is 0.77. Like the total import demand, real effective exchange rate elasticity is smaller and income elasticity is greater in the short run for intermediate goods import demand. The error correction term ECMINT(-1) is significant at an estimated value of 0.65 and has a negative sign.

Equation (4) shows that the capital goods import is positively related to gross domestic income and negatively related to real effective exchange rate. The gross domestic income has both current and one period lag effect on capital goods import with short run elasticities 1.66 and 1.11 respectively. The real effective exchange rate has two period lag effect on capital goods import with a short run elasticity 0.62. The real exchange rate elasticity is greater and income elasticity is smaller in the short run than their long-run counterparts. ECMCAP(-1) is also significant and has a value of -0.52.

Equation (5) implies that the consumption goods import is positively related with its own first and second lag and with gross domestic income and negatively related with real effective exchange rate. Short run elasticity of consumption goods import with respect to income is 3.54 and with respect to real effective exchange rate is 1.09. Both income and real effective exchange rate elasticities are smaller in the short run than its long run elasticities. ECMCONS(-1) is also significant and has a negative sign. The adjustment speed towards the estimated equilibrium state is 0.50.

CHAPTER 7: CONCLUSION

The main purpose of this thesis is to investigate the foreign trade performance of Turkey within the context of estimating econometric models for export supply and import demand over the period 1989-2000. What distinguishes this study from those previously undertaken is modeling not only total imports but also subcategories of imports; since a model for total imports may mask important differences in the effect of income and price for sub-categories of imports.

In empirical analysis, cointegration and error correction modeling approaches have been used. To estimate the long run relationship between exports and imports and related sets of variables, we applied two different types of cointegration tests: one based on residuals from a cointegrating regression (Engle-Granger approach) and the other is the systems-based test using the vector autoregressions (VAR) (Johansen approach). With these tests, it has been found a unique long run equilibrium relationship exists among the real exports, real exchange rate and real GDP and also among the real imports (total and sub-items), real exchange rate and real GDP. In Engle-Granger's approach, all the variables have the expected sign but in Johansen's approach, real effective exchange rate enters with a wrong sign to export supply and capital goods import demand equations. So, we estimated error correction models based on lagged residuals from the cointegrating regressions obtained in ngle-Granger cointegration analysis. The error correction terms in all models have found to be statistically significant, suggesting the validity of the long run equilibrium relationships.

One of the main conclusion that emerges from the empirical results is that export supply is price (exchange rate) inelastic but income elastic in the long run whereas it is price insensitive and income inelastic in the short run. This shows that the depreciation of the exchange rate is not the best solution for developing strategy of Turkish exports. More specifically, according to the export-led growth model, a depreciation of the exchange rate can result, via the exploitation of economies of scale, in improvement of price competitiveness and therefore in further increase of exports only temporarily. But since imports are critical inputs into the production of exports in Turkey, in the long run depreciation of TL would have an adverse impact on export performance. It appears, therefore, that exchange rate policies couldn’t be succesful in promoting export growth and the improvement of competitiveness of the Turkish exports depends on the remodeling and updating of export supply.

Econometric estimate of aggregate import demand function suggests that import demand is price (exchange rate) inelastic but highly elastic with respect to income both in the short and long run. Thus, import demand is largely explained by real GDP which relates to the general level of economic activity in the country. The low elasticity of aggregate import demand with respect to price may partly reflect the fact that primary commodities and raw materials constitute a large fraction of Turkish imports.

The short and long run price and income elasticities for total imports and intermediate goods imports are very close. Since approximately 65 percent of total imports consist of intermediate goods, this is an expected result. So the intermediate goods import demand is also price inelastic but highly elastic with respect to income both in the short and long run which indicates that the decision to import an intermediate good will be related primarily to economic activity.

As investments in Turkey are financed mainly with foreign capital and it takes time to make a decision on investment, the real exchange rate affects capital goods import demand two periods before in the short run. The capital goods import demand is also price inelastic but income elastic both in the short and long run. This indicates, like the intermediate goods imports, the capital goods imports are related mostly with the economic activity.

On the other hand, consumption goods import demand is price and income elastic and the respective elasticities are higher than those of other items both in the short and long run. This reflects the responsiveness of consumption decisions generally to changes in prices, given the availability of substitutes.

