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Seyed Komail Tayyebi

University of Wollongong

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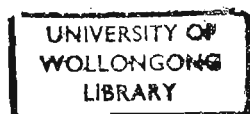
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ECONOMETRIC MODELLING OF IMPORT DEMAND IN DEVELOPING COUNTRIES: THE CASE OF IRAN (1970-1993)



A thesis submitted in fulfilment of the requirements

for the degree of

Doctor of Philosophy

from



University of Wollongong

Department of Economics
New South Wales
Australia

by

Seyed Komail Tayyebi

B.Sc. (Economics, University of Isfahan, Iran)
M.Sc. (International Economics, University of Isfahan, Iran)

March, 1996

DECLARATION

I hereby certify that this thesis has not been submitted previously as part of the requirements of another degree and that it is the result of my own independent research.

Seyed Komail Tayyebi

DEDICATION

TO THE MEMORY OF MY BROTHER
SEYED MOHAMMAD REZA TAYYEBI
(1966-1987)

and

To my Parents, my wife, and my daughters for the devotion and support given during
the research project.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to Professor Tran Van Hoa, my first supervisor, whose invaluable suggestions and advice helped me direct and focus the research and for his guidance throughout the dissertation process.

Special appreciation is also extended to my second supervisor, Professor Charles Harvie, who patiently encouraged, supervised, and guided me in the process of developing this thesis. I am indebted as his comments and suggestions were invaluable in the writing of this thesis.

I am also appreciative of Professor Rob Castle, Head of Department of Economics University of Wollongong, who provided a considerable number of valuable comments and suggestions on the improvement of the content and presentation of the dissertation.

Many thanks to Professor Don Lewis, the Acting Head of Department of Economics University of Wollongong, and Ms Di Kelly for the friendly working environment they created, to Wolfgang Brodesser who assisted me with computing needs, to Ms. Sophie Abercombie and Ms. Julie Chin who were invaluable in assisting with administrative needs and in the provision of their friendship, and to many of my friends, for moral support throughout my study.

I would like to express my thanks to the Head of Department of Scholarship, the Ministry of Culture and Higher Education of Iran, for giving me the opportunity to do this study and providing me with a scholarship.

The moral support I received from my wife, Sedigheh, and my daughters, Zeinab and Farzaneh, is inexpressible. Their patience and cooperation helped me to complete the thesis on time. It is hard to express in words the encouragement and support I received from my parents, my brother, and my sister, and my other relatives towards the completion of this thesis. They tried to overcome my absence at home for the sake of my career development.

ABSTRACT

The linkage between changes in economic variables, such as relative prices, exchange rates, and income, and import demand has many implications. The major objective of this thesis is to develop and estimate an econometric model explaining such a relationship for a developing country. The thesis contributes significantly to analytical and empirical work on the Iranian economy. It focuses on the behavior of Iranian import demand through estimation of linear econometric models.

Imports are considered at both aggregate and disaggregate levels. The behavior of the Iranian aggregate import demand function is considered within the framework of a macroeconomic model, identifying applicable relationships between the demand for aggregate imports and such economic variables. Disaggregated imports appear in the form of the import composition (consumer goods, intermediate goods, and capital goods imports), various imported commodity groups, and imports by country of origin. The macro-model developed in this thesis as well as three different import models are estimated over the period 1970-1993. The estimation results for all stochastic import equations are mostly obtained by OLS, and other appropriate empirical techniques.

The estimation results indicate that there is a strong negative relationship between import demand and the relative price of imports to domestic goods, but a positive relationship between import demand and an activity variable. The results reveal that Iranian aggregate import demand is relatively inelastic with respect to income and relatively elastic with respect to prices, and this contrasts with results found in the literature for other developing countries. In the case of disaggregated imports, however, the demand for a number of essential imports are inelastic or even insignificant with respect to prices.

The most important results obtained from the estimations provide evidence of an insignificant coefficient for the official exchange rate in the estimated aggregate import demand and many of the disaggregated import demand equations. This is likely to arise from the existence of an important parallel (black) foreign currency market. The empirical results indicate that the parallel market exchange rate premium has a significantly negative effect on Iranian import demand, but a significantly positive effect on import prices. In general, a comparison of the results shows that consumer goods imports are more sensitive with respect to the black market premium than imports of intermediate and capital goods.

A historical simulation of the macro-model as well as an import demand model is performed to test the validity and the fitness of these models as a whole. Several policy experiments are conducted to show the dynamic response of each model to changes in key policy variables. The simulation results, arising from changes in the black market premium and non-oil exports as policy variables, indicate that the elimination, or reduction, of the black market exchange rate premium increases imports substantially, while its price effect is disinflationary. The private sector is significantly influenced by the performance of the parallel market premium policy whereas its effect on the government sector is rather small. Although an increase in non-oil exports, as another policy experiment, increases imports, its price effect is inflationary. Overall, the policy of the elimination of the black market exchange rate premium seems to be more effective than the others, conducted in this study, if the country's major objective is a reduction in prices. But if the country puts more emphasis on the achievement of economic growth, the promotion of non-oil exports policy looks more effective.

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CHAPTER ONE

1. INTRODUCTION

1.1 Background to the Study

The foreign sector plays a large and significant role in a developing economy. It is also well known (Murray and Ginman 1976) that the effectiveness of international trade policy is highly dependent on the size of import and export price and income elasticities. In the determination of imports and exports, both demand and supply should be incorporated in the modelling of the international sector of an economy. Many econometric models [such as Goldstein and Khan (1978), Metwally and Tamaschke (1980) and Asseery and Perdikis (1993)] have been developed to explain developments in this sector for various developed and developing countries.

A knowledge of the relationship between imports, relative prices and economic activity is important for policy decisions. Changes in the foreign inflation rate, the exchange rate, and the level of tariffs and other trade barriers all affect foreign trade. Import elasticity estimates are required not only as a basis for policy decisions but also for assessing the effects of both domestic and foreign price changes on employment and production. In addition, imports play a vital role in the contribution of trade to the economic development process in developing countries. Economic development, in turn, influences the trade and import patterns of these countries (Govindan 1993). Hence understanding how import flows react to changing economic conditions is essential to the design of a successful development program.

However, several factors make predicting import flows in developing countries difficult for varying reasons. Khan (1975) and Melo and Vogt (1986), for instance, indicate that the dependency of developing countries on foreign capital goods makes aggregate estimation sometimes misleading, because the marginal propensity to import is highly dependent on the composition of income. In addition, another factor includes the presence of high and variable tariffs which make observed border prices an unreliable indicator of import costs (Faini, et al. 1992).

The above mentioned problems do not undermine the important role of the relationship between imports and other economic variables in developing countries, which have a particularly high dependency on intermediate and capital goods imports for their development projects. The modelling of import demand explores this relationship and links imports to its determinants. By modelling import demand (or exports), it is possible to draw policy conclusions about the ability of the foreign sector to affect variables such as consumption, income etc.¹

In this study an attempt is made to provide an empirical framework within which the import demand of Iran can be systematically analysed. Iran, as an oil-based developing country, is located on the Persian Gulf between the Middle East and South Asia. It is bordered to the north by Turkmenistan and Azerbaijan, to the east by Afghanistan and Pakistan, to the south by the Persian Gulf and the Gulf of Oman, and to the west by Iraq and Turkey. Iran's population has reached over 62 million (World Bank 1995). Apart from its large deposits of oil and natural gas, Iran has a range of other natural resources and a variety of climates and soils, which make it potentially self-sufficient in food-stuffs and agricultural materials. However, its industrial manufacturing is highly dependent on foreign intermediate and capital goods. Iran's exports consist largely of oil with a smaller portion of non-oil exports. Before the oil age Iran was exporting agricultural products, cotton, animal hides and skins, and rugs. Thereafter, Iran began to steadily export oil which has been its main source of foreign exchange since 1959. Such

¹ This study will only focus on the Iranian import sector.

exports ultimately led to a deterioration in the country's terms of trade over a long period of time. The average annual rate of deterioration in the terms of trade was 5.8 percent over the 1980s. Non-oil exports increased somewhat after the Islamic revolution of 1979. The first jump was in 1979 and the second one occurred in 1986 after the huge decline in oil revenues. The quadrupling of oil prices in 1973-74 dramatically increased the share of oil exports in Iran's foreign sector. The subsequent increase in oil prices in the early 1980s maintained the dominance of oil exports. The economy then faced a decline in oil prices in 1986, leading to a sharp decline in the ratio of oil exports to total exports.

1.2 Statement of the Problem

This study is concerned with the modelling of imports, and with the interrelationships between import demand and its major determinants. A number of important issues arise from this including the appropriate structure of an econometric import demand model, particularly in the context of a developing oil-economy, the contribution of the import sector to the economy, the impact of an increase in relative prices and income on the demand for aggregate imports and on the demand for disaggregated imports, the influence of exchange rates on imports, and does import demand vary in response to these changes? These are some of the key questions focused upon in this study.

A general framework is employed to identify systems of equations explaining import demand at both the aggregate and disaggregate levels. A macro-model is initially developed, and aggregate import demand is specified within this model. Structural equations for the macro-model and disaggregated import model are estimated, and the estimation results are discussed and interpreted. As already mentioned, Iran provides the focus for this study for the following reasons:

- (1) Iran has vast natural resources and potential for increased international trade.

- (2) Exports are predominantly of primary products and the country's imports consist mainly of capital goods and semi-manufactured goods.
- (3) Its population growth (about 2.7% in 1992) has accelerated during the last two decades, and this has imposed an additional burden upon the country's development efforts.
- (4) The black (parallel) market exchange rate has played an important role in the Iranian economy during the 1980s and the early 1990s.
- (5) While it is true that Iran can potentially become self-sufficient in food-stuffs, its imports of these products have been rising.
- (6) Presently, contrary to the situation in the 1980s, the private sector has got the highest priority in the country's economic programs. It has now a determining role in both agriculture and industry and a number of other key areas.
- (7) More importantly, there are few studies which empirically model imports for Iran.

1.3 Objectives of the Study

The main objectives of this study are as follow. (1) The major objective of this study is to contribute to analytical and empirical work on Iranian import demand. Our interest is both with the theory of international trade (focusing on imports) and the empirical implementation of the theory in the context of a developing economy such as Iran's. Therefore, an attempt is made to construct an econometric model for imports and test its relevance and power in explaining the import behaviour of the Iranian economy.

- (2) The purpose of this study is to detect any significant relationships between import demand and its determinants. It is expected that the following hypothesis will be tested: that there is a negative relationship between import demand and relative import prices, a positive relationship between import demand and economic activity (income,

expenditure, etc.), and a significant (negative) relationship between import demand and exchange rates.

(3) The elasticities of the demand for imports vary considerably from good to good, because the responsiveness of import demand for each good with respect to changes in the explanatory variables is quite different. These elasticities for various imports are important for policy determination. One of the main objectives is to evaluate policy implications arising from empirical results obtained by estimating disaggregated import elasticities.

(4) To investigate trade relationships between the country and its trading partners, we will model imports by country of origin. Standard trade theory indicates that the origin of imports has little importance. Nevertheless, the geographical distribution of trade may be important (in political, security, and policy relevance) in the case of Iran. It is undeniable that bilateral trade positions have become a major political issue between countries. Political problems, for instance, have certainly affected the economic relationships between Iran and the United States.

(5) The Iranian economy has been suffering from a widening gap between the official exchange rate and its black market equivalent, especially since the early 1980s. This gap has always shown an overvaluation of the official domestic currency, and played a key role in measures to control the inflation rate and to stabilise the economy. It will be shown (in Chapter Five and Chapter Six) that the black (parallel) market premium significantly affects the economy as indicated by the significance of its coefficient in both the import demand and import price equations. A key objective of this study is to analyse the impact of a shock to the black market exchange rate premium, as a policy variable, on the economy. In addition, the promotion of non-oil exports has always been one of the major economic goals in Iran. Hence evaluating the dynamic response of the economy to an increase in non-oil exports, as a policy variable, will be the final objective of this study.

1.4 Methodology of the Study

An import demand function can be theoretically derived in several alternative ways. In principle, several economic approaches, such as profit maximisation, cost minimisation, and utility maximisation, enable us to construct a theory of import demand. In this study a utility function, which relies on society's preferences, is maximised to derive the traditional form of the aggregate import function.

Imports are modelled at the aggregate and disaggregate levels. The aggregate import demand is simultaneously estimated with the other endogenous variables included in a macro-model. Following Aghevli and Sassanpour (1982), Khan and Knight (1991), and a number of other studies, a macro-model for the demand side of the Iranian economy is developed, which consists of the domestic aggregate demand sector, the external sector, the monetary sector, and prices. In addition, the model of disaggregated imports consists of three separate categories; the composition of imports, imports of commodity groups, and imports by country of origin. Based upon the policy of quantitative restrictions on imports, commodity groups are divided into two different classifications: restricted imports and free imports.

The study will try to specify some simple theoretical models of imports, and then estimate them in order to put some empirical estimates on the results that the theoretical models yield. Since different functional forms lead to different estimates of demand elasticities, and thus different conclusions about the impact of various international policy changes, the specification of the functional form is an important methodological question.

Import equations often appear in either linear or log-linear forms. Because of their empirical superiority (Khan 1975), all behavioural equations are specified in log-linear forms. The specification of the import demand equations is also expressed as a dynamic form. In this study the formulation of import demand will rely on partial adjustment, in which actual and desired imports are assumed to adjust with a one period lag.

By using dummy variables and then different arrangement of variables, we can produce an impressive variety of models (Greene 1993). The period under consideration of this study (1970-1993) contains a range of different episodes for Iran; a sharp increase in the oil price in 1974 and 1979-81, the Islamic revolution in 1979, the commencement of the eight-year Iran-Iraq war in 1980, and a sharp collapse of the oil price in 1986. Three dummy variables are constructed, to examine the effects of these events on imports and other dependent variables.

All stochastic import equations are estimated by the OLS (ordinary least squares) method. For the case of the macro-model developed in Chapter Five, the estimation results obtained by 2SLS and 3SLS methods are almost the same in comparison with those obtained by OLS. They are given for illustration in Appendix D. Diagnostic tests are used to test the estimated regressions for several problems which may influence the validity of the estimation results. The properties of the error term are examined by using the ARCH statistic to test for heteroscedasticity, the Jarque-Bera test for normality of residuals, the Ramsay RESET test for regression misspecification, etc. These results are obtained by the SHAZAM computer program. To overcome the problem of autocorrelation, a first-order auto regressive technique (AR1), including maximum likelihood and Cochrane-Orcutt iterative techniques, are applied to the estimation equations whose disturbances indicate first order serial correlation. The estimation parameters, then, are used in the simulation process. The macro-model presented in Chapter Five, and the import model (consisting of consumer goods, intermediate goods, and capital goods imports), presented in Chapter Six, are simulated by the Newton technique which is available in the TSP computer program. A number of dynamic simulation tests will evaluate the validity of the historical simulation results for conducting policy shocks.

1.5 The Plan of the Thesis

The remainder of this thesis proceeds as follows. Chapter Two outlines the main economic characteristics of the Iranian economy. The concentration is on the domestic sectoral structure characteristics as well as the foreign sector of the Iranian economy. Developments in GDP and its sectoral composition, export sector, import sector and Iran's exchange rates and foreign debt are analysed in this chapter. The chapter partitions the study period into two phases, namely pre-revolutionary period (1970-78) and post-revolutionary period (1979-1993), to highlight most developments in the economy.

Chapter Three conducts an overview of the role of the external sector within the context of a macroeconomic model, focusing in particular on the literature concerned with import demand. It will be shown that the external sector plays an important part in the economic growth process. Particular emphasis is placed on the importance of imports for development in developing countries. This chapter then focuses upon the structural form of the import function, and will identify the major explanatory variables affecting import demand. Alternative ways by which a functional form for import demand can be derived from economic theory is also discussed. Finally, Chapter Three summarises and reviews some of the previous studies of import demand models developed for Iran and other developing as well as developed countries.

To explore relevant economic variables associated with the empirical modelling of import demand functions, Chapter Four formulates these functions for Iran. This chapter is concerned with the theoretical and empirical demonstration of the nature of relationships between the demand for imports and the explanatory variables. Of particular concern in this chapter is the development of import models at the aggregate and disaggregate levels. The disaggregated import model is developed by using three separate equation systems for import demand consisting of composition of imports, a number of classifications of imported commodity groups, and imports by country of

origin. The system equation for the composition of imports includes import equations for consumer goods, intermediate goods, and capital goods, while the equation system for imported commodity groups is specified for a variety of both restricted and free imports. A system of equations for imports by country of origin is specified to identify the trade relationship between Iran and its major trading partners.

Chapter Five introduces a macro-model emphasising the demand side of the Iranian economy. Attention is initially focused on a study of an aggregate import demand function, and its contribution to the macro-model is examined. It will be shown that aggregate import demand is explained by economic variables incorporated in the macro-model, and also the extent to which those variables affect import demand. The chapter then examines economic relationships in the model which rely on estimates of the parameters, mostly obtained by the OLS method and other appropriate empirical techniques. For comparative purposes the responses of import patterns, including import demand and import price, with respect to changes in two different categories of exchange rate regime, the official exchange rate and its black (parallel) market equivalent, are examined.

In addition to the aggregated import demand, as covered in Chapter Five, Chapter Six shows that the demand for various disaggregated imports can be significantly determined by the relevant explanatory variables. The disaggregation of imports can be performed according to several criteria: the composition of imports, the types of commodity groups, and the origins of imports. This chapter will consider all these possibilities. The system equation for the composition of imports, as formulated in Chapter Six, is estimated by the relevant econometric techniques from the time series data. Chapter Six then examines the estimation results obtained for twenty equations of imported commodity groups, including thirteen restricted imports and seven free imports.² This chapter also covers an analysis and interpretation of the estimation

² As classified in Chapter Six, imported commodity groups with an average tariff of less than 10% are assumed to be freely imported, otherwise they are included in the restricted import classification.

results for fifteen equations of imports by country of origin, in which estimated elasticities indicate the trade relationships between Iran and its major trading partners. Several diagnostic tests evaluate the validity of all estimated import equations.

The purpose of Chapter Seven is to investigate the impact of various policy shocks on the Iranian economy, using the parameter estimates presented in the previous chapters. The macro-model, developed in Chapter Five, as well as the three-equation model of the composition of imports, estimated in Chapter Six, are considered. Using the relevant techniques, Chapter Seven firstly traces the establishment of the dynamic simulation tests to evaluate the historical simulations of these models. To test the reliability of these models for predicting changes in the dependent variables, dynamic simulations of the models are then conducted for the period 1970-1993. The chapter will present an interpretation of these simulation results. The policy simulations conducted in this chapter include shocks to the black market exchange rate premium, and an increase in non-oil exports.

Chapter Eight summarises the major conclusions derived throughout the thesis. This chapter presents a summary of the previous chapters and their conclusions, and discusses the policy implications of the major results. Finally, suggestions for future work are given at the end of the chapter.

CHAPTER TWO

2. AN OVERVIEW OF DEVELOPMENTS IN THE IRANIAN ECONOMY

2.1 Introduction

This chapter outlines the main economic characteristics of the Iranian economy. The main concentration will be on the structure of the foreign sector and its role in the economy. However, the chapter will firstly make some brief remarks about the domestic sectoral characteristics of the Iranian economy. The study period has been partitioned into two important but different periods, namely the pre-revolutionary period (1970-78) and post-revolutionary period (1979-1993), to highlight most developments in the economy. The first period experienced the first OPEC oil shock in 1974 in which an upward trend happened in oil prices until 1978. After the shock the rapid growth in oil exports was accompanied by a significant hike in the inflation rate. In the second period, the post-revolutionary period, the Islamic revolution, the eight-year Iran-Iraq war and the oil crisis in 1986 governed the economic performance. In short, in the past 17 years the economy has suffered from a capital and human flight, a devastating war, a decreasing price of oil, uncertainty in the business environment and a growing population.

The organisation of the chapter is as follows: Section 2.2 conducts an overview of economic growth in which developments in GDP and its sectoral composition are analysed. Section 2.3 studies the structure of the Iranian foreign sectors. Developments

in the export sector and import sector as well as relationships between imports and some economic activities are described in this section. An analysis of Iran's exchange rates (official and black market) and foreign debt are also described in Section 2.3 while Section 2.4 presents the major conclusions of the chapter.

2.2 Gross Domestic Production (GDP) and its Sectoral Composition

As Table 2.1 indicates, the annual growth rate of GDP has experienced considerable fluctuations since 1970. It registered its sharpest rise in 1971, 1972, and 1976 for the pre-revolutionary period, and in 1982 and 1990 for the post-revolutionary period. Its largest decrease occurred during 1977-78 for the former period, and during 1979-81 and 1986-88 for the later period. As a whole, four cycles can be specified for the post-revolutionary period: sharp decrease (1979-81), strong growth (1982-83), sharp decline (1986-88), and strong growth (1990-92).

Overall, the annual average real growth rate of GDP for the post-revolutionary period (1979-93) shows a 8.8 percent decline when compared to the corresponding figure for the pre-revolutionary period (1970-78). The flight of capital and skilled workers, and the commencement of an eight-year Iran-Iraq war were the major factors for the drastic decline in GDP during 1979-81, while the oil crisis and a sharp drop in foreign exchange in 1986 led to the recession during 1986-88. However, the high growth achieved in recent years (since 1990) largely reflects the initial effects of the trade and foreign exchange liberalisations and the utilisation of unused capacities in the economy (Pesaran 1995).

Table 2.2 shows that a growing population led to a drastic decline in the average living standard of people over the 1970-93 period, particularly over the post-revolutionary period. GDP per capita declined by about 49.8 percent from a high of 389,050 rials in 1976 to a low of 193,650 rials in 1988 (in 1982 prices). GDP per capita decreased at an average rate of about 10.4 percent per year between 1977-81. Again, it registered its

Table 2.1: GDP and its sectoral composition, 1970-1993 (% , 1982 constant prices).

Sectoral Composition of GDP and Growth Rates (%)										
Year ^a	GDP		Agriculture		Oil		Industries ^b		Services ^c	
	Growth Rate	Share	Growth Rate	Share	Growth Rate	Share	Growth Rate	Share	Growth Rate	
1970	10.17	16.79	3.07	44.02	11.32	11.03	14.01	25.61	9.87	
1971	15.83	14.62	0.89	46.16	21.49	11.04	15.94	25.49	15.26	
1972	17.07	14.14	13.30	45.11	14.39	11.23	19.13	27.30	25.37	
1973	11.90	13.45	6.47	47.27	17.27	12.30	22.57	25.36	3.96	
1974	8.79	12.82	3.71	44.40	2.19	13.16	16.41	31.01	33.04	
1975	5.45	13.35	9.79	37.08	-11.94	14.86	19.04	35.79	21.70	
1976	16.93	12.73	11.52	35.67	12.50	17.51	37.83	34.62	13.13	
1977	-1.10	12.38	-3.86	33.26	-7.80	17.58	-0.74	36.34	3.81	
1978	-11.05	14.82	6.51	26.67	-28.68	17.85	-9.69	41.06	0.49	
1979	-7.97	17.06	5.95	23.37	-19.36	16.35	-15.71	45.76	2.55	
1980	-12.80	20.24	3.44	9.15	-65.84	19.81	5.68	51.32	-2.20	
1981	-3.00	21.28	1.97	9.62	1.91	20.43	0.04	49.11	-7.16	
1982	14.85	19.84	7.10	18.48	120.68	17.88	0.47	43.11	0.80	
1983	13.05	18.40	4.86	16.84	3.01	18.92	19.67	43.10	13.03	
1984	0.53	19.65	7.33	13.57	-18.98	19.74	4.87	43.92	2.43	
1985	1.75	20.82	7.81	13.49	1.16	18.31	-5.59	44.08	2.14	
1986	-9.10	23.92	4.45	12.66	-14.68	18.35	-8.94	42.01	-13.37	
1987	0.04	24.50	2.46	14.42	13.95	18.80	2.53	39.16	-6.75	
1988	-4.42	24.99	-2.50	16.56	9.71	18.67	-5.09	38.04	-7.15	
1989	4.46	24.81	3.70	17.07	7.73	19.06	6.62	37.06	1.75	
1990	11.24	24.11	8.07	18.40	19.86	19.43	13.40	36.55	9.72	
1991	10.64	22.91	5.15	18.48	11.13	20.57	17.15	36.31	9.92	
1992	6.10	23.19	7.42	17.67	1.46	20.29	4.65	36.98	8.04	
1993 ^d	2.31	23.91	5.49	17.89	3.60	20.29	2.31	38.85	7.49	
Annual Average Figures										
1970-78	8.21	13.9	5.71	39.96	3.42	14.06	14.94	31.40	14.07	
1979-93	1.85	21.98	4.85	15.84	5.02	19.13	2.80	41.69	1.42	

Source: Compiled and calculated on the basis of the Budget and Planning Organisation of Iran (BPOI), (1994) Time series of National, Financial and Monetary Accounts", BPOI, Tehran.

^a The Iranian Calendar year starts on March 21 each year and ends 20 March the following year. By adding 621 to the Iranian year, we convert it to the Gregorian calendar. Thus, the Iranian year 1349, for instance, is equated with 1970.

^b Includes mining, manufacturing, water and power (electricity, gas) and construction.

^c Includes trade, restaurants and hotels; transportation, communication and storage; banking and insurance; housing ownership and professional and specialised services; social, private, and household services.

^d Figures for 1993 are preliminary.

Table 2.2: GDP per capita, 1970-1993 (1982 constant prices).

Year	GDP Per Capita (1000 rials)	Growth Rate of GDP Per Capita (%)	Year	GDP Per Capita (1000 rials)	Growth Rate of GDP Per Capita (%)
1970	n.a	n.a.	1982	245.88	9.90
1971	260.31	-.	1983	266.00	8.18
1972	295.54	13.53	1984	255.90	-3.80
1973	319.37	8.06	1985	249.17	-2.63
1974	336.55	5.38	1986	218.21	-12.43
1975	343.75	2.10	1987	210.31	-3.62
1976	389.05	13.18	1988	193.65	-7.92
1977	372.40	-4.28	1989	194.88	0.64
1978	320.60	-13.91	1990	208.84	7.16
1979	285.56	-10.93	1991	225.04	7.76
1980	241.01	-15.60	1992	232.52	3.32
1981	223.73	-7.17	1993 ^a	230.41	-0.91

Source: Compiled and calculated on the basis of the Budget and Planning Organisation of Iran (BPOI), (1994) *"Time series of National, Financial and Monetary Accounts"*, BPOI, Tehran, and World Tables (1993 and 1995).

^a Estimate.

sharpest increases over the 1982-1983 period, during the post-revolutionary period. This reflects increased oil revenues in the period by 92.5 percent in 1982 alone (Amirahmadi 1990). However, the indicator experienced a decline during the 1984-88 period, with an average rate of about 6.1 percent per year. The sharpest reduction of GDP per capita was reported at a rate of about 12.4 percent in 1986, when the economic crisis began following the decline in GDP, oil revenue and inflation. In addition, the fall in per capita GDP was also related to the rapid growth of population during the post-revolutionary period.³ Following the government's stabilisation programs under the First Five-Year Economic, Social and Cultural Development Plan conducted for the 1989-1993 period, GDP per capita grew at an average annual rate of about 3.6 percent during this period (Table 2.2).

³ According to the figures given in World Tables (1995), the average growth rate of the Iranian population was about 4.4 percent per annum during the 1980s.

2.2.1 Agricultural Sector

As shown in Table 2.1, the sectoral composition of GDP consists of domestic sectors such as agriculture, oil, industries, and services. Noticeable changes have also occurred in the sectoral composition over the period 1970-1993. The available statistics show a decline in the contribution of the agricultural sector to GDP during the pre-revolutionary period, while this contribution increased substantially after the 1978/79 revolution. The share of agriculture to GDP decreased from 16.8 percent in 1970 to 12.4 percent in 1977. It increased from 17 percent in 1979 to the highest level of 25 percent in 1988. According to Table 2.1, the annual average share of agriculture in GDP for both pre-revolutionary and post-revolutionary periods were 13.9 percent and about 22 percent, respectively. As a result, agriculture took over from the oil sector as Iran's leading sector over the post-revolutionary period.

After the Islamic revolution, the government has given top priority to the agricultural sector, aiming at improving the quality of life in the rural areas, and enhancing the likelihood of achieving self sufficiency in foodstuffs. The annual average growth rate of the sector during the first five-year development plan (1989-1993) was about 6 percent, while the annual average share of GDP of the sector was about 24 percent during this period.

2.2.2 Oil Sector

The oil industry is one of the largest enterprises in Iran, and technologically the most advanced. Particularly in the 1970s, it was the most important stimulus in speeding economic progress. The expansion of the economy showed the significant role played by the oil sector, whose annual average share in GDP was about 40 percent during the pre-revolutionary phase (1970-1978). Oil revenue (in current price terms) in 1974 was about 11 times higher than that of 1970. But the rapid growth in oil revenue was accompanied by a significant hike in the inflation rate. In aggregate the pre-revolutionary period (1970-1978) was characterised by stagnation in production due to a

shortage of complementary inputs such as skilled labour, infrastructure and appropriate technology (Valadkhani 1995a). Oil production began to decline in 1977, a trend that worsened as a result of strikes in 1978 and the subsequent revolutionary upheavals (Amirahmadi 1990). Oil production picked up again in 1982 so that its rate grew at its highest recorded rate of about 120 percent. Thereafter oil production dropped and, as a result, the real value of the sector's production grew at an annual rate of 3.57 percent over the 1979-1984 period (see Table 2.1).

The events such as the Islamic revolution, the eight-year Iran-Iraq war and the oil shock in 1986 governed the economic performance during the 1980s. Accordingly, the annual average contribution of the oil sector to GDP (about 16 percent) over the post-revolutionary period (1979-1993) has dropped from 40 percent for the 1970-78 period (Table 2.1). The annual average growth rate of the oil sector over this period also dropped by 46 percent in comparison with the pre-revolutionary period.⁴

The importance of oil in Iran's economic development can also be measured by its role in the development budget. The share of oil income in the development budget increased from 47 percent in 1970 to 86.4 percent in 1974, but decreased to 74.8 percent in 1977. This explains the government's decision, in the pre-revolutionary period, to create an industrialisation program through imported technology, financed by the money that oil exports earned (Alavi 1985). However, the contribution of the oil sector to the development budget dropped from 66 percent in 1980 to 23.4 percent in 1986, the year of the oil crisis, and 14.8 percent in 1991. In contrast, the share of tax revenue to the budget increased from 25.2 percent in 1980 to 57.5 and 39.5 percent in 1986 and 1991, respectively (BPOI 1994).⁵ This reveals that the government has tried to reduce the dependence of the budget on the oil sector over the post-revolutionary period.⁶

⁴ The annual average growth rate of the oil sector for the period 1970-78 was 3.42 percent, while this rate decreased to 1.58 percent over the period 1979-93 (excluding 1980 and 1982).

⁵ The Budget and Planning Organisation of Iran (BPOI).

⁶ The annual average share of the oil sector to the development budget was about 25.4 percent over the period 1970-78.

Both direct and indirect taxes from corporations and individuals have substantially raised the government's revenue base from the non-oil sector during this same period. A better indication of the role of taxation in the budget is the proportion of government expenditure that is financed by taxes. Over the period 1979-88, the proportion of government expenditure financed by direct and indirect taxes on average amounted to 24 percent compared to 16 percent during 1974-78. It seems that attempts (after the revolution) have been made to increase non-oil taxation revenue. Nonetheless, Pesaran (1992) argues that it would be incorrect to interpret the rise in the share of non-oil revenue as a sign of a more effective system of tax collection.

However, the war destruction with a resulting high level of government expenditure and the reduction in oil revenues widened the budget deficit. The fiscal deficit reached a peak of about 50 percent in 1988-89, while it was reduced to 6.7 percent in 1992-93 (Valadkhani 1995a). The budget deficit was financed almost wholly through bank credits.

2.2.3 Industrial Sector

The industrial sector is composed of non-oil mining, manufacturing, utilities (water, gas and electricity) and construction. Most industries are dependent on foreign markets for between 65 percent and 85 percent of their inputs (Haerian 1996). The dependence of domestic industries on scarce raw materials and spare parts resulted in a drastic drop in capacity utilisation, especially after the revolution. An analysis of the industrial sector indicates that fluctuations in the level of foreign exchange receipts has been a major factor responsible for the changing performance of this sector. This is mainly due to the high dependence of these industries on imports of raw materials, technology and equipment.

The data given in Table 2.1 reveal that the role of industries (including mining and manufacturing) has been growing in both periods. Actually the annual average contribution of industries to GDP over the pre-revolutionary period (1970-78) was about

14 percent, while this share increased to about 19.1 percent over the post-revolutionary period (1979-93). However, the annual average growth rate decreased from about 15 percent over the pre-revolutionary period to 2.8 percent during the post-revolutionary period. During the period of economic stabilisation however, namely 1989-93, the annual growth rate of value-added by industries (such as mining manufacturing, construction, etc.) was about 8.9 percent. In fact, the annual rate of growth of this sector exceeded those of other sectors during this period (see Table 2.1).⁷

2.2.4 Services Sector

The decline in GDP caused by the relative decline in oil was partially compensated by the continued expansion of services. This sector grew at about 14 percent per year over the 1970-78 period. However, in the subsequent years, the sector gradually declined, registering only about a 1.4 percent average annual growth rate over the period 1979-1993. Its share, however, increased from 31.4 percent on average per year in the former period to 41.7 percent in the later period.

The rapid expansion of the services sector is generally difficult to analyse. The promotion of the service sector does not necessarily reflect the same sort of structural change which resulted from the process of development in the present developed economies. The growth of public services prior to the revolution was largely due to the expansion of the bureaucracy, armed forces and intelligence services. After the revolution, domestic trade demonstrated an extraordinary growth largely because of the steep decline in profitability in other sectors of the economy. The functions of the banking system also played a significant role in the performance of services. Specifically, banks were to become partners in development projects.

⁷ Agriculture, oil, industries and services grew respectively by about 6.9, 6, 8.8 and 7.4 percent on average during 1989-1993.

2.3 The Structure of the Foreign Sector

As a result of the intensification of the war with Iraq and the collapse of oil prices in 1986, Iran experienced a severe balance of payments crisis during the 1980s. The result, therefore, was a substantial loss of foreign exchange revenues from oil exports. The policy conducted by the government was to control imports through quantitative restrictions and import licenses.

As a whole, for most years after the revolution, the current account indicated a deficit of between US\$ 2 billion and US\$ 5 billion, with the exception of 1982 in which a surplus of US\$ 5.7 billion was achieved due to an unexpected increase in oil revenue as a result of an increase in the oil price and oil exports. The cumulative surplus of the current account during the pre-revolutionary period, specifically for the 1973-78 period, amounted to US\$ 27.9 billion, while the cumulative deficit on the current account over the 1980-1992 period amounted to US\$ 25.6 billion (World Bank 1995). Overall Iran's balance of payments was negative for most years since 1960, particularly in the post-revolutionary period (Amirahmadi 1990). Capital flight became a major drain on foreign exchange reserves during the post-revolutionary period, and despite government control of the exchange rates it could not affect a growing black market for foreign currency.

2.3.1 Exports

The oil sector has played a dominant role in the history of the Iranian economy since the late 1950s. This was particularly the case during the period 1973-1977, when oil exports began exerting a growing effect on the economy. Thus it is reasonable to expect that relevant policies were directed toward the transformation of the dynamic oil sector into an engine of growth. But after the 1979 revolution, the pace of the economy, its philosophy, and administrative goals, have changed the previous government's oil policies.

As Iran's economy has developed, the share of exports in GDP increased from about 20 percent in 1970 to 45 percent in 1977 (pre-revolutionary period). In the post-revolutionary period this share fell to about 16 percent in 1982 but dramatically decreased to 3.4 percent in 1986. It increased again to about 25 percent in 1992.⁸ Figure 2.1 depicts both the share of exports and the share of imports in GDP. The figure indicates that after an initial increase (during the period 1970-75), both exports and imports as a share of GDP decreased up until the mid 1980s. However, after 1990, both shares of exports and imports increased while the share of imports in GDP exceeded that of exports.

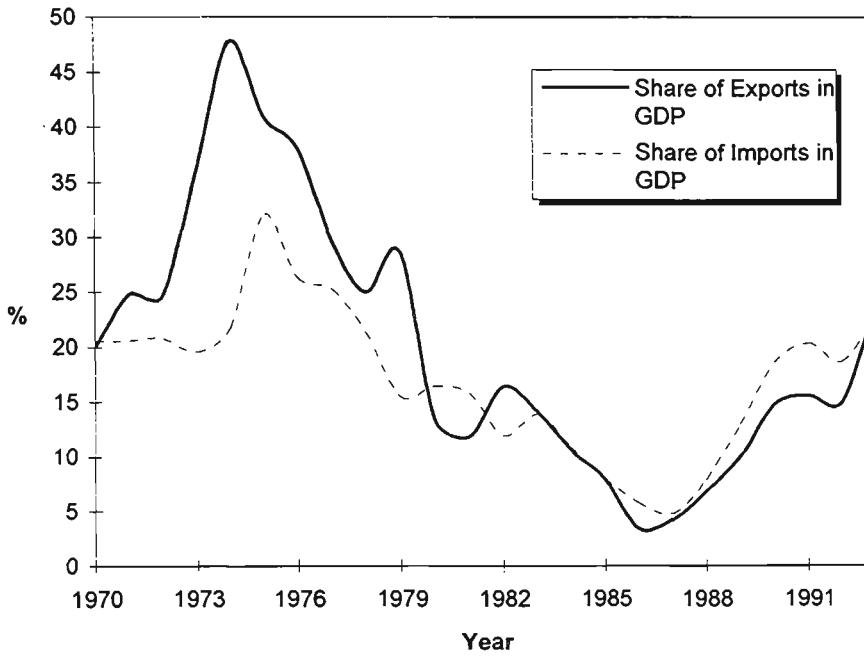
It is clear that Figure 2.1 shows “repercussion” or “feedback” effects in which there is a relationship between Iran's exports and imports. Metwally and Tamaschke (1980) argue that an increase in exports results in an increase in domestic income, causing an increase in demand for imports. The increase in imports leads to a rise in income of those countries which export goods and services to Iran. This rise in income in the rest of the world will have a feedback effect on the domestic country whose exports will increase.