High values of income elasticities and low values of price elasticies means that, except consumption goods import, import developments are highly dependent on the economic activity and the effects of exchange rate policy on imports appear to be fairly limited.

The coefficient of the error correction term in the export supply model is smaller than that in import demand model. This indicates that the export supply model has low speed of adjustment and hence a prolonged period of disequilibrium in the markets before attaining long run equilibrium.

According to presented empirical results of Turkish exports and imports, we can say that, from an economic point of view, depreciation of TL would not be the best solution for helping exporters in a small, open economy like Turkey. As shown by Bole (1992), this approach would work better in large economies where the domestic market is not yet saturated and exports represent a smaller ratio to GDP. In Turkey, depreciation of TL would lead to an increase in interest rates, thus increasing other costs and hampering economic growth.

When we compare our results with other studies done for Turkey; Kotan and Saygılı (1999) who estimated import demand function for Turkey, found that the exchange rate is the most effective policy tool on import demand. However, we found that the effects of exchange rate policy on imports appear to be fairly limited.

Şahinbeyoğlu and Ulaşan (1999) estimated export supply and export demand functions for Turkey and found that Turkish exports are dominantly explained by real exchange rate in the short run which is an opposite result of ours. We found that export supply is price inelastic in the long run and price insensitive in the short run.

Özatay (2000) investigated import demand and export supply functions within the context of a macroeconometric model that describes the functioning of the Turkish economy and he found that income affects total imports significantly only in the short run. However, we found that import demand is largely explained by income both in the short and long run.

Ghosh (2000) estimated an import demand function for Turkey and he found that the income elasticity is higher in the long run and price elasticity is higher in the short run for aggregate import demand which is a consistent result with ours.

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APPENDIX A

Table 1.1 Data Sources

Variable	Base year	Source
Total Exports (X)	-	SIS
Total Imports (I)	-	SIS
Intermediate goods Imports (INT)	-	SIS
Capital goods Imports (CAP)	-	SIS
Consumption goods Imports (CONS)	-	SIS
Crude oil Imports (OIL)	-	SIS
Total Export Price Index (XPI)	1987	SIS
Total Import Price Index (MPI)	1987	SIS
Gross Domestic Product (GDP)	-	SIS
US dollar ($)	-	CBRT
German mark (DM)	-	CBRT
Private Manufacturing Price Index of Turkey ($PMPI_{Turkey}$)	1987	SIS
Producer Price Index of USA (PPI_{USA})	1987	IFS
Producer Price Index of Germany ($PPI_{Germany}$)	1987	IFS
Consumer Price Index of Turkey (CPI_{Turkey})	1987	SIS
Consumer Price Index of USA (CPI_{USA})	1987	IFS
Consumer Price Index of Germany ($CPI_{Germany}$)	1987	IFS

Table 1.2 The Data Set

	X	I	INT	CAP	CONS	OIL
1989Q1	2803.3	3319.0	2601.5	591.2	124.7	636.8
1989Q2	2573.9	3807.3	3031.9	636.9	136.9	551.7
1989Q3	2568.1	3994.4	3220.4	571.3	200.8	662.0
1989Q4	3679.4	4671.4	3645.8	748.6	275.2	604.5
1990Q1	2994.3	4706.6	3692.9	699.8	312.9	794.2
1990Q2	2745.5	4875.3	3548.4	853.4	472.8	507.0
1990Q3	2858.7	5434.6	3864.4	947.9	618.8	890.2
1990Q4	4360.8	7285.6	5048.3	1539.7	671.0	1303.3
1991Q1	3378.7	4915.9	3611.5	877.1	395.9	592.0
1991Q2	2904.9	4745.6	3470.9	906.4	332.2	584.4
1991Q3	3208.7	5244.0	3694.0	1116.0	408.1	590.9
1991Q4	4101.2	6141.5	4277.0	1396.1	438.8	688.8
1992Q1	3549.9	4942.1	3521.7	1035.1	369.0	506.2
1992Q2	3303.3	5484.9	3793.8	1300.6	363.5	700.6
1992Q3	3701.3	5856.5	4292.0	1033.1	511.9	722.8
1992Q4	4160.0	6587.6	4577.2	1456.8	527.8	702.4
1993Q1	3673.3	5908.0	4151.0	1253.0	487.1	618.7
1993Q2	3477.3	7778.2	5216.5	1883.4	645.7	649.3
1993Q3	3562.0	7465.9	4961.3	1825.1	646.0	639.1
1993Q4	4632.5	8276.3	5074.1	2396.1	746.9	643.3
1994Q1	3826.4	5887.1	4106.0	1307.6	451.3	534.6
1994Q2	3830.8	4953.9	3342.9	1330.9	260.2	534.9
1994Q3	4815.2	5416.3	3982.3	1112.0	284.6	712.1
1994Q4	5633.5	7012.8	5134.2	1469.9	385.2	650.9
1995Q1	4756.4	6853.7	5275.5	1149.1	402.5	660.6
1995Q2	5199.1	8615.3	5972.7	2117.6	500.7	760.9
1995Q3	5288.1	9134.8	6640.8	1770.7	701.9	811.5
1995Q4	6393.4	11105.1	7188.8	3082.1	811.3	684.2
1996Q1	5541.4	9757.8	6793.3	2092.8	799.1	763.4
1996Q2	5197.5	10985.3	7152.6	2681.4	1101.9	831.6
1996Q3	5753.8	10754.4	7104.7	2515.2	1084.9	861.5
1996Q4	6731.7	12129.1	7686.2	3076.5	1280.3	959.5
1997Q1	6077.8	10545.1	7398.0	2055.7	1017.6	916.1
1997Q2	6349.3	11695.2	7570.1	2790.5	1268.0	691.5
1997Q3	6511.9	12650.0	8216.0	2975.6	1352.1	832.0
1997Q4	7322.1	13668.3	8687.3	3230.1	1697.1	754.5
1998Q1	6735.2	11344.3	7739.7	2326.0	1226.6	584.4
1998Q2	6596.9	11975.9	7618.2	2886.6	1398.0	491.1
1998Q3	6654.8	11581.7	7425.8	2732.2	1331.4	534.3
1998Q4	6987.1	11019.5	6778.3	2720.8	1366.3	474.1
1999Q1	6480.0	8059.8	5417.5	1619.2	950.7	481.9
1999Q2	6300.9	10345.4	6723.0	2194.9	1309.1	641.7
1999Q3	6468.6	10440.1	6875.0	2282.5	1193.4	805.2
1999Q4	7337.7	11841.5	7552.7	2632.5	1609.3	826.1
2000Q1	6692.5	11324.6	7916.6	2095.4	1254.5	906.7
2000Q2	7097.3	14149.2	9106.7	2989.4	2005.9	993.9
2000Q3	6678.1	13971.5	9020.2	3011.0	1883.3	950.1
2000Q4	6856.7	14537.6	9283.8	3153.5	2044.3	1357.5

	XPI	MPI	GDP	$REER_2$	$REER_1$
1989Q1	94.3	101.1	14394.9	95.3	108.4
1989Q2	95.8	100.1	16557.1	89.0	118.3
1989Q3	96.1	100.5	25902.5	84.5	120.7
1989Q4	102.3	108.1	19643.8	83.0	116.1
1990Q1	102.0	104.0	15942.4	79.3	117.8
1990Q2	106.0	100.5	18762.7	77.1	117.3
1990Q3	108.3	114.8	27520.9	76.3	120.1
1990Q4	111.5	119.1	21352.5	73.2	121.3
1991Q1	107.7	109.5	15872.1	74.7	115.9
1991Q2	101.8	101.7	18672.8	74.6	116.4
1991Q3	102.0	100.3	28607.2	76.3	113.7
1991Q4	109.0	104.6	21200.6	75.7	110.6
1992Q1	105.5	98.8	17175.5	74.0	106.3
1992Q2	106.7	104.4	19730.2	82.7	102.0
1992Q3	109.0	103.9	30137.9	82.0	105.2
1992Q4	103.3	101.3	22357.1	77.2	109.4
1993Q1	107.7	101.7	18019.7	75.3	111.4
1993Q2	105.7	94.7	21964.1	76.3	109.8
1993Q3	102.1	96.0	32372.1	76.8	107.8
1993Q4	98.4	95.9	24234.6	75.1	106.5
1994Q1	102.7	94.1	18954.9	96.3	92.1
1994Q2	101.1	105.2	19616.8	110.1	89.3
1994Q3	97.6	111.1	29845.9	109.9	88.2
1994Q4	102.7	113.1	22903.1	95.7	96.0
1995Q1	112.4	116.7	18671.2	98.1	93.9
1995Q2	116.0	126.0	22272.4	91.4	98.9
1995Q3	115.3	124.6	32524.8	85.4	103.2
1995Q4	112.3	126.8	24419.4	87.1	96.4
1996Q1	110.5	114.9	20290.1	88.8	94.3
1996Q2	107.8	109.9	24071.5	89.1	95.2
1996Q3	107.5	112.5	34245.9	89.1	95.2
1996Q4	107.4	115.0	26137.6	88.9	94.7
1997Q1	108.0	105.3	21692.7	86.0	96.3
1997Q2	104.5	102.6	26110.7	85.8	97.1
1997Q3	99.1	101.8	36655.4	83.3	100.7
1997Q4	102.3	102.2	28172.4	79.9	100.1
1998Q1	100.0	102.3	23697.3	80.1	97.6
1998Q2	98.5	99.5	26959.6	81.9	97.2
1998Q3	99.5	97.8	37632.6	77.6	99.2
1998Q4	98.8	95.9	27824.0	76.3	97.0
1999Q1	95.9	90.7	21758.6	77.3	95.0
1999Q2	90.2	89.5	26368.8	77.5	94.9
1999Q3	87.3	95.2	35279.1	75.5	96.1
1999Q4	90.0	98.8	27239.5	73.5	96.7
2000Q1	90.4	97.7	22974.5	71.8	99.7
2000Q2	89.1	99.1	28059.1	71.9	100.5
2000Q3	86.9	100.5	38027.0	69.4	102.4
2000Q4	89.1	99.1	29499.6	65.3	104.2