Almost all of the change in the increasing share of exports in GDP, particularly during the 1973-76 period, has been caused by the increasing volume and value of oil exports prior to the revolution. For the case of Iran, export-led growth has been related to earnings from oil exports.⁹ The oil export boom after 1973 not only resulted in a substantial increase in income for Iran but also in a substantial increase of international reserves. For instance, in 1977 total international reserves was 40 times the 1969 level (Metwally and Tamaschke 1980). Total exchange receipts from exports, consisting of oil, traditional goods (such as carpets and handicrafts), and industrial goods and services increased from US \$528 million in 1960 to US \$6.2 billion in 1973, and further to \$21.1 and \$24.3 billion in 1974 and 1977, respectively. After the Islamic revolution, this amount decreased to \$14.1 billion in 1980, but increased to \$20.3 and \$16.7 billion in

⁸ Figures are in current prices.

⁹ Export-led growth is based on earnings from exports. It depends on the argument that export earnings are the most reliable source of foreign exchange. (Alavi 1985)

Figure 2.1: Shares of exports and imports in GDP over 1970-1993, (current price, %).



1983 and 1991 respectively. Because of the oil crisis in 1986, total receipts from exports decreased to their lowest level (\$8.3 billion) during the post-revolutionary period.

The dramatic increase in foreign exchange receipts from the oil sector caused the share of non-oil exports in total foreign exchange revenues to fall from 32 percent in 1960 to 11.7 percent in 1974 (Looney 1977). This share increased to 13.4 percent in 1986, and then jumped to 47 percent and 45 percent in 1988 and 1992, respectively (BPOI 1994). The most important development in Iran has been the emergence of the need for foreign exchange receipts, from non-oil exports as the value of oil exports has decreased in recent years. However, more changes in the country's trade policies are still required to bring about a basic change in the composition of Iran's external sector in favor of non-oil exports.

2.3.2 Imports

From 1970 until 1992 real aggregate imports have grown by on average 6.9 percent per annum. This growth rate on average was 22.6 percent annually from 1970 to 1977, the pre-revolutionary period, and 2.4 percent between 1979 and 1992, the post-

revolutionary period. Figure 2.2 shows movements in real imports over the past two decades. Real imports reached their peak in 1977, whereas their lowest level (after the revolution) was obtained in 1988. Between 1970 and 1978, US\$ 72.8 billion were paid for imports, and about US\$ 203.3 billion during the post-revolutionary period, 1979-1992. After a sharp fall during the revolution imports picked up again after 1980 with the improvement in economic conditions, and reached their peak in 1983 when oil revenue and GDP were also at their peak.¹⁰ With the fall in oil revenues and GDP in the post-revolutionary period, the imbalance in the country's foreign trade worsened. Between 1984 and 1988, the value of imports dropped by 58 percent as GDP and oil revenues declined to their lowest levels.

After the Islamic revolution, the commodity composition of imports has changed substantially. Imports of raw materials and intermediate goods have increased their share in total imports at the expense of consumer goods imports. The major reason for the increase in the share of raw materials and intermediate goods imports has been the priority given by government to "essential" imports. The share of food imports (grain, meat, etc.) increased from about 9.5 percent of total imports in 1976 to about 17 percent in 1988. But, the shares of imports of iron and steel, mechanical equipment and vehicles declined over the 1977-88 period.

2.3.2.1 A Description of the Relationship between Iranian Economic Activity and Imports

The timing of major fluctuations in imports suggests some responsiveness to macroeconomic shocks and the existence of bottlenecks in the Iranian economy. For example, there have been changes in the oil price and then in foreign exchange receipts over the period, fluctuations in economic variables, and changes in the exchange rate.¹¹ Each of these factors has, as we might expect, affected import flows.

¹⁰ It should be noted that a substantial part of imports during this period (1980-83) were to support the war effort.

¹¹ There have been particularly sharp fluctuations in the black market exchange rate.

There is a positive relationship between economic activity and imports, in which changes in government and private expenditures are correlated positively with changes in imports. The relationship between these variables and imports is shown in Figure 2.3. The revolution in 1978/79 led to a sharp fall in the growth of imports and in the growth of government expenditure. The extreme collapse of the oil price and then foreign exchange earnings after 1984, led again to sharp falls in imports and total expenditure. However, these falls were less pronounced than those of 1978-79. In contrast to previous episodes, import growth recovered ahead of economic activity after 1988. This was as a result of the government's liberalisation efforts in recent years.

The annual change in imports is also compared with that of the relative price of imports.¹² The relationship between relative prices and imports is presented in Figure 2.4. There has been a negative relationship between these two series as evidenced over the period analysed. The decrease in relative prices between 1974 and 1976, and increase in 1977 and 1979 is related respectively to a jump and a sharp fall in imports. The sharp fall in relative prices between 1980 and 1983 was accompanied by a sharp increase in the volume of imports. An increase in relative prices between 1984 and 1988 was related to a fall in import growth, while a fall in relative prices in the late 1980s and the early 1990s corresponded to a rise in import growth.

As a result of the collapse of the oil price in 1986, as well as the war with Iraq during the 1980-1988 period, Iran lost a large amount of foreign exchange earnings, from 21.5 billion US dollars in 1983 to 7.2 billion U.S. dollars in 1986 (IMF 1994). The government established direct controls on imports through quantitative restrictions and import licenses. During the periods of balance of payments crises, there was a policy of "import compression" by which imports were programmed annually within a foreign exchange budget based on oil and non-oil exports (Pesaran 1992). Figure 2.5 shows the degree of import compression by comparison with the ratios of imports to GDP and

¹² The relative price of imports is defined as the ratio of the import price index to the domestic price index.

Figure 2.2: Iran's real imports during the 1970-1992 period.

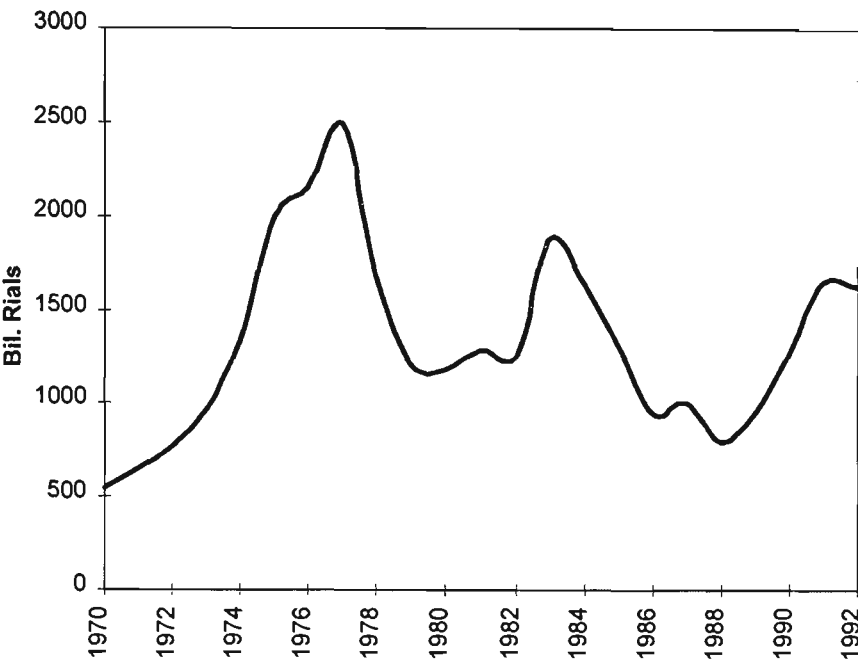


Figure 2.3: Percentage changes in real imports and real government and private expenditures.

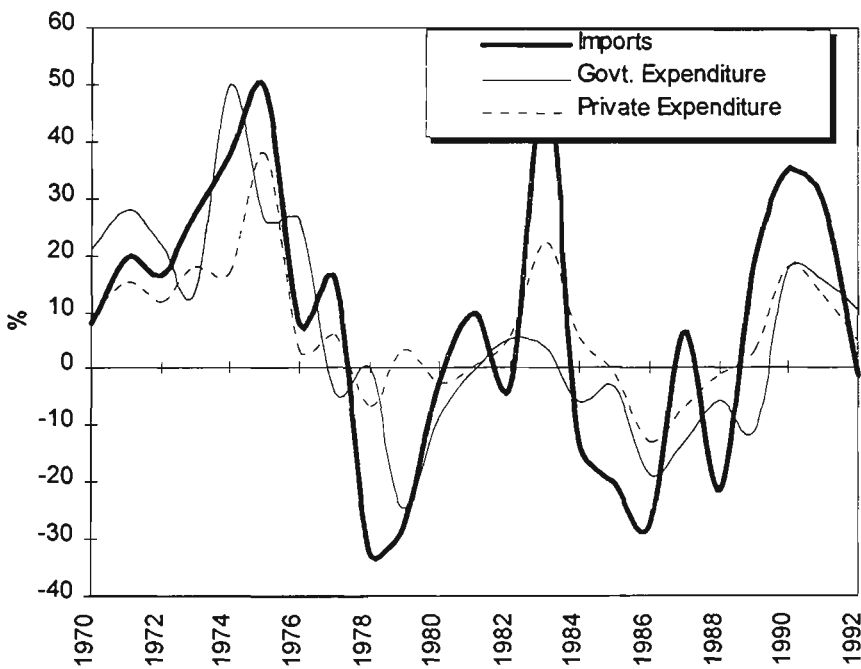


Figure 2.4: Percentage changes in imports and relative prices.

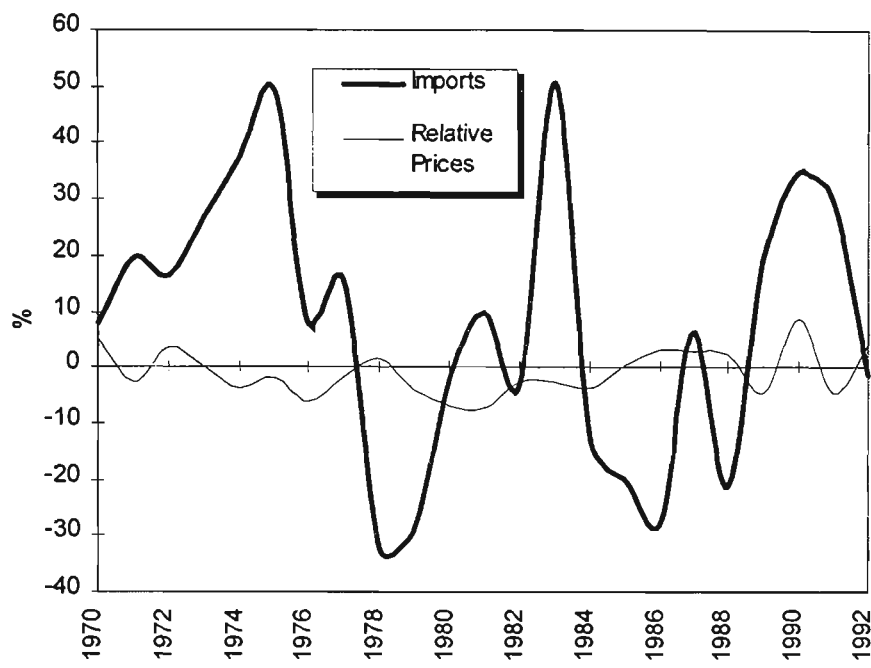
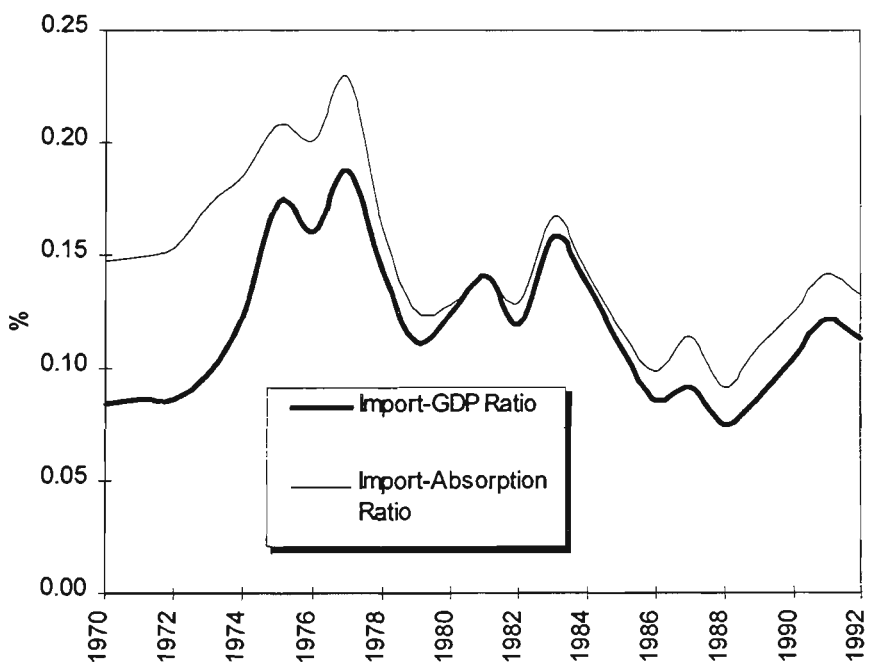


Figure 2.5: Alternative measures of the propensity to import (real).



absorption during the period 1970-1992. The average propensity to import (the ratio of imports to GDP) came down from a peak of 19 percent in 1977 to 7 percent in 1988. The ratio of imports to absorption also decreased from a peak of 22.9 percent in 1977 to 9 percent in 1988.

The policy of import compression was not successful in preventing deterioration in the balance of payments. Apart from 1982-83, when there was a surplus of US\$ 6.1 billion due to an unexpected rise in the oil price and oil exports, for most years the current account showed a deficit of between US\$ 2 -5 billion (IMF 1992). It highlights the fact that trade policy has mainly been based on the control of imports. In addition, the low oil price and the doubling of the balance of payments deficit has led to the black market for foreign currency growing steadily in recent years.¹³ This is explained further in Section 2.3.4 below.

2.3.3 Distribution of Foreign Trade by Type of Economy

As indicated in Table 2.3, Iran's trading partners remained largely dominated by the developed countries even though a degree of diversification occurred in the post-revolutionary period. Imports from developed countries decreased from about 85 percent of total imports in 1976 to 62.6 percent in 1982, reflecting the impact of the US's trade embargo and the freezing of Iranian assets after the 1979 revolution. Imports increased again and reached a peak of 70.7 percent of the total in 1984. But imports from these countries declined after 1984 along with the drop in oil prices. Non-oil exports to developed markets rose again in the post-revolutionary period, from 46 percent in 1976 to about 57 percent of total non-oil exports in 1986. However, the trend of non-oil exports to these economies decreased after 1980 in which 75 percent of non-oil exports were sold to them. Figures from Table 2.3 show that although Iran's imports from the developed countries declined about 0.7 percent on average per annum during

¹³ In 1988, for example, the official exchange rate for one US dollar announced by Iran's Central Bank was 70 rials (IMF 1994), while it was exchanged on average for 1048 units of Iranian currency (rial) on the black market (Technical Information Centre of Iran 1991).

Table 2.3: Distribution of external trade by type of economy, 1976-86 (percentage based on current price figures).

Years	Developed Countries ^a				Socialist Countries ^b				OPEC Member Countries ^c				Others	
	Imports	Non-oil Exports	Imports as % of Non-oil Exports		Imports	Non-oil Exports	Imports as % of Non-oil Exports		Imports	Nonoil Exports	Imports as % of Non-oil Exports		Nonoil Exports	Imports as % of Non-oil Exports
1976	85.1	46.1	184.6	2.9	25.9	11.2	1.1	19.9	5.5	10.4	8.1	128.4		
1977	85.4	41.7	204.8	5.4	39.1	13.8	1.1	14.3	7.7	8.1	14.9	54.4		
1978	86.8	34.3	253.1	5.1	22.8	22.4	0.1	15.5	0.6	7.3	27.5	26.5		
1979	81.9	71.5	114.5	6.2	12.3	50.4	2.9	8.5	34.1	9.0	7.7	116.9		
1980	67.8	75.5	89.8	13.7	15.4	89.0	5.2	5.6	92.9	13.3	3.5	380.0		
1981	69.9	63.6	109.9	8.4	17.3	48.6	4.6	11.6	39.0	17.1	7.3	234.2		
1982	62.6	54.4	115.1	12.7	24.2	52.5	2.1	15.6	13.5	12.6	3.8	331.6		
1983	68.1	46.6	146.1	7.3	18.5	39.5	3.5	18.2	19.2	21.1	16.7	126.3		
1984	70.7	46.8	151.1	6.5	29.5	22.0	2.9	12.2	23.8	19.9	11.5	166.1		
1985	65.8	52.8	124.6	9.7	17.7	54.8	3.5	16.1	21.7	21.0	13.4	156.7		
1986	66.7	56.8	117.4	5.8	7.3	79.5	6.4	19.2	33.3	21.1	16.7	126.3		

Source: Amirahmadi, H. (1990), "Revolution and Economic Transition: the Iranian Experience", Albany: State University of New York Press, USA.

^a The United States, Canada, Australia, Western Europe, Japan, and Turkey.^b The USSR and Eastern Europe.^c Saudi Arabia, Iraq, Kuwait, The United Arab Emirates, Qatar, Venezuela, Indonesia, Libya, Algeria, Gabon, Equador, and Nigeria.

the 1978-1986 period, Iran's annual average non-oil exports to these countries increased 6.3 percent during this same period.

Imports from socialist bloc countries increased steadily from about 3 percent of total exports in 1976 to about 13.7 percent in 1980 but fell thereafter to 5.8 percent in 1986. Table 2.3 also shows that non-oil exports to this same bloc decreased from 26 percent in 1976 to 12.3 percent of total non-oil exports in 1979, but increased to 29.6 in 1984, and dropped again to 7.3 percent in 1986. Overall, as a result of an improvement in economic and political relationships between Iran and the bloc after the revolution, Iran's imports from these countries grew 20.1 percent on average per annum during the 1978-1986 period, while the annual average of Iran's non-oil exports to these countries increased 1.5 percent.

Imports from the OPEC countries rose to a peak of 5.2 percent of total imports in 1980, since then the trend has fluctuated but in a downward direction. In contrast, Iran's non-oil exports to these countries fell sharply from about 20 percent in 1976 to 5.6 percent of total non-oil exports in 1980, but increased to 18.2 percent in 1983 and 19.2 percent in 1986. Finally, imports from the remaining developing countries registered a low of 7.3 percent of total imports in 1978 whereas they reached a peak of 21.1 percent in both 1983 and 1986. Although non-oil exports to these countries decreased from a high of 27.5 percent in 1978 to a low of 3.5 percent in 1980, they increased again to 16.7 percent in 1986.

Overall, Table 2.3 reflects a substantial feedback effect in terms of the trade relationships between Iran and the OPEC members and the other developing countries. Because of the reduced tariffs on imports from developing countries, Iran has increased its imports from these countries (Pesaran 1992). An increase in imports from these countries has led to an increase in income of these countries. This has raised demand for Iranian goods, resulting in an increase in Iran's non-oil exports. Thus, during the period 1976-1986 the imports of Iran from these countries increased respectively by 287.6 and

8.6 percent (in nominal terms) on average per annum. While the annual average growth rate of non-oil exports of Iran to the OPEC members and the other countries was 8.3 and 43.5 percent, respectively.

2.3.4 Official Exchange Rates and the Black Market Equivalent

In Iran, prior to the revolution of 1979, the official exchange rate between the Iranian rial and the US dollar was about 70 rials per US dollar. The official exchange rate was fixed at 92.3 rials per SDR (special drawing rights) in May 1980.¹⁴ This exchange rate was applied to all government imports and to some private imports, oil exports, and official capital transactions. Besides the basic official rate, in 1989 the government introduced a “preferential” rate at 420 rials per US dollar and a “competitive” rate of 800 rials per US dollar were applied to specified imports. Furthermore, a “service” rate of 845 rials per US dollar was also introduced that applied to services such as travel, education, and medical services. The official exchange rates applicable to non-oil exports also differed depending on the proportion of the proceeds that the exporters were permitted to sell on the “free” market. However, the multiple exchange rate regime led to a principal source of resource distortion and contributed to the overall inefficiency of the Iranian economy (Farzin 1995).

Because of capital flight during the post-revolutionary period, the government had to restrict the availability of foreign exchange by relying on multiple exchange-rate practices until 1993 (Bahmani-Oskooee 1995b). Such a practice resulted in a substantial gap between the official and black market exchange rates. The black market for dollars, therefore, emerged out of restrictions on foreign trade and capital flows. The war with Iraq, trade sanctions, and a sharp fall in oil revenue in 1986 also contributed to foreign exchange shortages and a rise in the black market premium. The premium rose from

¹⁴ There was a list of 16 “essential” consumer items plus items for development projects and defence needs whose imports were eligible for foreign exchange allocation at the basic official exchange rate (70 rials per US dollar).

200-300% in the early 1980's to 500-600% by the mid 1980's and reached incredible rates of over 2000% by 1989 (Pesaran 1995).

The maintenance of a large gap between the official exchange rate and the black market rate, along with the control of imports, created vast opportunities for rent-seeking activities in which the system becomes subject to serious microeconomic as well as macroeconomic distortions (Pesaran 1992). From the macroeconomic point of view the high premium in the black market is reflected in import price and domestic inflation.¹⁵ The high levels of the premium also promote corruption, encourage capital transfers abroad, and lead to misallocation of resources from manufacturing to the trade and distribution sectors.

On March 27, 1993, the Iranian government introduced exchange rate reform by officially pegging the rial at US\$1 = IR 1538, an effective 95.6% devaluation from the average rate of US\$1 = IR 786.3 prior to March 21, 1993 (Farzin 1995). From April to September 1993 the two rates of foreign exchange (in the official and black markets) differed by less than 0.5%. Since late October 1993, however, the gap between the two rates began to widen and the trend continued so that one US dollar was transacted at about 3240 rials in mid January 1995 in the black market, while the floating (official) rate remained unchanged at a level of 1750 rials per US dollar since December 1993.

2.3.5 External Debt

In this section an attempt is made to illustrate developments in external debt during the post-revolutionary period. The large foreign debt in turn has created serious external financing difficulties for the government. Iran has been experiencing a severe external debt crisis, particularly after the revolution. Total external debt stocks, consisting of long-term debt as well as short-term debt, increased from a low value of about US\$ 3.9 billion in 1981 to a high value of US\$ 22.4 billion in 1994 (Table 2.4). The annual

¹⁵ An increase in the import price can increase the cost of domestically produced goods, which are highly dependent on imported inputs. This will lead to an increase in domestic prices.

average growth rate for total external debt was 18.44 percent over the 1980-1994 period. The Central Bank of Iran (CBI) has recently announced that Iran's total foreign debt, including relevant interest, at the end of September 22 1995, amounted to US\$30.6 billion.¹⁶

Despite military needs during the war (1980-88), the amount of external debt remained constant and the long-term debt decreased (see Table 4.2). Since then, however, the external debt has grown substantially. It registered an annual growth rate of 38.4 percent in 1990 and reached its peak of 59.7 percent in 1993. At the beginning most of the debt was short-term, but after 1993 borrowings were turned into long-term debt owed by the government or government guaranteed (Dadkhah 1996).¹⁷ The short-term debt, which is defined as a debt that has an original maturity of one year or less, increased to a peak of about US\$ billion in 1992. However the long term debt, which is defined as a debt that has an original maturity of more than one year, was lower amounting to about US\$ 1.7 billion in this same year.

Table 2.4 also indicates that from 4.8 percent in 1980, the total foreign debt as a percentage of GNP increased to more than 30 percent in 1993-94. The debt-to-exports ratio (total debt as a percentage of total exports) rose from 32 percent in 1980 to about 115 percent in 1994. The higher debt-to-exports ratio reveals Iran's economic condition, as an oil economy, is vulnerable to fluctuations in the international oil markets, causing far-reaching economic consequences. Furthermore, the debt service-to-exports ratio (debt service as a percentage of total exports) has increased to more than 21 percent (Table 4.2). In other words, the country has to spend one fifth of its foreign exchange earnings on servicing its external debt. Since oil is still dominant in Iran's exports, selling oil abroad is equivalent to selling its assets. To sell assets to service foreign debt would make sense only if the funds borrowed are used for productive projects.

¹⁶ Kayhan Havai, the International Weekly for Iranian Abroad, February 14, 1996 (Bahman 25, 1374) No. 1169, Iran.

¹⁷ In principle, a government guaranteed debt is an external obligation of the private sector that is guaranteed for repayment by the government.

Table 2.4: External debt stocks and growth rates, 1980-1993 (US\$ million, %).

<i>Year</i>	<i>Total Debt</i>	<i>Growth Rate %</i>	<i>Long-Term Debt</i>	<i>Public and Policy Guaranteed</i>	<i>Short-Term Debt</i>	<i>Total Debt as a % of GNP</i>	<i>Total Debt as a % of Exports</i>	<i>Debt Service as a % of Exports</i>
1980	4500	-	4500	4500	0	4.8	32.0	6.8
1981	3858	14.27	3790	3800	68	3.8	29.4	n.a.
1982	8236	113.48	3467	3467	4769	6.2	38.2	5.4
1983	7106	-13.72	2968	2968	4139	4.6	31.1	n.a.
1984	5160	-27.39	2457	2457	2703	3.2	28.6	n.a.
1985	6057	17.38	2390	2390	3667	3.2	40.5	4.1
1986	5827	-3.80	2413	2413	3414	2.7	74.9	7.3
1987	6144	5.44	2280	2280	3864	4.5	49.7	3.6
1988	5831	-5.09	2055	2055	3776	4.6	52.2	5.6
1989	6519	11.80	1862	1862	4657	5.3	47.0	3.3
1990	9021	38.38	1797	1797	7224	7.6	44.7	3.2
1991	11331	25.61	2065	2065	9266	9.4	58.0	4.1
1992	12867	13.56	1716	1716	11151	14.7	77.4	5.2
1993	20550	59.71	11666	11666	8884	32.6	121.0	9.3
1994	22300	8.52	16000	15600	7300	31.0	114.9	21.8

Sources: World Debt Tables (1994-1995), External Finance for Developing Countries, Volume 2, The World Bank, Washington, D.C., and Dadkhah, K.M. (1996), "Iran and the Global Financial Markets: Direct Foreign Investment versus International Borrowing", *Conference on Iran and the Emerging Global Order*, 28-31 March, 1996, Coventry University, Coventry.

2.4 Summary and Conclusions

In this chapter, an attempt has been made to explain developments in the Iranian economy over the period 1970-1993, broken down into two distinct phases: pre-revolutionary and post-revolutionary periods.

Over the pre-revolutionary period, as a result of rapid growth in oil exports, the economy grew at an average annual rate of about 8.2 percent, and was accompanied by an important jump in the inflation rate. The massive dependence on oil earnings and the injection of huge amounts of money into the economy expanded inflationary expectations and high consumption levels. In other words, there was a misallocation of oil revenues towards consumption rather than productive investment (Valadkhani 1995a). The contribution of the agricultural sector to GDP decreased during this period, while this contribution increased substantially after the 1978/79 revolution. The increasing share of oil income in the development budget, enabled the King's regime

(the previous government) to create an industrialisation program through imported technology financed by oil revenues.

Over the post-revolutionary period, the pace of economic growth slowed down considerably. In fact the economy only grew at an annual average rate of about 1.8 percent. The economy experienced higher rates of inflation, and increased budget and trade deficits and foreign debt. The black market exchange rate premium rose dramatically from the early 1980s and then reached phenomenal rates of over 2000 percent by the end of the 1980s. The most striking events such as the revolution of 1979, the eight-year war with Iraq and the oil crisis in 1986 happened during this period. The fluctuations in the level of foreign exchange receipts, as a result of these episodes, was a major factor for the sharp fall in capacity utilisation in the industrial sector. Although non-oil exports increased substantially during the 1980s, the most significant development arising from these exports was the emergence of the need for foreign exchange receipts, as the value of oil exports declined. The extreme collapse of the oil price and then exchange earnings after 1984 especially, led to sharp falls in imports and total expenditure. In recent years, however, the government has tried to stabilise the economy by reducing foreign exchange expenditure, increasing foreign exchange receipts by increasing non-oil exports and moderating public expenditures.

The main features of the Iranian economy have been described in this chapter, highlighting the underlying economic reasons behind the structural characteristics to be modelled (particularly for the foreign sector) in the forthcoming chapters.

CHAPTER THREE

3. LITERATURE SURVEY ON IMPORT DEMAND

3.1 Introduction

Much of the literature [e.g. Houthaker and Magee (1969), Goldstein and Khan (1976), Weisskoff (1979), Thursby and Thursby (1984), Bahmani-Oskooee (1986), and Bairam (1993)] has emphasised import demand determination, with a particular focus on the effect of prices and income on import demand. Some of these studies, such as Bahmani-Oskooee (1986), indicate that import demand can also respond to exchange rate changes. The sensitivity of imports to changes in income is important to a country's economic development and is of particular interest for predicting how imports will change over the business cycle. Moreover, price elasticities are also of concern because import demand will change over time in relation to changes in foreign prices, domestic prices, and exchange rates (Deyak, et al. 1993).

From the macroeconomic point of view, import demand can be modelled within the external sector of a macro-model. A knowledge of the external sector can assist us to realise the impact of economic variables on the import sector. Hence the main purpose of this chapter is to conduct an overview of the role of the external sector in macroeconomics, focusing in particular on the literature concerned with import demand. The chapter is organised as follows. Section 3.2 identifies the theoretical role of the external sector in the framework of a macroeconomic model. The macroeconomic effects arising from changes in both domestic and foreign prices and the exchange rate

on this sector will be examined in this section. Section 3.3 addresses the role of the external sector in economic growth, but more specifically the importance of imports in the development process. Section 3.4 is concerned with the structural form of the import demand function, and identifies the explanatory variables influencing import demand. Section 3.5 presents a functional form for imports derived from economic theory. Previous studies of import demand are reviewed in Section 3.6, while empirical results for Iran are analysed in Section 3.7. Finally Section 3.8 summarises the major conclusions derivable from this chapter.

3.2 The External Sector within the Framework of a Simple Macroeconomic Model

The purpose of this section is to identify the behavioural role of the external sector, and in particular imports, within the framework of a conventional macroeconomic model. The traditional macroeconomic analyses of open economies under flexible and fixed exchange rates are due to Mundell (1963) and Fleming (1962). The Mundell-Fleming model develops further the Keynesian IS-LM model for a closed economy, by incorporating relationships considered pertinent for the open economy (Gartner 1993). The model deals with a number of sectors, consisting of the goods, monetary, and external sectors. Following Gartner (1993), a simple Mundell-Fleming model would consist of the following equations:

Goods Market;

$$Y + IM = C + I + G + X \quad \text{goods market equilibrium (3.1)}$$

$$C = C(Y) \quad 0 < C_Y < 1 \quad \text{consumption (3.2)}$$

$$I = I(i) \quad I_i < 0 \quad \text{investment (3.3)}$$

By definition, equation (3.1) is the familiar equilibrium condition in which domestic national income (Y) plus imports (IM) is equal to planned expenditure on domestic goods including that of consumption (C), investment (I), government spending (G) and

exports (X). Behavioural equations (3.2) and (3.3) explain consumption which is related positively to income and investment which is related inversely to the nominal interest rate (i).

Monetary Sector

$$M^d / P_d = L(Y, i) \quad L_Y > 0, L_i < 0 \quad \text{money demand} \quad (3.4)$$

$$M^s / P_d = M^d / P_d = M / P_d \quad \text{money market equilibrium} \quad (3.5)$$

where M^d and M^s are respectively the demand for nominal money balances and the nominal money supply. P_d is the domestic price variable converting nominal money demand/supply into real values. Equation (3.4) postulates a behavioural function explaining the demand for real money balances, and identity (3.5) indicates equilibrium in the monetary sector.

External Sector

$$X = X(EP^* / P_d, Y^*) \quad X_{EP^*/P_d} > 0, X_{Y^*} > 0 \quad \text{demand for exports} \quad (3.6)$$

$$IM = IM(EP^* / P_d, Y) \quad IM_{EP^*/P_d} < 0, IM_Y > 0 \quad \text{demand for imports} \quad (3.7)$$

$$BP = CA + CP = 0 \quad \text{balance of payments} \quad (3.8)$$

$$CA = PX - EP^* IM \quad \text{current account} \quad (3.9)$$

$$CP = K[i - i^* - E(\dot{e})] \quad K_i = -K_{i^*} = -K_{E(e)} > 0 \quad \text{capital account} \quad (3.10)$$

Based on household choice theory, exports and imports depend on relative prices (EP^*/P_d) where E and P^* denote respectively the nominal exchange rate and the foreign price level. But the demand for exports and the demand for imports are affected directly by foreign real national income (Y^*) and domestic national real income (Y), respectively. Equations (3.8) and (3.9) show identities for the balance of payments (BP) and current account (CA), while equation (3.10) assumes a behavioural function which explains the capital account (CP). i^* and $E(\dot{e})$ in this equation denote the foreign interest rate and the expected exchange rate changes, respectively.

Substitution of equations (3.9) and (3.10) into equation (3.8), and using equations (3.6) and (3.7), yields the following equation (3.11) which defines the balance of payments equilibrium.

$$PX(EP^*/P, Y^*) - EP^*IM(EP^*/P, Y) + K[i - i^* - E(\dot{e})] = 0 \quad (3.11)$$

According to the Mundell-Fleming model with a flexible exchange rate, this also reflects equilibrium in the foreign exchange market. Gartner (1993) refers to this balance of payments equilibrium condition as the *FE* schedule. This schedule possesses a positive slope in the i/Y plane as follows:

$$\frac{\partial i}{\partial Y} = -\frac{-EP^*IM_Y}{CK_i} > 0 \quad (3.12)$$

3.2.1 The Impact of Prices on Trade Flows

As mentioned, the demand for imports depends inversely on the relative prices of foreign and domestic goods. The relative prices of foreign goods and domestic goods indicates the so-called terms of trade, $TOT = EP^*/P$, the number of units of domestic goods which have to be given up to obtain one unit of the foreign good. But exports depend positively on the relative prices of foreign to domestic goods (plus foreign income). Thus imports and exports can be re-specified as a function of the terms of trade:

$$IM = IM(TOT, Y), \quad \Delta IM / \Delta TOT < 0 \quad (3.13)$$

and

$$X = X(TOT, Y^*), \quad \Delta X / \Delta TOT > 0 \quad (3.14)$$

The traditional aspect of the relationship between the terms of trade and the external balance is on the basis of the HLM (Harberger 1950, Laursen and Metzler 1950) hypothesis.¹⁸ The HLM effect implies that the current account will deteriorate

¹⁸ According to the HLM hypothesis, an improvement in the terms of trade leads to a rise in the country's real income level, on the assumption that the marginal propensity to consume is less than one ($MPC < 1$), a rise in saving improves the current account. (Ostry and Reinhart 1992).

(improve) in response to a terms of trade deterioration (improvement). The total effect of a change in the terms of trade on the trade balance can be separated into a direct effect, in which the real exchange rate is constant, and an indirect effect in which the real exchange rate changes through the shock to the terms of trade (Ostry 1988). When a deterioration in the terms of trade occurs, the trade balance worsens and is accompanied by a real depreciation of the exchange rate. The trade balance improves when the terms of trade improves, and is accompanied by a real appreciation of the exchange rate. Hence the direct effect is assumed to outweigh the indirect effect. For the case of developing countries, Cuddington and Urzua (1989) and Mendoza (1992) have found that 60 percent of all shocks to commodity prices produce temporary changes in the terms of trade.

Based on the literature of international economics, the short-run and long-run effects of relative price changes on the trade balance can be different. Junz and Rhomberg (1973), Krueger (1983) and Cha (1993) find that the relationship between the trade balance and the terms of trade depends critically on the source of the fluctuations. Moreover, Sen and Turnovsky (1989) claim that the HLM effect depends on the assumptions and specifications of the model for a small economy. If the rate of time preference, for example, depends upon utility, a deterioration in the terms of trade leads to more saving and to an improvement in the current account.

In general, a rise in foreign income (Y^*) increases exports which leads to an improvement in the trade balance and therefore aggregate demand rises. A rise in domestic income (Y) also raises import spending and hence deteriorates the trade balance.¹⁹ If the price of one unit of foreign currency is defined in terms of the number of units of domestic currency, an increase in the exchange rate (E), will raise the domestic price of foreign goods at a given foreign price level thereby tending to reduce imports (Branson 1989). Thus a real depreciation of the home currency can decrease

¹⁹ The change in import demand caused by a change in income is in fact called the *marginal propensity to import*. According to Dornbusch and Fischer (1994), when a part of income is spent on imports the *IS* curve will be steeper than that in a closed economy.

spending on imported goods and increase exports, which improves the trade balance and therefore raises aggregate demand. In addition, in the open economy domestic policy changes can affect developments abroad, which then feed back on to the home economy. For example, an increase in government spending (G) increases income and in turn imports increase. Increasing imports will raise foreign income, too. This in turn increases foreign demand for home goods, causing domestic income to expand further. These effects are the so-called ‘repercussion effects’, and in the words of Dornbusch and Fischer (1994):

“These repercussion effects can be important in practice. When the United States expands, it tends, like a locomotive, to pull the rest of the world into an expansion. Likewise, when the rest of the world expands we share in that expansion because the market for our exports expands.” (Dornbusch and Fischer (1994), page 163)

3.2.2 The Effect of the Exchange Rate Devaluation on the Trade Balance

One of the most important issues arising from a study of the external sector is the effect of a nominal or real exchange rate change on the trade balance. A devaluation (of a fixed exchange rate) improves the balance of trade and positively influences the growth rate, depending on the existence of available capacity in an economy, and will worsen the internal disequilibrium in a situation of limited capacities. A devaluation also deteriorates the terms of trade and increases directly the domestic price level. Accordingly, a devaluation should lead to an increase in domestic demand because it switches demand away from imports to domestic goods (Gotz-Kozeierkiewicz 1991).