Table 2.1: Augmented Dickey-Fuller Test Results for levels

Variable	k	ADF Test Stat.	5% Critical Value
LRM	5, T	-2.640	-3.519
LRX	4, T	-2.504	-3.516
LRINT	1, T	-3.126	-3.508
LRCAP	5, T	-2.651	-3.518
LRCONS	1, T	-3.004	-3.508
LGDP	6, T	-3.010	-3.521
LREEROZIM	2, C	-2.128	-2.927
LREERCPI	3, C	-1.534	-2.928

Table 2.2: Augmented Dickey-Fuller Test Results for first differences

Variable	k	ADF Test Stat.	5% Critical Value
DLRM	4, C	-4.096	-2.932
DLRX	3, C	-3.897	-2.930
DLRINT	1, C	-5.337	-2.927
DLRCAP	5, C	-3.935	-2.933
DLRCONS	1, C	-4.311	-2.927
DLGDP	4, C	-2.975	-2.932
DLREEROZIM	2, C	-3.936	-2.928
DLREERCPI	1, C	-4.935	-2.927

Notes: 1) L denotes the log form of the variable and D stands for the first difference.
2) The value of k corresponds to the highest-order lag for which the t-statistic in the regression is significant. "C" denotes a significant intercept and "T" denotes a significant trend and intercept.

Table 3.1 Estimated Cointegration Relationship for Export Supply

	Coefficient	t-statistic
C	-12.34	-4.78
S1	0.28	4.22
S2	-0.05	-0.98
S3	-0.72	-10.92
$LREER_1$	-0.78	-2.96
LGDP	1.98	12.42

Table 3.2 Estimated Cointegration Relationship for Aggregate Import Demand

	Coefficient	t-statistic
C	-24.20	-22.88
S1	0.51	13.46
S2	0.17	5.26
S3	-0.94	-23.35
$LREER_2$	-0.32	-2.95
LGDP	2.96	36.01

Table 3.3 Estimated Cointegration Relationship for Intermediate Goods Import Demand

	Coefficient	t-statistic
C	-21.94	-20.33
S1	0.51	13.20
S2	0.17	5.01
S3	-0.81	-19.88
$LREER_2$	-0.24	-2.16
LGDP	2.66	31.66

Table 3.4 Estimated Cointegration Relationship for Capital Goods Import Demand

	Coefficient	t-statistic
C	-30.02	-14.42
S1	0.42	5.58
S2	0.15	2.35
S3	-1.13	-14.36
$LREER_2$	-0.05	-0.23
LGDP	3.29	20.27

Table 3.5 Estimated Cointegration Relationship for Consumption Goods Import Demand