Since a devaluation makes exported goods cheaper abroad, that is, $X_E = \partial X / \partial E > 0$, and decreases the demand for imports, $IM_E = \partial IM / \partial E < 0$, *Ceteris paribus*, the current account improves. This indicates the familiar Marshall-Lerner (M-L) condition under which a devaluation improves the trade balance. Applying (3.11), and using a little algebra, we derive the equation of the Marshall-Lerner condition as follows:

$$|\eta_{X,E}| + |\eta_{IM,E}| > 1 \quad (3.15)$$

where $\eta_{X,E} [(\partial X / \partial E) / (X / E) > 0]$ and $\eta_{IM,E} [(\partial IM / \partial E) / (IM / E) < 0]$ denote the elasticities of exports and imports with respect to the nominal exchange rate, respectively. This condition is derived under the assumption that the supply of domestic and foreign goods is infinitely elastic in small countries.

According to Gartner (1993), the M-L condition holds only in the long-run. This arises from the J-curve effect, in which a devaluation worsens the current account before the effects stressed by the M-L condition become strong enough to improve the current account. He describes the J-curve effect by differentiating the current account equation [equation (3.9)] with respect to the exchange rate, while keeping the foreign price level fixed.²⁰

$$\frac{\partial CA}{\partial E} = P_d X_E + P_E X - EP^* IM_E - P^* IM \quad (3.16)$$

Immediately after the devaluation, the current account deteriorates.²¹ The reason is that the devaluing country has to pay more domestic currency for imports, which are fixed in volume and in foreign currency. However, the current account is expected to improve after several years have passed, when import and export volumes have changed in response to the new relative prices.

However, devaluation effects on the trade balance are more complex to evaluate compared with changes in domestic incomes and prices. Dornbusch and Fischer (1994) have attempted to model the responsiveness of import prices to exchange rate changes. Dornbusch (1987) finds that the sensitivity of import prices to exchange rates depends positively on the ratio of the number of foreign firms to total firms. Fischer (1987) analyses a market where if there is no home production and firms are price takers, there will be a one-for-one response of import prices to exchange rates. If firms are not price takers the response may be greater than or less than unity. Sibert (1992) analyses the response of import prices, volumes and values to exchange rate changes. According to

²⁰ Since the Mundell-Fleming model considers both domestic and foreign prices as exogenous variables.

²¹ Based on equation (3.16) the current account worsens by $P^* IM$, since $X_E = P_E = IM_E = 0$.

him, if there is no home production a devaluation reduces the value of imports if and only if the demand curve is elastic. This is because the revenues of foreign firms decrease. Sibert (1992) concludes that regardless of firm behaviour, or the relative size of the external sector, a devaluation also decreases the volume of imports.

3.2.2.1 The Importance of Black Markets in Developing Countries

The existence of black market exchange rates is common knowledge in developing countries. In many countries black markets have often developed in which foreign exchange trades at a higher local currency price than in the official market, and this black market exchange rate may be as important a determinant of import costs as the official rate (Kamin 1990). Illegal imports and capital flight are the sources of demand in the black market. Currency substitution is an additional basis of demand in the black market. However, the market is illegal in that the dealers are not allowed to trade in foreign exchange and the participants are not allowed to hold foreign exchange. More specifically, the black market, as the parallel market, has an intermediate position of legality in that it is illegal but also, noticeably, publicly and officially tolerated (Dornbusch, et al. 1983). The black (parallel) market premium is the amount by which the black (parallel) market exchange rate exceeds the official rate.²² In periods that there is uncertainty about macroeconomic policies or political and social conditions are unstable, this premium tends to react quickly to expected future changes in economic situations (Agenor 1992).

Several authors have analysed how international trade, in violation of exchange or trade restrictions, can give rise to black markets for foreign exchange. Sheikh (1976), Braga de Macedo (1982), Dornbusch (1983), and Nowak (1984) have modelled black markets for foreign exchange in the tradition of asset market models of exchange rate determination. Huizinga (1991) indicates that risk aversion as a rationale for the coexistence of legal and illegal trading provides a basis for distinguishing between

²² The expressions 'parallel' and 'black' markets have been used interchangeably in the literature (Agenor 1992).

illegal international trade and trading on the black market for foreign exchange. For Brazil he also shows empirically that there have been large variations in the number of people charged with import violations, and that these numbers are negatively correlated to changes in the black market exchange rate premium. He presents some evidence on the relationship between law enforcement, as measured by the number of people charged with import violations, and the black market premium. The evidence confirms that there is a negative relationship between enforcement and changes in the premium.

According to Kamin (1990), a devaluation of the official exchange rate will result in a smaller depreciation of the black market rate, indicating that average import costs will rise by less than they would in a non-black market economy. In addition, any shock in the black market may have important effects on the domestic money market, on the balance of payments, and on the current account. Kaminsky (1987) finds that since the existence of a black market exchange rate may affect the consumption-based real interest rate and the level of real disposable income, it may modify the equilibrium consumption profile as well as the trade balance.

Giddy (1978) points out that changes in the black market rate reflect changes in fundamental economic and political conditions and expectations. The presence of the black market helps the development process by reducing the transactions cost of obtaining foreign currency. But black market transactions impose a drain on valuable and scarce international reserves by aiding capital flight. According to Dowla (1995), this market provides an extra channel to satisfy unfulfilled demand for foreign currency in the official market.

Several factors are responsible for the emergence of a black market for foreign exchange. In the literature some of them are; overvaluation of the domestic currency, foreign exchange control, capital controls, and trade restrictions (Agenor 1992). Developing countries face serious balance of payments, international reserves, and external debt problems. These problems have led governments to stiffen trade

restrictions and foreign exchange controls. These policy responses have encouraged existing excess demand for foreign currency to be satisfied in the black market. In fact, one effect is that private agents prefer to hold foreign currency because existing inflation decreases the attractiveness of holding domestic currency, expanding further the black market for foreign exchange. Hence, in economies with a black market for foreign exchange, the rate can play an important role in the allocation of resources and also affect the level of foreign reserves and the distribution of income. (Dowla 1995). Consequently, an examination of the black market rate effect on such economies is an interesting and important issue.

The emergence of black markets in general and the currency black market in particular, is the consequence of official control of free market operations. In the case of the exchange rate, an additional factor, which is a government's perception of the currency's prestige, is also important (Biswas and Nandi 1986). For example, the political stability of many governments in developing countries is often in danger when the government decides to devalue its currency, even when such a decision is economically correct.

Overall, there are various policy problems such as exchange restrictions, nominal devaluations, and the unification of the exchange market available to control the black market premium. However, evidence from the imposition of exchange restrictions suggests that controls have not been effective in practice (Agenor 1992). Rationing creates shortages of imported goods and shortages encourage smuggling. Instead of increasing reserves, official controls may succeed only in diverting a substantial part of the available foreign exchange to illegal use. Further, the rationing of foreign exchange may have a negative effect on output, including that of export-oriented goods, and employment.

When the difference between the black market exchange rate and the official exchange rate becomes too large, the central bank usually devalues the official exchange rate.

Such devaluations bring the official rate closer to the black market rate. The view that a devaluation of the official exchange rate may reduce the level of the premium is a current issue. A model developed by Dornbusch et al. (1983) for Brazil explains how an expectation of a future official devaluation leads to an immediate depreciation in the black market rate and subsequent fall in the premium when the expected official depreciation actually occurs. Furthermore, in 1990, the authorities in Guyana devalued the domestic currency by 36% relative to the US dollar, and announced that a series of devaluations would take place in 1991 until the official and parallel market rates for the currency were equal. In 1989, the Argentine government announced it would reduce the 54% premium in the parallel market through fiscal reforms, rather than devaluation.

According to Agenor (1992), under a fixed rate regime the long-run effect of an official devaluation on the black market rate is ambiguous because the effect depends on the transaction reaction to changes in the premium, the rationing scheme imposed by the central bank, and the elasticity of exports with respect to changes in relative prices. The Bolivian experience in the early 1980s is another example of the role of devaluation in which its effect on the premium is not clear (Kharas and Pinto 1989). The official devaluation reached 350% in the last quarter of 1984 and 455% in the first quarter of 1985. The premium fell at first, but it rose again, resulting in inflation in 1985. These episodes show that targeting the premium by exchange rate policy alone can be costly.

3.3 The Significance of Imports to Economic Development

In the literature, there is debate over whether growth leads trade or trade causes growth (Hanink 1994). Ram (1985) indicates that exports play an important role in the growth process, whereas Sato (1977) provides evidence that exports can grow only if led by a growing domestic economy. The more general view is that trade is the engine of growth (Hanink 1994). For instance, for the case of Iran, Metwally and Tamaschke (1980) give evidence that investment is extremely sensitive to the growth in oil exports during the period 1960-1975. Primarily, the theory of comparative advantage indicates the benefits

of free trade. Besides more benefits in consumption and production, additional gains can be obtained by technology transfers through importing, more particularly through foreign direct investment. Krugman (1990) describes technology transfer as a process in which less developed countries (LDC) develop domestic technologies by copying such technology, which is involved in their imports from developed countries.

Fishlow (1994) stresses how imports register as a significant variable in assessing growth, and not exports alone. In fact, imports are worthy of greater weight as an independent factor in explaining growth performance. They provide a regular supply of needed capital inputs as well as of essential intermediate products. Fishlow (1994) provides evidence from Latin America in which a rapid and drastic decrease in imports contributed to the slowdown in productive activity in the 1980s. Hentschel (1992) also indicates that imports of capital goods play a major role in the installation of machinery for twelve developing countries. In fact, the sharp import declines in the 1982-84 period led to a drop in domestic production in all of these countries. No country was able to raise the domestic production of investment goods.²³

However, the way in which countries emphasise import management is important. In this regard, Korea and Taiwan have controlled and limited imports that were not essential to subsequent exports. On the contrary Latin America has not been successful in managing imports, resulting in a small effect upon development (Fishlow 1994).

Briefly, imports can improve the domestic economy in several ways. First, competitive imports require domestic products to become more efficient and also to be more competitive in both cost and quality than if the economy was closed. Second, by importing intermediate and capital goods which are sometimes not available domestically, the economy can produce a wider variety of finished goods for both domestic consumption and export. According to Hanink (1994), "it takes imports to make exports".

²³ These developing countries are Argentina, Brazil, Chile, Columbia, Ecuador, Indonesia, Malaysia, Mexico, Peru, Philippines, Uruguay, and Venezuela.

In practice, developing countries adopting an *export promotion* strategy have not only achieved a rapid growth of traditional exports but also a more rapid growth of non-traditional exports (Krueger 1980). It is practically impossible to conduct any highly protective system for intermediate and capital imports if an export-oriented trade strategy is to be followed successfully, and exporters are expected to compete in international markets. The imposition of any system of controls or licensing produces obstacles which are inconsistent with the export strategy (Krueger 1980).

In general the majority of developing countries studied by Hentschel (1992), as mentioned earlier, relied heavily on imported capital goods in total capital formation, and produced only a limited range of products compared to developed countries. Ikemoto (1986) also studied the source of economic growth in some Asian countries from 1970 to 1980. He investigated the contribution of labour, domestic capital inputs, and capital imports, and concluded that imported capital goods had a positive effect on growth independent of domestic capital inputs. However, according to Hentschel (1992), the role of imports in the supply of capital and intermediate goods is different among countries. This can reflect the size of the economies, natural resource endowments, and the development strategy adopted.

Itsumi and Moriguchi (1978) and Schiavo-Compo (1980) consider imports and domestic inputs (capital and labour) as perfectly complementary in production. They introduce production functions in which capital and labour can be substituted for each other, while imports are complementary to them. Bardhan and Lewis (1970) also discuss how in the growth process there is limited substitutability between imports and domestic inputs. The important feature of the perfectly complementary models is that the domestic rate of growth depends on the outside world, where export growth and the availability of foreign exchange are determined. Itsumi and Moriguchi (1978) show that the long-run growth of the economy is determined by the relationship between the growth of the labour force and the growth of world demand which determines exports.

3.3.1 An Empirical Example of the Importance of Imports

Chopra and Montiel (1986) formulate a simple classical model for a small and open developing economy, the Philippines. Their model is a simple adaptation of the Mundell-Fleming framework with imported intermediate goods, limited capital goods, and foreign exchange rationing.

Assuming that imports consist only of imports of intermediate goods, Chopra and Montiel (1986) define the short-run production function for domestic output as follows:

$$y = a_0 + a_1 n + a_2 im + a_3 t + u_1 \quad (3.17)$$

where y is the log of domestic real output, n is the log of employment, im denotes the log of real intermediate imports, t stands for a time trend, and u_1 is an error term. Solving for the labour market, they derive the aggregate supply curve for domestic output (y^s) which is given by

$$y^s = b_0 + b_1(p - p^e) + b_2 im + b_3 t + u_2 \quad (3.18)$$

where p and p^e are the log of the price level and the expected price level, respectively. On the demand side of the economy, they assume that exportable and importable goods are imperfect substitutes, and thus the world demand for domestic output is, according to the Mundell-Fleming model, a function of relative prices, the real money supply, and foreign real income. Hence the aggregate demand relationship (y^d) is as follows:

$$y^d = c_0 + c_1(p^* - p) + c_2(m - p) + b_3 y^* + u_3 \quad (3.19)$$

where p^* is the log of the foreign price level, m is the log of the money supply, and y^* denotes the log of foreign real income. Chopra and Montiel (1986) derive and estimate a Barro-type reduced form equation for domestic real output from the structural model, in which markets clear continuously and expectations are rational.

Both anticipated and unanticipated changes in the availability of imported intermediate goods affect real output, because, as Chopra and Montiel (1986) show, this variable

operates through the supply side of the economy. They find that an increase in intermediate imports leads to an increase in output and an improvement in the economy's competitiveness. Such an increase in imports reduces the domestic price level, causing an improvement in domestic competitiveness and a rise in the real money supply.

3.4 The Structure of Import Demand

As previously discussed, because of the role of trade in economic development, the estimation of import or export functions for various countries or commodity groups has received a great deal of attention in the empirical literature on international trade. The usual view is that the quantity of imports is determined by domestic demand conditions, while the quantity of exports is determined by foreign demand conditions (Kohli 1978). However, Metwally and Tamaschke (1980) have specified a simultaneous equation model for some of the oil-exporting countries in which exports can be determined by domestic demand for imports and export prices. Hereafter we focus only on the structural form of import demand existing in the literature.

3.4.1 Key Variables in the General Functional Form

Price and Income Effect

The structural model of imported goods is determined by the interplay of demand and supply forces, both at home and abroad. But the conventional empirical relationship determines imports through a demand function with prices and a variety of activity variables, such as income and expenditure, as the explanatory variables (Petoussis 1981). Traditional studies assume that imports depend upon the price of imports in domestic currency, the price of domestically produced substitutes, as well as income (Murray and Ginman 1976).

A number of authors such as Leamer and Stern (1970) and Goldstein and Khan (1985) have applied the following equation as the general form of an import function:

$$IM = IM(P, Y) \quad (3.20)$$

where IM is the quantity of imports, P is the ratio of the import price index to the domestic price index and Y is real income. Traditionally, as previously discussed, the aggregate import demand equation relates inversely the quantity of imports to relative prices ($\partial IM / \partial P < 0$), *ceterus paribus*, and positively to domestic real income ($\partial IM / \partial Y > 0$).

Import Elasticities

The price elasticity of demand for imports ($\eta_{IM,P}$) refers to the ratio of the percentage change in the quantity of imports (IM) with respect to the percentage change in relative prices (P), and the income elasticity of demand for imports ($\eta_{IM,Y}$) is defined as the ratio of the percentage change in the quantity of imports to the percentage change in income (Y). The formulas used are:

$$\begin{aligned} \eta_{IM,P} &= (\partial IM / \partial P) / (P / IM) \\ &= \partial \ln IM / \partial \ln P \end{aligned} \quad (3.21)$$

and

$$\begin{aligned} \eta_{IM,Y} &= (\partial IM / \partial Y) / (Y / IM) \\ &= \partial \ln IM / \partial \ln Y \end{aligned} \quad (3.22)$$

The expected sign of the price elasticity of demand for imports is theoretically negative. If the price elasticity, for example, is low (less than $|1|$), changes in price will be associated with lower changes in the demand for imports. A low price elasticity has some obvious consequences for economic policy. It can make a selective tax, or even tariff, on imported goods a more efficient way of improving the external balance than general export subsidies or indeed devaluation of the currency (Ethier 1988).

If the income elasticity of demand for imports is greater (less) than unity (in absolute value); moderate changes in per capita income will result in larger (smaller) changes in the demand for imports. Its expected sign in the framework of an import model is positive. Because of potential problems with the balance of payments, the practical and

theoretical role of the income elasticity is important in an economy. According to Houthakker and Magee (1969), the direction of the trade balance over time depends on a country's income elasticity of demand for imports and on the rest of the world's income elasticity of demand for each country's exports.

Murray and Ginman (1976) estimate the price and income elasticity coefficients of a traditional aggregate import function, in which these elasticities are constant over the sample range. The specification of this import function is:

$$IM = \beta_0 P^{\beta_1} Y^{\beta_2} e^u \quad (3.23)$$

where e denotes the base of the natural logarithm, β_0 is the constant intercept term, β_1 and β_2 stand for the price and income elasticity coefficients, and u is the stochastic disturbance term. The equation is linearised for estimation by taking the natural logarithm as indicated below:

$$\ln IM = \beta_0 + \beta_1 \ln P + \beta_2 \ln Y + u \quad (3.24)$$

The use of the relative price index ($P = P_m / P_d$) instead of the import price index (P_m) eases estimation problems. In other words, it reduces multicollinearity between these prices.

Marquez (1994) argues that since an elasticity is a ratio between a marginal propensity and an expenditure share, treating the parameters of equation (3.24) as autonomous implies that the propensities and shares are fixed or their changes are offsetting. For instance, the income elasticity ($\beta_2 = \eta_{IM,Y}$) given by this equation is equal to $(\partial IM / \partial Y) / (Y / IM)$ where the numerator is the marginal propensity ($\partial IM / \partial Y$) and the denominator is the expenditure share (Y / IM). If these shares change through time, β_2 (assumed constant) needs to compensate changes in $\partial IM / \partial Y$, a response with no theoretical basis. Moreover, if the parameters of equation (3.24) are constant and individuals optimise their spending decisions subject to a linear budget constraint, these parameters may be: $\beta_1 = -1$, $\beta_2 = 1$, making econometric restrictions. To overcome these

problems, Marquez (1994) makes assumptions in which consumers substitute between domestic and external products, and parameter estimates recognise the interdependence between spending and pricing decisions.