	Coefficient	t-statistic
C	-34.27	-16.07
S1	0.79	10.33
S2	0.27	4.08
S3	-1.28	-15.83
$LREER_2$	-1.69	-7.68
LGDP	4.33	26.06

Table 4.1 Engle-Granger Cointegration Test Results

	ADF Test Statistic
RESIDEQ_XS	-3.76*
RESIDEQ_ID	-5.37***
RESIDEQ_INTD	-4.70**
RESIDEQ_CAPD	-4.24**
RESIDEQ_CONSD	-3.85*

* denotes significant at 10 % critical value
** denotes significant at 5 % critical value
*** denotes significant at 1 % critical value

Table 4.2 Critical values for the Engle-Granger Cointegration Test (given in Table 2 in Engle and Yoo (1987)

		significance level		
number of variables	**Sample size**	**1%**	**5%**	**10%**
3	50	4.84	4.11	3.73

Table 5 Schwarz Information Criteria

	number of lags			
	1	2	3	4
LRX	-8.26	-7.73	-7.17	-6.54
LRM	-7.62	-7.42	-6.47	-5.80
LRINT	-7.49	-7.22	-6.25	-5.58
LRCAP	-6.52	-6.15	-5.52	-4.84
LRCONS	-6.26	-5.76	-4.98	-3.99

Table 6.1 Johansen Test Results for Export Supply

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	5 Percent Critical Value	Max-Eigen Statistic	5 Percent Critical Value
Ho:r=0*	H1:r≥1	0.41	40.24	34.91	24.18	22.00
Ho:r≤1	H1:r≥2	0.19	16.06	19.96	9.64	15.67
Ho:r≤2	H1:r≥3	0.13	6.41	9.24	6.41	9.24

Normalized cointegrating coefficients (std.err. in parentheses)			
LRX	C	LGDP	$LREER_1$
1.00	23.49 (-5.97)	-2.80 (-0.36)	-0.06 (-0.59)

Table 6.2 Johansen Test Results For Aggregate Import Demand

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	5 Percent Critical Value	Max-Eigen Statistic	5 Percent Critical Value
Ho:r=0*	H1:r≥1	0.62	53.17	34.91	44.86	22.00
Ho:r≤1	H1:r≥2	0.13	8.31	19.96	6.45	15.67
Ho:r≤2	H1:r≥3	0.04	1.86	9.24	1.86	9.24

Normalized cointegrating coefficients (std.err. in parentheses)			
LRM	C	LGDP	$LREER_2$
1.00	25.93 (0.88)	-3.13 (0.07)	0.28 (0.09)

Table 6.3 Johansen Test Results For Intermediate Goods Import Demand

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	5 Percent Critical Value	Max-Eigen Statistic	5 Percent Critical Value
Ho:r=0*	H_1:r≥1	0.57	50.53	34.91	39.30	22.00
Ho:r≤1	H_1:r≥2	0.16	11.23	19.96	8.21	15.67
Ho:r≤2	H_1:r≥3	0.06	3.01	9.24	3.01	9.24

Normalized cointegrating coefficients (std.err. in parentheses)			
LRINT	C	LGDP	$LREER_2$
1.00	23.90 (0.95)	-2.83 (0.07)	0.16 (0.10)

Table 6.4 Johansen Test Results For Capital Goods Import Demand

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	5 Percent Critical Value	Max-Eigen Statistic	5 Percent Critical Value
Ho:r=0*	H_1:r≥1	0.50	47.97	42.44	32.71	25.54
Ho:r≤1	H_1:r≥2	0.24	15.26	25.32	12.57	18.96
Ho:r≤2	H_1:r≥3	0.06	2.68	12.25	2.68	12.25

Normalized cointegrating coefficients (std.err. in parentheses)			
LRCAP	C	LGDP	$LREER_2$
1.00	33.52 (1.94)	-3.61 (0.15)	-0.06 (0.21)

Table 6.5 Johansen Test Results For Consumption Goods Import Demand

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	5 Percent Critical Value	Max-Eigen Statistic	5 Percent Critical Value
Ho:r=0*	H_1:r≥1	0.42	36.15	34.91	25.13	22.00
Ho:r≤1	H_1:r≥2	0.14	11.02	19.96	7.16	15.67
Ho:r≤2	H_1:r≥3	0.08	3.86	9.24	3.86	9.24