Demand curves are generally homogeneous of degree zero in money income and prices. To test for homogeneity, Murray and Ginman (1976) enter in their model money income (Ym) rather than real income (Y) and a set of prices including the import price index (P_m), the domestic price index (P_d), and the domestic price index of non-traded goods (P_n) rather than relative prices (P). The reason for the choice of the non-traded price is that consumers are likely to change the allocation of their spending between traded and non-traded goods when there are different money income elasticities over time. According to Murray and Ginman (1976) the test for the homogeneity of degree zero in the following equation implies that $\sum_{i=1}^4 \alpha_i = 0$:

$$\begin{aligned} \ln IM &= IM(Ym, P_m, P_d, P_n) \\ &= \alpha_0 + \alpha_1 \ln Ym + \alpha_2 \ln P_m + \alpha_3 \ln P_d + \alpha_4 \ln P_n \end{aligned} \quad (3.25)$$

To test for homogeneity, they examine equation (3.25) by considering the presence of money illusion in the results. However, the estimated results lead them to reject the homogeneity assumption. In fact they find no necessity of specifying an important demand equation which is restricted by the homogeneity postulate.

3.4.2 Other Explanatory Variables in the Import Function

In the literature of import demand most authors such as Houthakker and Magee (1969), Khan (1974) Murray and Ginman (1976), Weisskoff (1979), Petoussis (1981), Dixon et al. (1984), Goldstein and Khan (1985), Marquez (1989), McCombine (1992), and Bairam (1993) have generally focused on real income as an activity variable and relative prices. Apart from these two major explanatory variables some authors have developed their models by emphasising particular variables to assess their effects on import flows

of both developed and developing countries. A number of variables, for instance, incorporated in import demand functions, and considered to be crucial are as follows:

- (a) Real exchange rate (ER) is included by Petoussis (1981), Dixon, et al. (1984), Bahmani-Oskooee (1986), Tegene (1989), and Haque, et al. (1991)
- (b) Potential income (Y^p) is included by Petoussis (1981) and Marquez (1989).
- (c) Real money supply (m), foreign reserves (Fr), and foreign debt (Fd), are included by Petoussis (1981) and Haque, et al. (1991).
- (d) World Income (Y_w) is included by Bairam (1993).
- (e) Export price of the country's trading partner (P_{xp}) is included by Marquez (1989)

According to Hentschel (1992) a number of developing countries are not able to finance desired imports because the availability of foreign exchange is restricted and export revenues cannot easily rise to reduce the foreign exchange shortage. With respect to this fact, the traditional import demand function which relates imports to relative price and income works well for developed economies. However, it has not always been useful in explaining the demand for imports of developing economies (Moran 1989). If the desired demand for imports at the world price is not compatible with the level of foreign reserves, the government limits imports in order to ensure that available foreign exchange equals its demand.²⁴ Hence, this suggests that a foreign exchange variable could be involved in the import demand function. Accordingly, Tegene (1989) finds that exchange rates play an important role in the determination of imports of developing countries. He suggests that exchange rates have in general adverse effects in the short-run, and improve the balance of trade in the long-run.

²⁴ For the case of Iran, see Chapter Two.

3.4.3 Aggregation and Disaggregation

Imports are usually modelled in both aggregate and disaggregate forms. At the aggregate level, estimates of the response of imports to price changes are important for policy realignments which affect income and employment. A knowledge of import elasticities at the aggregate level is significant for setting policies on tariffs, subsidies, indirect taxes, and currency depreciation (Apostolakis 1990). Equations (3.24) and (3.25) describe the demand for aggregate imports and do not distinguish between different product classes. Goldstein and Khan (1985) argue that if the effect of the determining variables is the same between aggregate and disaggregate imports, one can be indifferent between the aggregate and disaggregate equations.

For the use of models over time periods there are both advantages and disadvantages of aggregation and disaggregation. In the case of aggregate advantages, one is the ability to handle and understand simple aggregate models. From the estimation point of view, some random or specification errors may be removed in the aggregation. Referring to disadvantages, aggregate models face the usual statistical problems in which parameters are less stable and there may be simultaneity problems between variables (Ysander 1986). This may lead to an aggregation bias in estimating behavioural reactions. As a result of the aggregation bias, the interpretation of the elasticities is not certain and the relations in such models are unstable in the long-run.

3.5 Alternative Ways to Derive Import Demand Functions

Equations such as $IM = IM(P_m, P_d, Y)$ are defined as standard import demand functions and are widely used in empirical work. According to Burgess (1974a), while the traditional forms have the advantage that the parameters measure the price and income elasticities of demand, they are not derivable from a trade model of optimal behaviour. Although trade theories cannot be implemented empirically, the import equations can be derived from consumer theory or production theory if imports are viewed as imperfect substitutes for a domestic good or factor. To emphasise more, Kohli (1991) argues that

“Even if the consumer model or the producer model is made explicit, there is almost never a trade theory to speak of that is brought into the picture.” (Kohli 1991, p. 8).

The majority of world trade is in raw materials and intermediate products which go through a number of domestic (imports) or foreign (exports) channels to meet final demand. Depending on whether traded goods are intermediate goods or finished products, there are a number of approaches by which demand for imports can be derived.

3.5.1 Profit Maximisation

Following Kohli's approach, it is assumed that a large number of competitive firms make their own import and product decisions on the basis of maximising profit. Given a vector of input and output prices, they employ a composite of input and output levels subject to a constant-returns-to-scale technology under these assumptions, the issue is to optimise an aggregate maximisation problem as follows:

$$\max \pi_{IM, Y_g}(P_m, P_{Y_g}, V) = P_{Y_g} Y_g - P_m IM \quad (3.26)$$

where Y_g stands for gross product that is a function of inputs including imports (IM) and the domestic composite factor (V), that is, $Y_g = f(IM, V)$. P_m and P_{Y_g} denote import prices and the price of gross product, respectively. Regarding Hotelling's Lemma, differentiating the profit function (3.26) with respect to the prices of imports and gross product concludes the demand for imports and the supply of gross products:

$$IM = -\partial \pi(P_m, P_{Y_g}, V) / \partial P_m = IM(P_m, P_{Y_g}, V) \quad (3.27)$$

and

$$Y_g = \partial \pi(P_m, P_{Y_g}, V) / \partial P_{Y_g} = Y_g(P_m, P_{Y_g}, V) \quad (3.28)$$

The strict quasi-concavity of the production function, $f(\cdot)$, guarantees that IM is decreasing in P_m , and that Y_g is increasing in P_{Y_g} . Moreover, both are homogenous of degree zero in prices, and linearly homogenous in V (Kohli 1991).

3.5.2 Cost Minimisation

The second approach implies the minimisation of aggregate cost, by which an aggregate cost function can be minimised subject to the aggregate production function (Burgess 1974b). The procedure can be represented as follows:

$$\min C = P_m IM + P_v V \quad (3.29)$$

subject to

$$f(IM, V) = Y_g \quad (3.30)$$

where C is increasing, linearly homogenous and concave in input prices (P_v), and linearly homogenous in Y . Applying a Lagrangian function that is differentiated with respect to IM (quantity of imports) and V (inputs), the optimum demands for imports and the domestic factor are obtained:

$$IM = IM(P_m, P_v, Y_g) = \partial C / \partial P_m \quad (3.31)$$

and

$$V = V(P_m, P_v, Y_g) = \partial C / \partial P_v \quad (3.32)$$

The strict quasi-concavity of $f(\cdot)$ implies that IM and V are decreasing in P_m and P_v , respectively. Moreover, the two demand functions are homogenous of degree zero in prices, and homogenous of degree one in Y .

An implication is that since imports are considered as a composite of finished and intermediate goods, they are processed domestically with a modified final price. Under this specification, therefore, cost minimising produces a specified bundle of goods that are purchased domestically or abroad. A change in the price of one input will result in changing demands for other inputs including imports.

3.5.3 Utility Maximisation

Another approach is to construct a theory of import demand from microeconomic foundations. Imports as final goods and services enter directly into consumers' utility functions and for which there are no perfect domestic substitutes. Gregory (1971) employs a C.E.S. functional form that relies on society's preferences. Finally, he derives a logarithmic form of the ratio of imported goods to the domestically produced goods that is a log-linear function of the ratio of prices. This specification of import demand yields an estimate of the elasticity of substitution between imports and domestic goods from which the elasticity of the import price can also be estimated.

Following Gregory's approach, as a practical problem, the utility function which relates domestically produced goods to imports is maximised subject to the budget constraint:

$$\max U(Y_d, IM) = [\alpha(Y_d)^{-\rho} + \beta(IM)^{-\rho}]^{1-\rho}, \alpha, \beta > 0, -1 < \rho < \infty \quad (3.33)$$

subject to

$$P_d Y_d + P_m IM = I \quad (3.34)$$

where Y_d , IM , P_d and P_m denote domestically produced goods, imported goods, domestic prices and import prices, respectively. The necessary condition for a solution to this problem is given by the equality of the marginal utility ratio with the ratio of prices. Based on this condition, in practice, the ratio of imports to domestic goods depends upon a price ratio such as that shown in (3.35):

$$\frac{IM}{Y_d} = \left(\frac{\beta}{\alpha} \right)^{\sigma} \left(\frac{P_d}{P_m} \right)^{\sigma} \quad (3.35)$$

where σ stands for constant elasticity of substitution ($\sigma = \frac{1}{1+\rho}$).²⁵ After a little algebra, the import function can be specified in a log-linear form:

$$\ln IM = a_0 + a_1 \ln \left(\frac{P_m}{P_d} \right) + \ln Y_d \quad (3.36)$$

²⁵ A detailed algebra to the utility maximisation is given in Appendix A.

or

$$IM = IM\left(\frac{P_m}{P_d}, Y_d\right) \quad (3.37)$$

However, Burgess (1974a) argues that due to Gregory's approach the hypothesis of separability between imports and all types of domestic goods has been maintained. Moreover, it fails to recognise that the bulk of goods in the trade flow are intermediate goods. Furthermore, the elasticity of the activity variable (Y_d) is determined to be unity. Nonetheless, in most import equations, the estimates of activity elasticities are significantly greater or smaller than one, leading to a misspecification, or the omission, of appropriate explanatory variables.

3.6 Previous Empirical Studies of Import Demand

Houthakker and Magee (1969) have developed the well-known models (in the literature) of import demand as well as export supply. They have estimated the following equation of total imports in a simple form:

$$\log IM_t = a_1 + a_2 \log Y_t + a_3 \log(PM_t / WPD_t) + u_t \quad (3.38)$$

where IM_t is the country's imports during year t , Y_t is the value of GDP, PM_t is a price index of imports, WPD_t is the country's wholesale price index, and u_t is an error term.

The export equation is formally similar to the import equation:

$$\log EX_t = b_1 + b_2 \log YW_t + b_3 (PEX_t / PXW_t) + v_t \quad (3.39)$$

where EX_t is the country's exports to all other countries during year t , YW_t is the GNP of importing countries, PEX_t is the export price index, and PXW_t is the index of the world export price. For the specification of the equation of the country's imports by origin, Houthakker and Magee (1969) apply income and two relative price variables to bring out competition among exporters to the economy. They have used the following import equation:

$$\begin{aligned} \log IM_t = & a'_1 + a'_2 \log Y_t + a'_3 \log(PM_t / WPD_t) \\ & + a'_4 \log(PEX_t^j / PM_t) + u'_t \end{aligned} \quad (3.40)$$

where PEX_t^j denotes the price index of country j 's exports. The following equation is also defined as the country's export equation to country j :

$$\log EX_t = b'_1 + b'_2 \log YW_t + b'_3 (PEX_t^j / PM_t) + v'_t \quad (3.41)$$

Having estimated these equations for many countries (both developed and developing countries), Houthakker and Magee (1969) conclude that the regression coefficients of income are significant and their numerical magnitudes are often between one and two.²⁶ However, they have obtained poor results in the estimation of price elasticities. Their results indicate that for a number of important countries the sum of the import and export price elasticities appears to be greater than one in absolute terms, as required for balance of trade stability (Marshall-Lerner Condition). Finally, they show that if all countries grow and inflate at the same rate, the trade balance of some countries would still be subject to secular improvement or deterioration because of disparities in income elasticities of demand for imports.

Since Houthakker and Magee (1969) have used only ordinary least squares methods, Murray and Ginman (1976) argue that their results may accordingly be subject to some bias. A bias could result from simultaneity between the quantity of imports and one or both of the explanatory variables. Khan (1974) and Khan and Ross (1977) have obtained some empirical evidence on the question of simultaneity, in which the simultaneous relationship between imports and the price of imports may produce biased estimates of the coefficients. Furthermore, the use of unit values in the price specification sometimes has led to estimation problems. Kemp (1962) and Kakwani (1972) indicate that OLS estimators of import demand elasticities based on unit values are biased and inconsistent. However, Shiels (1991) obtains consistent estimates of import-demand

²⁶ See Table 3.1 and Table 3.2.

parameters by using instruments (the import price index) instead of unit-value indexes.²⁷

3.6.1 Application of Import Functions to Developed Countries

Table 3.1 summarises the previous studies of the import demand functions for developed countries. As the table shows, some of these studies use a model specification that enables identification of both the long-run and short-run estimated elasticities of the income and relative price elasticities. In addition, most studies specify the price variable as a relative price ratio that implies an assumption of homogeneity in prices. Some studies do not impose such homogeneity and instead estimate separately import prices and domestic prices. Estimated elasticities of income vary widely from 0.71 to 2.07, while the estimated elasticities of relative prices ranges from -0.03 to -1.46 with the expected sign. The disparity in the estimation results could be due to many reasons, such as different specific time series data used to estimate the model²⁸ or different specification models employed (Deyak, et al. 1993).

Assuming disequilibrium between desired and actual imports, Goldstein and Khan (1976) specify a dynamic form of the import demand function for some countries (Belgium, France, Italy, and U.K.) and then estimate the coefficient of lagged imports as the speed of adjustment. Horton and Wilkinson (1989) have added another explanatory variable (the ratio of the export deflator to the GDP deflator) to the traditional model of Australian imports to examine its effect on import demand. However, they are not able to say whether the relative export price is an important explanatory variable.

As a result, the results indicate that imports of developed countries may be increasingly responsive to income changes and less responsive to price changes. However, Blecker (1992) finds empirical results for the U.S. in which the estimates of income elasticities

²⁷ Instruments used by Sheils (1991) refers to the import price index based on a special survey of importers which has been published by the U.S. Bureau of Labor Statistics (BLS).

²⁸ For example, the composition of imports may change over time when changes happen in the exchange rate or commodity prices.

Table 3.1: Previous estimates of the elasticities for import demand of developed countries

Study	Estimation Period	Country	Income	Relative Prices ^a	Import Price	Domestic Price	Lagged Imports
Houthakker and Magee (1969)	1951-66	Canada,	1.20	-1.46,			
		U. S.,	1.51	-.54*,			
		Japan,	1.23	-.72,			
		Australia	.90	.86*			
Kreinin (1973)	1964:1-1968:4	Germany	0.97	-1.24			
Goldstein-Khan (1976)	1955:3-1973:4	Belgium,	1.072,	-0.357,			0.398,
		France,	1.68,	-1.23,			-0.261,
		Italy,	0.71,	.007*,			0.639,
		U. K.	1.85	0.18			-.04*
Murray-Ginman (1976)	1950-64	Canada,	0.51,		-0.72,	1.26,	
		U. S.	1.43		-0.71*	3.11	
Thursby-Thursby (1984)	1957-77	Canada	1.35	-0.46			
Horton-Wilkinson (1989)	1974:3-1989:3	Australia	1.85	-0.63			
Deyak, et al. (1989)	1958:4-1983:4	U. S.	0.81	-0.11			0.24
Urbain (1992)	1952-85, 1953-85	The Netherlands,	1.1		-0.29	0.21	
		Belgium	1.53		-0.15	-0.09	
Bairam (1993)	1970-89	The Netherlands,	1.23	-0.21			
		Belgium,	2.06	-0.03*			
		France,	1.7	-0.76			
		Germany,	1.86	-0.25*			
		U. K.	2.07	-0.36			

*Values are statistically not significant at the 5 percent level.

^a P_m / P_d

are highly sensitive to model specification, including the choice of what variables to involve, and what time periods to cover.

Bairam (1993) concludes that variables in level form for five European countries²⁹ are not cointegrated, even though their estimated elasticity coefficients are mostly significant. In the modelling of aggregate imports, Urbain (1992) focuses on the use of econometric analysis of time series in the estimation of long-term relationships, through the use of cointegration techniques and error correction models. He uses these techniques to take account of the non-stationary aspect of the variables used in the estimation of aggregate import demand. This dynamic specification of import functions is very important, in which the price elasticities of supply and demand are evaluated correctly.

By classifying imports into different categories, for instance, Phillips (1989) has estimated import demand equations for the Australian economy, dividing imports into the competitive and non-competitive categories. The import demand equations have been estimated for the two categories of imports with unconstrained lags, as well as several Almon polynomial lag specifications which restrict the shape of the lag distribution. The major conclusions from the econometric results for both competitive and non-competitive categories, indicate that real imports of competitive goods exhibit a greater degree of price responsiveness than non-competitive imports.

3.6.2 Application of Import Functions to Developing Countries

The traditional model of import demand has also been employed by many researchers who have worked with developing countries. Table 3.2 summarises some of these studies for developing countries where differential impacts of economic activity variables, relative prices, and the exchange rate have been exhibited. Price elasticities

²⁹ Bairam (1993) has estimated static and dynamic import demand equations for Belgium, France, Germany, the Netherlands, and the UK.

change from -0.020 to -2.3, while income elasticities vary from 0.261 to 2.56 with the expected signs.

In spite of being significant, the price homogeneity assumption in developed countries, would be rejected in accordance with the results from the Greek import demand model according to Petoussis (1981). He then shows that the demand for imports is more responsive to changes in domestic than foreign prices. Bahmani-Oskooee (1986) has found both estimated price and exchange rate elasticities for some developing countries (such as Brazil, Greece, India, South Africa, and Thailand) to be low, indicating that relative prices do not have an important effect on imports.

Sarmad and Mahmood (1987), in their studies for Pakistan, indicate that the absolute relative price elasticities are low and clearly different from those estimated for developed countries. The higher income elasticity could be evidence that an increase in income leads to a rise in the ratio of imports to income. Sarmad (1989) in another study for Pakistan finds that the estimated price and income elasticities are distinctly different from those of the developed and middle-income countries.

In Vaez-Zadeh's (1989) model, both private and government expenditures enter separately as activity variables in the import function. The estimation results show that government expenditure and relative prices are the major determinants of import demand. Regarding this study the elasticity of government expenditure is roughly four times larger than the elasticity of private expenditure, representing the large import content of government outlays. Bertola and Faini (1991) have been able to predict the behaviour of imports in response to the omission of tariff and non-tariff barriers to trade, by estimating the demand for imports. For the Moroccan context, they suggest that the numbers are significantly larger when the liberalisation process involves non-tariff barriers. By lifting quantitative restrictions for consumption goods, the income elasticity increases from 0.93 to 1.20.