Normalized cointegrating coefficients (std.err. in parentheses)			
LRCONS	**C**	**LGDP**	**$LREER_2$**
1.00	34.81 (4.48)	-4.63 (0.35)	1.72 (0.48)

Table 7.1 Single Equation Estimation Results for DLRX

Export Supply (DLRX)		
Variable	**Coefficient**	**t-statistic**
C	0.30	3.62
S1	-0.31	-8.27
S2	-0.32	-2.29
S3	-0.49	-2.62
DLRX(-2)	-0.41	-2.95
DLGDP	0.50	1.73
ECMXS (-1)	-0.30	-2.96
Diagnostic Statistics		
R-squared	0.81	
Adjusted R-squared	0.78	
F-statistic	27.23	
Durbin-Watson statistic	2.22	
Jarque-Bera	1.57	p-value:0.45
Serial LM	1.31	p-value:0.28
White Heteroskedasticity Test	1.23	p-value:0.30
ARCH	0.10	p-value:0.90

Table 7.2 Single Equation Estimation Results for DLRM

Aggregate Import Demand (DLRM)		
Variable	**Coefficient**	**t-statistic**
C	0.69	9.02
S1	-0.40	-11.09
S2	-0.87	-7.33
S3	-1.53	-8.67
DLRM(-1)	0.26	3.15
DLGDP	2.12	8.08
$DLREER_2$	-0.41	-2.16
ECMID(-1)	-0.72	-5.57
Diagnostic Statistics		
R-squared	0.88	
Adjusted R-squared	0.85	
F-statistic	38.77	
Durbin-Watson statistic	1.84	
Jarque-Bera	2.41	p-value:0.29
Serial LM	0.10	p-value:0.90
White Heteroskedasticity Test	0.44	p-value:0.92
ARCH	0.25	p-value:0.62

Table 7.3 Single Equation Estimation Results for DLRINT

Intermediate goods Import Demand (DLRINT)		
Variable	**Coefficient**	**t-statistic**
C	0.58	6.63
S1	-0.23	-5.99
S2	-0.79	-5.84
S3	-1.29	-6.50
DLGDP	1.88	6.29
$DLREER_2$	-0.77	-3.77
ECMINT(-1)	-0.65	-4.52
Diagnostic Statistics		
R-squared	0.73	
Adjusted R-squared	0.69	
F-statistic	18.35	
Durbin-Watson statistic	1.87	
Jarque-Bera	0.009	p-value:0.99
Serial LM	0.16	p-value:0.85
White Heteroskedasticity Test	0.65	p-value:0.74
ARCH	0.5	p-value:0.48

Table 7.4 Single Equation Estimation Results for DLRCAP

Capital goods Import Demand (DLRCAP)		
Variable	**Coefficient**	**t-statistic**
C	0.28	1.30
S1	0.05	0.16
S2	-0.05	-0.15
S3	-1.10	-3.58
DLGDP	1.66	3.60
DLGDP(-1)	1.11	2.29
$DLREER_2$(-2)	-0.62	-1.97
ECMCAP(-1)	-0.52	-3.72
Diagnostic Statistics		
R-squared	0.88	
Adjusted R-squared	0.85	
F-statistic	33.13	
Durbin-Watson statistic	2.06	
Jarque-Bera	0.09	p-value:0.95
Serial LM	0.32	p-value:0.72
White Heteroskedasticity Test	1.63	p-value:0.14
ARCH	0.11	p-value:0.73

Table 7.5 Single Equation Estimation Results for DLRCONS

Consumption goods Import Demand (DLRCONS)		
Variable	**Coefficient**	**t-statistic**
C	1.04	7.31
S1	-0.47	-7.56
S2	-1.43	-6.54
S3	-2.26	-7.06
DLRCONS(-1)	0.15	1.79
DLRCONS(-2)	0.19	2.36
DLGDP	3.54	7.31
$DLREER_2$	-1.09	-3.19
ECMCONS(-1)	-0.50	-4.40
Diagnostic Statistics		
R-squared	0.83	
Adjusted R-squared	0.79	
F-statistic	21.89	
Durbin-Watson statistic	2.02	
Jarque-Bera	2.97	p-value:0.22
Serial LM	0.24	p-value:0.78
White Heteroskedasticity Test	1.76	p-value:0.09
ARCH	0.86	p-value:0.35