Table 3.2: Previous estimates of the elasticities for import demand for developing countries

Study	Estimation Period	Country	Income	Relative Prices	Import Price	Domestic Price	Exchange Rate	Other Variables	Lagged Imports
Houthakker and Magee (1969)	1951-66	Mexico, India, Portugal	0.52* 1.43 1.39	-0.53*					
Weisskoff (1979)	1948-75	Brazil	2.33	-0.37					
Weisskoff (1979)	1948-75	Brazil		-0.031				1.60 ^a	
Petoussis (1981)	1960-1979	Greece	0.261	-0.481	-0.18*	0.84		0.417 ^b	
Bahmani-Oskooee (1986)	1974-79, 1973-80, 1973-79, 1973-80, 1973-80	Brazil, Greece, India, S. Africa, Thailand	0.886, 1.68, 0.06,* 1.39, 0.933	-0.059*, 0.092*, -0.42, -0.656, -0.356			0.214, 0.549, -0.021*, -0.226*, -0.339		
Sarmad-Mahmood (1987)	1969/70- 1983/84	Pakistan	1.29	-0.239 ^c					
Vaez-Zadeh (1989)	1965-81	Venezuela		0.878 ^d				0.316 ^e 0.835 ^f	0.327
Faini, et al. (1992)	1966-85	Argentina, Bangladesh, Colombia, Indonesia, Jamaica, Kenya, Malaysia, Morocco, Pakistan, Syria, Zambia	2.56, 1.51, 1.25, 1.02, 1.12, 1.37, 1.67, 1.38, 0.76, 1.44, 0.78	-2.1, -0.36, -0.52, -1.5, -0.18, -1.48, -2.3, -0.42, -0.48, 0.43, -1.14					
Asseery and Perdakis (1993)	1963-85, 1963-85, 1970-85, 1963-85, 1970-85	Kuwait, Oman, Qatar, S. Arabia U. A. E. ^g	1.55, 1.22, 0.407, 0.340, 1.023	-0.78, -.020, -0.89, -1.22, -0.46					

* The elasticity of the coefficient is not significant at the 5 percent level.

^a Capital formation as an activity variable replaces real income.

^b Refers to the one period lagged value of real money balances.

^c The relative import price index to the domestic price index has been adjusted for tariffs.

^d Refers to the ratio of the price index of non-traded goods to the price index of traded goods.

^e Refers to the estimated coefficient for the elasticity of private expenditure.

^f Refers to the estimated coefficient for the elasticity of government expenditure.

^g United Arab Emirates

Estimating price and income elasticities is not easy when quotas exist. This problem, which was discussed by Khan (1974) in the case of developing countries, is re-examined by Faini et al. (1992) with a data bank including 50 countries. To analyse the effect of quotas on import demand, they indicate that import controls will reduce import responsiveness to price changes, when the imported and domestic goods are net substitutes.

Income elasticities are generally estimated to be higher than unity in most countries (such as Bangladesh, Colombia, Malaysia, etc.). Accordingly, Faini et al. (1992) stress that the assumption of a unit income elasticity proves to be quite inadequate. The income elasticity estimates for developing countries reported in this study are quite close to other estimates for developed countries. Price elasticities are generally less precisely estimated. The average price elasticity of six countries is less than one. Five countries have estimated price elasticities significantly greater than one. In another study, Bahmani-Oskooee (1986) uses quarterly data to estimate long-run price elasticities for several developing countries, obtaining an average of 0.39. This study confirms the consensus that the estimated historical long-run price responsiveness in developing countries is less than one.

Apostolakis (1990) investigates whether the composition of output affects the demand for imports by allocating output between consumption and investment goods. He determines the relationship between three factors (capital, labour, and imports) in the production process of nine industrialising countries of Europe (Greece, Spain, and Portugal) Asia (S. Korea, India and Malaysia), and America (Mexico, Colombia, and Brazil) in a time-series (1953-85) framework. For three Asian countries under investigation, imports have played the dominant role in industrialisation. Imports of oil, other raw materials, and semi-manufactured goods are crucial for industrialisation. Investment goods are significantly import-intensive so that any fall in such imports may lead to a postponement of industrialisation.

Most aggregate import demand functions are generally in log-linear form. However, Asseery and Perdakis (1993) attempt to develop their models in both linear and log-linear forms. They carry out tests on five oil-exporting countries of the Gulf Cooperation Council (GCC) including Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. They choose linear formulations of the import function for Kuwait and Oman and log-linear for Qatar, Saudi Arabia and the United Arab Emirates. In another study for GCC countries, Metwally (1993) analyses the impact of fluctuations in oil revenue on the import patterns of these countries. He finds changes in the patterns of imports of the GCC countries are due to substantial reductions in income and the operation of Engel's Law rather than to import restriction. This means that there is a significant negative correlation between the size of the import elasticity and the level of per capita income.

Dissaggregate import demand analyses for developing countries is scarce. In the case of different classes of imports Vernardakis (1978) develops a macroeconomic model that contains the functioning of Greek imports in three categories: consumer imports, investment imports, and raw materials. Consumer imports are explained in terms of disposable income, distribution of income, relative prices and import substitution. Imports of investment goods are explained in terms of relative prices and different types of investment including investment in manufacturing, investment in transportation and communication; and total investment. Imports of raw materials depend on manufacturing output, import substitution, and lagged imports to account for the stock effect. Based on the estimated equations, the main result is that the role of relative prices is found important only for consumer imports.

Mirahkor and Monteil (1987) identify the determinants of import demand for capital and intermediate goods for forty seven developing countries. But they do not classify commodity groups by the nature of the traded goods (for example, manufactures versus non-manufactures). Salas (1982) finds that the price elasticity of intermediate goods in

the estimated import equations for Mexico is higher than that of capital goods, which he relates to the complete import substitution of intermediate goods in Mexico.

A traditional model of imports at the disaggregate level for Pakistan has been developed and estimated by Sarmad and Mahmood (1987). They specify the functional form by relating the quantity of imports to a domestic economic activity variable and to the ratio of the price of imports with respect to domestic prices. The function is, in logarithm form, as follows:

$$\log IM_{it} = \alpha + \beta \log(1 + \tau_{it})P_{it} + \gamma \log Y_t + u_{it} \quad (3.42)$$

where IM_{it} , τ_{it} , P_{it} , and Y denote the quantity of good i imported, tariff rate on the i th import, the ratio of the unit value of the i th import to its domestic price, and the activity variable, respectively. The results reinforce the argument that development policy affects the growth of specific import-substitution industries like consumer goods and capital goods. Following Sarmad and Mahmood (1987), Sarmad (1989) finds price elasticities for Pakistan to be highest for transport and machinery, while Khan (1975) and Melo and Vogt (1986) obtain the lowest price elasticities of the same import category for Venezuela.

Hentschel (1992) estimates macroeconomic production functions for a number of developing countries, which are different in terms of the level of economic development and trade strategies. Considering the elasticity of substitution between imported and domestic production allows him to answer several questions, which are related to the role of imported capital and intermediate goods in developing countries. Are such imports substitutes or complements to domestic capital and labour? How does the importance of imports in the domestic production process affect the reaction of the trade balance to external shocks? According to Hentschel (1992), knowledge of the import elasticities gives some more specific answers when the analysis is conducted for an individual country.

3.7 Previous Empirical Results on Import Functions for Iran

There are limited studies for Iran in the literature regarding the modelling of import demand. Metwally and Tamaschke (1980), Aghevli and Sassanpour (1982), Heiat (1987), and Noferesti and Arabmazar (1994) have specified import demand functions within different macroeconomic models developed for the Iranian economy. Based on a variety of variables such as GDP, investment, foreign exchange and the exchange rate, the specified equations appear in different forms while the ratio of prices is the major determining variable.

Metwally and Tamaschke (1980) examine the relationship between exports and income and develop a three-simultaneous equation model over the period 1960-75, where the interaction process between the relevant variables is explicitly taken into account. In their structural equations the first equation examines the relationship between income and exports, while the second equation tests the relationship between imports and exports. Finally, the third equation shows the demand for imports is a function of income in the current and past periods. The results indicate that past changes in income (lagged income) seem to be important determinants of imports in Iran. However, the role of the relative price in import demand is absent in this study.

Aghevli and Sassanpour (1982) develop a macro-model designed to analyse the impact of a rise in oil prices on the Iranian economy over the period 1960-77. The basic framework of this model, since the bulk of government revenues is derived from oil exports, is that the spending of these revenues raises aggregate demand for traded and non-traded goods which leads to an increase in imports. They specify the demand for total imports as a function of government expenditures and private expenditures. The terms of trade between imports and domestic goods (relative prices of traded goods to non-traded goods) captures the impact of relative prices on the volume demand for imports. Based on these results, Aghevli and Sassanpour (1982) indicate that an increase in government and private expenditures contribute significantly to the increase in

imports. The elasticity of imports with respect to private expenditure is 0.89, which is nearly 1.5 times higher than the elasticity with respect to government expenditures (0.63). The elasticity of relative prices is -0.83 with the expected sign, but is not significant.

In the study conducted by Heiat (1987), the Iranian economy is found to have a high reliance on imports of capital as well as consumer goods. The import demand equation for capital goods indicates the existence of a positive relationship between investment and imported capital and intermediate goods. In addition, a government import substitution strategy failed to reduce the economy's dependence on foreign resources over the period under consideration.

In the specification of the consumer import model, Heiat (1987) employs only two explanatory variables, that of gross domestic product (GDP) and the lagged import of consumer goods. He ignores the effect of price changes on this sort of imports. The demand for capital and intermediate imported goods are assumed to be a function of both private and public investment in the urban sector, and value added in the urban sector lagged one year.

Heiat (1987) concludes that the import equation for capital goods exhibits the existence of a positive relationship rather than a negative relationship between investments made in the urban sector and the import of capital and intermediate goods. In the equations for consumer imports estimated by OLS, the GDP coefficient and the coefficient of lagged consumer imports are 0.12 and 0.46, respectively. Using 2SLS, the coefficients are significantly larger, 0.6 and 0.73, than those estimated by OLS. The coefficients of investment, estimated by both OLS and 2SLS, are 0.88 and 0.25, and the coefficients of value added in the urban sector vary from -0.07 to 0.32, respectively.

In the model of Johari (1993), the aggregate import function is a log-linear function of relative prices (the ratio of import prices to export prices) and foreign exchange revenues. In the framework of this model, however, the domestic income variable is

absent. Econometric tests yield significant parameters for relative prices and foreign exchange variables. The price elasticity of imports has the expected sign and is noticeably high (-1.53), playing a dominant role in the model. Based on the Marshall-Lerner condition, and then assuming a zero value for the export price elasticity, Johari (1993) concludes that an exchange rate devaluation may be an appropriate policy to reduce the trade balance deficit of Iran.

In the study of Noferesti and Arabmazar (1994) over the period 1959/60-1990/91, imports are influenced by income (GDP), foreign exchange (OR), the exchange rate (E), and relative prices (P_m / P_d). Because of the importance of the import composition in economic development, Noferesti and Arabmazar (1994) have considered imports in four sub-sections: imports of consumer goods, imports of intermediate goods, imported capital goods, and imports of services. A general form of the import demand function as specified in their macroeconomic model is indicated as follows:

$$IM_t = IM(GDP_t, OR_{t-1}, E_t, P_m / P_d) \quad (3.43)$$

Regarding the results for four specified linear equations for imports, only the coefficients of relative prices and foreign exchange have the correct signs and significantly explain imports. Although the coefficients of GDP and the exchange rate have the expected signs, they are too low and insignificant.

Relying on the study of the Iranian external sector, Bahmani-Oskooee (1995b) has recently used both the Engle-Granger technique and the Johansen-Juselius cointegration analysis to investigate the long-run relationship between Iranian imports and exports. He finds evidence of cointegration between imports and exports for the 1959-1990 period. According to Bahmani-Oskooee (1995b), this finding reveals the fact that in the long-run the Iranian trade balance is in equilibrium or trade policies adopted during that period were effective in making imports and exports converge. In another study for oil-

exporting countries including Iran,³⁰ as previously explained, Metwally and Tamaschke (1980) argue that there may be feedback effects between oil exports and imports of these countries. If oil exports and the incomes of these countries are interrelated simultaneously, an increase in exports increase incomes which result in an increase in demand for imports. The rise in imports leads to an increase in incomes of those countries which export goods and services to the oil producing countries. This in turn stimulates demand for oil which will result in an increase in exports of the oil-exporting countries. However, their statistical results of the simultaneous relationships suggest the absence of feedback effects for Iran and other oil-exporting countries.

3.8 Summary and Conclusions

The present chapter has developed three main issues. Firstly, there is the analysis of an open economy macroeconomic model (Mundell-Fleming type) from which the structural form of the foreign sector can be determined. Changes in the corresponding variables like terms of trade and the exchange rate influence crucially this sector, causing effects on the whole economy. This shows the importance of the external sector in the framework of a complete macro-model.

Secondly, import demand plays a significant role in the conduct of development plans and in the attainment of other required economic goals in developing countries. It is evident that in the growth process imports provide required capital and intermediate inputs if the importation of these goods is managed well (Fishlow 1994). In fact, imports are effective in generating efficiency and competitiveness in domestic economic activities, as well as in producing exportable goods. Therefore, this requires us to pay more attention to the structure of the import model and recognise the main determinants to be incorporated in import functions. Furthermore, one section of the present chapter

³⁰ This study has been conducted for six major oil producers of North Africa and the Middle-East: Algeria, Iran, Iraq, Kuwait, Libya and Saudi Arabia over the period 1960-75.

has been concerned with the literature in which the theoretical schemes derive import demand functions.

From these studies we are able to observe the significant explanatory variables (prices and activity variables) of import functions, in the context of both developed and developing countries. As previously indicated, there have been only a few studies conducted on import demand for Iran. As a result, an appropriate study of an import model and its determinants for the case of Iran seems to be necessary. Hence the next step is to assess how the Iranian import demand can be formulated, which will be the task of Chapter Four.

CHAPTER FOUR

4. FORMULATION OF THE IMPORT MODEL

4.1 Introduction

The major objectives of this chapter are to formulate import demand functions for Iran, and to explore relevant economic variables associated with the empirical modelling of these functions. The others are to identify and demonstrate theoretically and empirically the nature of the relationship between the demand for imports and these explanatory variables. In order to quantify the importance of import demand in the Iranian economy, a major attempt is made to develop an import model at the aggregate and disaggregate levels. In practice imports are disaggregated into three different categories, in which the first category includes only three classifications of imports (consumer imports, intermediate imports, and capital imports), while the second one consists of more detailed classes of imported commodity groups. Thirdly, import demand can be formulated on the basis of imports by country of origin, explaining thereby the relationship between Iran and its major trading partners

This chapter is organised as follows. Section 4.2 discusses the underpinnings to the specification of the import demand functions. In this section the choice of functional form between linear and log-linear is discussed, while emphasis on modelling imports is conducted on the basis of it being a dynamic process. In Section 4.3, relevant explanatory variables in the import function will be discussed, as will the theoretical justification of the relationship between these and import demand. Iranian demand for

imports is modelled at both the aggregate and disaggregate levels in Section 4.4. Overall this section specifies the functional form of import demand equations for both aggregate imports as well as for disaggregated imports, which include specifications for the composition of imports, imported commodity groups, and imports by country of origin. Finally, Section 4.5 will make some concluding remarks.

4.2 Theoretical Specification of the Functional Forms

Various functional forms for imports lead to different estimates of elasticities and thus different conclusions in regard to the effects of policy changes. However, the general specification is quite simple. It indicates that the quantity of imports demanded is related to the ratio of the import price level to the domestic price level and domestic income in real terms.³¹ However, following the view of Gregory (1971) and Kohli (1991), data availability and goodness of fit play a major role in the selection process of relevant variables in the derived import formulation as mentioned in the previous chapter, Section 3.6. Variables such as real GNP (Y), gross output (Y_g), domestically produced goods (Y_d), domestic inputs (V), the price of gross output (P_{Y_g}), the price of domestic goods (P_d), import prices (P_m), the price of the domestic composite inputs (P_v), and the GNP deflator (P_Y) are often used in empirical work on import determination. Among the possible combinations, eight specifications are considered below:

$$IM = IM(P_m, P_v, Y_g), \quad (4.1)$$

$$IM = IM(P_m, P_{Y_g}, V) \quad (4.2)$$

$$IM = IM(P_m, P_v, V) \quad (4.3)$$

$$IM = IM(P_m, P_{Y_g}, Y_g), \quad (4.4)$$

$$IM = IM(P_m, P_{Y_g}, Y), \quad (4.5)$$

$$IM = IM(P_m, P_Y, Y) \quad (4.6)$$

³¹ See Van (1984).

$$IM = IM(P_m, P_d, Y), \quad (4.7)$$

and

$$IM = IM(P_m, P_d, Y_d) \quad (4.8)$$

Obviously, such functional forms of $IM(.)$ will differ from specification to specification. For each of the eight specifications, one can define elasticities of the own price of import demand, corresponding cross price, and activity variables based on the relevant specification³². Based on the country characteristics, it makes no difference which specification is preferred,. Depending on the appropriate estimation results, every specification would be the most meaningful in a deterministic framework if the results obtained satisfy theoretical schemes which rely on the import demand function. For example, many authors have used such formulations in their empirical studies. Specifications (4.1) and (4.2) have been used by Burgess (1974a) and Kohli (1991) for developed countries. Formulations similar to equations (4.5), (4.6), and (4.7) have been widely used by Houthakker and Magee (1969), Khan and Ross (1977), and Thursby and Thursby (1984), and Bahmani-Oskooee (1986) in the context of both developed and developing countries. Some of these authors have used dynamic models by including lagged effects.

4.2.1 Linear and Log-linear Forms

In the literature, researchers have specified functional forms in either linear or log-linear forms. In Apostolakis' view (Apostolakis 1990), the use of a linear functional form for an aggregate import demand equation implies a decreasing price elasticity of import demand and an income elasticity tending to unity. Linear form is used for forecasting, and allows the dependent variable to react to a rise or a fall in the explanatory variables.

According to Khan and Ross (1977) in estimating demand equations for imports, there is no theoretical presumption regarding the linear or log-linear functional form. But

³² The relative price elasticity usually replaces these two price elasticities in most import equations.

most results indicate that the log-linear form of the import demand equation is preferable to a linear one.³³ The log-linear specification constrains the elasticity of relative import prices on domestic prices to be constant through time. Hence the log-form allows imports to react proportionally to a rise and fall in the explanatory variables; that is, on the assumption of constant elasticity, the logarithmic form avoids the problem of changes in the elasticities as import quantity changes (Goldstein and Khan 1976).

Results obtained from using the Box-Cox (1964) analysis of transformations indicate that for the specification of the import equation, a log-linear form is more appropriate than a linear function. Khan and Ross (1977) and Asseery and Perdakis³⁴ (1993) have applied this procedure (Box-Cox analysis of transformation) to overcome the possibility of biased and inconsistent estimates arising from the misspecification of the functional form.

As a result it is much more convenient to use the log-linear specification as it constrains the elasticity estimates to be constant over the estimation period, preventing the possibility of a secular fall in the elasticities with respect to price and activity variables when the dependent variable rises faster than the independent variable. Furthermore, the choice between functional forms of a linear or log-linear type in econometric work is usually made on the basis of its empirical superiority, principally the goodness of fit. By applying a log-linear form, we will obtain reliable results for import demand of the Iranian economy.

4.2.2 Dynamic Specification of the Import Function

The actual level of imports observed in any period can be expressed as a distributed lag function of the independent variables including the lagged values of both the

³³ The results provide lower residual sum of squares (RSS) for the log-linear form rather than that for the linear one

³⁴ Asseery and Perdakis (1993) have applied the Box and Cox analysis of transformation for import models of GCC (Gulf Cooperation Council) countries including that of Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

independent and dependent variables, implying a dynamic adjustment process in which prices, income, and other variables may appear as moving averages over time. The respective coefficients of the import equation can be interpreted as short-run elasticities from which long-run elasticities are calculated (Deyak, et al. 1989).

Since imports will not adjust immediately to a long-run equilibrium following a change in the independent variables, a polynomial lag value of the independent variables reveals the actual level of trade flows in which the lagged responses of trade flows to changes in independent variables rationally vary through time.

A polynomial lag structure may be useful to show how imports in a model react to changes in the independent variables. Lags on relative prices and other variables imply the short-run dynamic structure of the effects of changes in these variables. For example, since limited foreign exchange availability can lead to some controls on imports and foreign exchange rationing, it is possible to consider the effect of the reserve-import ratio lagged one period, $(R / IM)_{t-1}$ on the import regression. This is because real imports are related negatively to the real exchange rate and positively to real domestic output in a conventional specification of import functions (Haque et al. 1991).

Moreover, the coefficient of the lagged value of imports indicates the speed of adjustment of actual to desired imports. Thursby and Thursby (1984) are concerned with the dynamic behaviour of an import demand model, and report that many import models frequently include dynamic behaviour through lagged values of the dependent variable. Following Thursby and Thursby (1984), therefore, the formulation of Iranian import demand will be on the basis of partial adjustment.

4.2.3 Assumptions

Our model rests on a number of assumptions. First of all the equilibrium between demand for and supply of imports is determined in the market for importable goods,

where demand and supply react with each other. In spite of the complexity in determining supply, the determinants of demand are conventionally obtained (Leamer and Stern 1970). More specifically, the foreign supply of imports and the domestic supply of substitutes can satisfy demand. Assuming no foreign exchange constraint, the foreign supply of imports is also postulated to be perfectly elastic. As a whole, the import supply function is perfectly elastic and observed imports lie along the import demand function.

Import flows are generally imperfect substitutes for domestic production so that independent import demand functions can be specified. Adopting the Armington assumption in which consumers follow a stepwise budgeting procedure, imports are influenced by total expenditure indices of domestic prices and import prices (Brenton 1989)³⁵ Moreover import demand is independent of the price of non-traded goods. The reason is that expenditure is allocated first between traded and non-traded goods and then between imports and domestic substitutes for imports. Thus, the cross price elasticity of demand is zero between imported goods and non-traded goods.

According to Urbain (1992) our model of import demand at last meets some conditions in which it is assumed to be data admissible, demonstrate parameter constancy, and encompass competitive models. The main hypothesis is that the empirical model reproduces the theoretical model under the conditions assumed by the theory.

We focus here on modelling Iranian imports at the aggregate and disaggregate levels. In the formulation of the model for both levels it is of essential concern to realise significant relationships between demand for imports and some economic variables such as expenditure, income, prices, and the exchange rate. The specification of the model is also determined by the availability of data, the underlying theory, and specific difficulties (oil crisis and the war over the last decade) of the Iranian economy.

³⁵ According to the Armington assumption, consumers differentiate products by their place of production. This leads to a stepwise budgeting procedure.

4.3 A Discussion of the Appropriate Choice of Explanatory Variables

4.3.1 Relative Prices

As shown in the previous chapter, in most studies imports are modelled as a function of the relative price of imports to domestic prices and some activity variables (Houthakker and Magee 1969, Khan and Ross 1977, and Horton and Wilkinson 1989). Changes in relative prices influence the demand for domestic products. For example, a decline in the relative price of an imported good would lead to a decrease in demand for the domestically produced substitute, resulting in a reduction in the production of this substitute (direct effect). This reduces the demand for imports of intermediate inputs used in the process of its production, even though the relative prices of these inputs remain unchanged (indirect effect). Similarly, an increase in the relative price of an imported good would cause increased imports of intermediate inputs used in the production of the domestic substitute (Rousslang and Stephen 1981).

4.3.1.1 Price Homogeneity

From an import function point of view, an important indicator incorporated in the model is the relative price of imports to domestic prices (P_m / P_d). According to most studies of import demand (such as Deyak, et al. 1993), this ratio implies an assumption of homogeneity in prices in which the use of the price ratio would express the responsiveness of imports to changes in both import price and domestic price separately. The other advantage of the price homogeneity in the functional form is that multicollinearity will be reduced from the introduction of the two price terms (Petoussis 1981). However there is a disadvantage of using the domestic price if it is considered as the measure of the price of domestically produced tradables goods, because it includes both prices of imported and non-traded goods. In other words, the price of all domestically produced goods is generally used as a proxy for the price of non-tradeables. This implies that the elasticity of demand for imports with respect to the ratio of the import price to the price of non-traded goods, is constrained to be the same

as the elasticity of the import demand with respect to the relative price of imports on the domestic price. But the relative price of imports to domestic products (P_m / P_d) is still the best available explanatory variable of the import demand function.

4.3.1.2 The Exchange Rate Effect

The exchange rate is defined as the domestic price of foreign currency. This form indicates that import prices will change if the exchange rate movements are fully passed on to import prices (Phillips 1989). The size of the relative price of imports on the domestic price depends on how much of the exchange rate change is actually reflected in import prices, or is also offset by changes in the price of domestically-produced goods.

However, to identify the effect of the exchange rate on the demand for imports, exchange rate changes are assumed not to be fully passed on to the import price. Hence, the exchange rate contributes to the import function by explaining import demand changes. Theoretically an exchange rate depreciation, if import and domestic prices are unchanged, leads to an increase in the value of imports because of the higher³⁶ price if the physical volume of imports does not change. The important response now is that demand for imports should decline because the value of imports becomes more expensive (Dornbusch and Fischer 1994).

4.3.2 Activity Variables and Other Explanatory Variables

Activity variables such as gross national expenditure (GNE) and gross domestic product (GDP) appear generally on the right hand side of the import demand function, explaining the income effect (Murray and Ginman 1976, Hamilton 1980, Bahmani-Oskooee 1986, Dwyer and Kent 1993). To realise the role of government and the private sector in spending on all goods (especially consumer goods) and to distinguish their

³⁶ Since the term $(EP^*/P_d)Q$ measures the value of imports in terms of domestic goods. E is the exchange rate, P^* and P_d are foreign and domestic prices, and Q denotes the import quantity.

contribution to the demand for imports, GNE is more appropriate than GDP as an activity variable in the import function. It means imports should be related to domestic spending on all goods. Alternatively, if imports are mostly intermediate goods used as an input to production, GDP or income is a more appropriate explanatory variable in the import function rather than gross national expenditure (Horton and Wilkinson 1989). Over the long run, of course, GNE data is highly correlated with GDP.

The money supply may explain the extent of import demand. Petoussis (1981) believes that changes in the money supply have an effect on import demand since both income and price elasticities can be influenced by monetary disequilibrium. Changes in the demand for money may disturb the positive relationship between imports and income, as well as the negative relationship between imports and relative prices. Thus, the ignorance of the effect of the money market in the process of estimating an import model can produce a biased income elasticity.

Contrary to the conventional theory, the expected positive elasticity of imports can be also questioned by the role of “capacity utilisation”.³⁷ Imports may be viewed as the difference between domestic consumption and domestic production of importables. In a particular case if production rises more quickly than consumption, income will increase and the demand for imports will fall assuming domestic production and imports are substitutable. The result of these changes will be a negative income elasticity of imports.³⁸

However, a large number of goods are not produced domestically in developing countries and can only be imported from abroad. This does not imply output homogeneity between domestic and foreign production if imports are viewed as the difference between consumption and production. Moreover, the capacity utilisation does not make sense if most imports include primary and intermediate goods. Increased

³⁷ In Petoussis' words: “An indicator of developments in the supply side of the economy, for example, is a capacity utilisation measure.” (Petoussis 1981, p. 314)

³⁸ For more discussion, see Magee (1975) and Petoussis (1981)

production has to rely on increased imports of intermediate goods, particularly in developing countries with a low degree of diversification.

Another potential identification problem of the import demand function is direct government intervention. Such intervention like quantitative restrictions, price controls, and licensing, especially in developing countries, sometimes leads to a biased measure in the estimation of income and price elasticities. It is clear that when government intervention is not considered, the estimated income and price elasticities are downward biased because an increase in income or domestic prices will not be allowed to cause the desired increase in imports. Hence, the bias will not be removed unless governments of such countries stop intervening (Petoussis 1981).

4.4 Aggregate and Disaggregate Imports in Functional Form

Activity variables in the import function can include gross national expenditure (GNE) or gross domestic product (GDP). GNE may be preferred if it is thought that the demand for imports should be related to domestic spending on all goods rather than to the sum of domestic and foreign spending on domestic goods only. Since about 60 percent of Iranian total imports are imported intermediate goods, the choice of the real GDP (real income), as discussed in the previous section, is more appropriate.

Following Khan (1974), Bahmanee-Oskooee (1986), Horton and Wilkinson (1989), and Haque et al. (1990), the desired aggregate demand for imports is assumed to contain the ratio of import prices to domestic prices, real income, and the real exchange rate. A type of desired import function will therefore be dependent on relative prices (P_m / P_d), real income (Y), and the official real exchange rate (ER):

$$IM^* = IM^*(P_m / P_d, Y, ER) \quad (4.9)$$

where IM^* denotes the desired level of imports.

Actual imports are assumed to adjust with a lag to the difference between desired demand for imports in the current period and actual imports at the end of the previous period.³⁹ In fact, the one-period lagged value of real imports is included in the function in order to allow for the partial adjustment of actual imports to the desired level. It means the level of actual real imports (IM) rises whenever there is an excess demand for imports. This mechanism is presented in (4.10):

$$\Delta IM = \lambda (IM^* - IM_{t-1}) \quad 0 \leq \lambda \leq 1 \quad (4.10)$$

where λ denotes the speed of adjustment. IM_{t-1} is the one period lagged value of total imports. The equation specifies that changes in Iranian import flows (IM) will respond partially to the difference between the desired value of imports and its past value. Suppose a linear equation for the desired import function (IM^*), we obtain (4.11):

$$IM^* = \alpha_0 + \alpha_1(P_m / P_d) + \alpha_2 Y + \alpha_3 ER \quad (4.11)$$

where $\alpha_1, \alpha_3 < 0$ and $\alpha_2 > 0$. Substituting for IM^* in equation (4.11) and solving for current imports (IM_t) yields the equation (4.12) in a log-linear form:

$$\log IM_t = \gamma_0 + \gamma_1 \log (P_m / P_d) + \gamma_2 \log Y_t + \gamma_3 \log ER_t + \gamma_4 \log IM_{t-1} \quad (4.12)$$

where $\gamma_i = \lambda \alpha_i$ for $i = 1, 2, 3$ and $\gamma_4 = 1 - \lambda$.

Trade flows can themselves be subdivided into several homogeneous groups. Some information on the competition between imports and domestically produced goods can obviously be obtained through classifying these groups. The purpose of investigating the disaggregate level of imports relies on the relationship between imports and relative prices and economic activity.

The empirical determination of this relationship is important for policy decisions associated with domestic and foreign inflation rates, exchange rate changes, changes in domestic indirect taxes and changes in the level of tariffs and other trade barriers

³⁹ Based upon Aghevli and Sassanpour (1982), it is assumed here that there is a disequilibrium between desired and actual imports for Iran.

(Sarmad and Mahmood 1987). The estimated price elasticity at a disaggregated level is also required for assessing the effects of price changes on employment and production in specific sectors and industries (Hamilton 1980).

We will expand our import model into three main categories that comprise the composition of imported goods in the first category, the selected commodity groups of imports in the second category, and imports by country of origin in the third one. The econometric results will be obtained and then interpreted in the next two chapters, with policy implications also identified in Chapter Seven.

4.4.1 Composition of Imported Goods

The bulk of world trade is in raw materials and intermediate products. Imports of raw materials and machinery have usually been considered by developing countries as substitutes for domestic inputs. Accordingly, consumer imported goods often go through a number of domestic channels such as transportation, insurance, storage, repacking and retailing, before being demanded by consumers. Hence, based on import substitution policies, it is convenient to subdivide imports into three classes including imports of consumer goods, imports of raw materials and intermediate goods, and imports of capital goods.

4.4.1.1 Imports of Consumer Goods

Changes in relative import prices to domestic prices, in GNE as an activity variable, and in exchange rates affect the import of consumer goods demanded by the country. Some of the imported goods are subject to quantitative restrictions (QRs) such as tariffs, quotas, etc. The functional form can be written as follows:

$$IMC = IMC \left(\frac{P_m^C}{P_d^C}, Ge, Pex, ER, \tau_C \right) \quad (4.13)$$

where IMC , P_m^C / P_d^C , ER , and τ_C denote imports of consumer goods, the ratio of the price of imported consumer goods to their domestic price, official real exchange rate,

and quantitative restrictions respectively. Government expenditure (Ge) and private expenditure (Pex) are components of domestic income and show the role of government and the private sector in spending on consumer goods as well as their contributions to the import demand for such goods. On the assumption that tariffs are the only trade barriers and the effects of the equivalent taxes on imports are identical to the effects of the ad valorem rates⁴⁰ (Chacholiades 1990), the consumer goods import function can be specified in a log-linear form as follows:

$$\log IMC_t = a_{c0} + a_{c1} \log(1 + \tau_C)(P_m^C / P_d^C)_t + a_{c2} \log Pex_t + a_{c3} \log Ge_t + a_{c4} \log ER_t + a_{c5} \log IMC_{t-1} \quad (4.14)$$

where τ_C is the ad valorem rate of tariff on these kinds of imported goods. IMC_{t-1} is a lagged term of consumer imports capturing dynamic adjustments.

4.4.1.2 Imports of Raw Materials and Intermediate Goods

As previously indicated, GDP is a more appropriate activity variable to be replaced with gross national expenditure in the functional form of imported raw materials and intermediate goods. Imports of such goods are then related to their relative prices (P_m^R / P_d^R), gross domestic output (Y), official real exchange rate (ER), and quantitative restrictions (τ_R). The demand for imports of intermediate goods and raw materials affects the domestic demand for these goods (DDR) through changes in prices and income. Hence, both the demand for imported and domestic raw materials and intermediate goods (IMR and DDR) can be simultaneously obtained:

$$IMR = IMR\left(\frac{P_m^R}{P_d^R}, Y, ER, \tau_R\right) \quad (4.15)$$

and

$$DDR = DDR\left(\frac{P_m^R}{P_d^R}, Y\right) \quad (4.16)$$

⁴⁰ The ad valorem rate of tax on imports (or exports) is legally a fixed percent of the import price, τP_m , which, in general, is the tax revenue per unit imported (Chacholiades 1990).

where $[\partial IMR / \partial (P_m^R / P_d^R)] < 0$ whereas $[\partial DDR / \partial (P_m^R / P_d^R)] > 0$. *DDR* stands for the domestic demand for raw materials and intermediate goods. Both functions, (4.15) and (4.16), can be presented in log-linear forms:

$$\log IMR_t = a_{r0} + a_{r1} \log(1 + \tau_R)(P_m^R / P_d^R)_t + a_{r2} \log Y_t + a_{r3} \log ER_t + a_{r4} \log IMR_{t-1} \quad (4.17)$$

and

$$\log DDR_t = b_{r0} + b_{r1} \log (P_m^R / P_d^R)_t + b_{r2} \log Y_t \quad (4.18)$$

where IMR_{t-1} expresses lagged imports, which accounts for the adjustment effect of the desired and actual import levels.

4.4.1.3 Imports of Capital Goods

Iran, as with many developing countries, is markedly dependent on imports of capital goods. The ratio of capital imports to total imports rose from 29 percent in 1976 up to 34 percent in 1991. Thus, aggregate investment (I) is an appropriate activity variable to explain imports of investment goods. Since the majority of capital imports go to manufacturing industry, total investment (I^T) can be subdivided into investment in manufacturing (I^M) and others ($I^T - I^M$). The following functional form defines the import function of capital goods in which its log-linear equation, specified in (4.20), is estimated later:

$$IMK = IMK (P_m^K / P_d^K, I^M, I^T - I^M, ER) \quad (4.19)$$

and

$$\log IMK_t = a_{k0} + a_{k1} \log (P_m^K / P_d^K)_t + a_{k2} \log I_t^M + a_{k3} \log (I^T - I^M)_t + a_{k4} \log ER_t + a_{k5} \log IMK_{t-1} \quad (4.20)$$

Assuming relative prices among capital goods are constant, P_m^K / P_d^K denotes the relative import price to domestic price of capital goods. Since capital imports play a significant role in Iran's development strategies, no quantitative restriction is assumed to have an impact on the import function. IMK_{t-1} is again the stock effect of imports of investment goods.

4.4.2 Commodity Groups of Imports

According to Shiells (1991), the quantity of imports demanded in a particular commodity group depends on the relative price of that commodity group and activity variables as well. Changes in the exchange rate can explain mainly the differential behaviour of import volumes across the disaggregated level.

The main issue is the recognition that in Iran, as in most other developing countries, all imports are not necessarily controlled by government. Several subsets of foreign goods are freely imported by the country. It is possible to estimate structural parameters that can be affected by trade liberalisation or trade controls. More specifically, commodity groups of imports are classified into two kinds of goods: free imports, and restricted imports.⁴¹

Assuming that restricted imports compete with domestic production the responsiveness of these imports to relative prices is more sensitive to changes in domestic output levels. Free imports that are non-competitive would be more strongly related to changes in domestic output levels rather than relative prices. The implication is that the low price elasticity for the groups of freely imported goods suggests that non-price factors lessen the impact of changes in relative prices on import demand. In other words, where substitute goods are produced domestically, one would expect restricted imports to exhibit a greater degree of price responsiveness.

⁴¹ Essential goods such as chemical and pharmaceutical products, which are freely imported without quantitative restrictions, are considered as free imports, while other imports (with an average tariff of 10% or more than that are defined as restricted imports.

Weisskoff (1979) has developed a general model for j classes of imports in the following form:

$$IM_{jt} = \alpha_j A_t^{\beta_{1j}} P_{jt}^{\beta_{2j}} e^{\delta_{jt}} d_j^{d_j} u_{jt} \quad (4.21)$$

where IM_{jt} is imports for the j th class of imports for year t . α_j is a constant for each class, A_t is the relevant activity variable (GDP, capital formation, ...), P_{jt} is the index of relative prices. The coefficients β_{1j} and β_{2j} are the income and price elasticities of import demand; δ_j is the trend coefficient; and d_j denotes a dummy variable that indicates shifts in the function due to changes in the regime.

Accordingly, explanatory variables in our functional forms for both restricted and free imports are relative prices and activity variables as well as the exchange rate. The demand for domestically produced products of commodity group j could be a convenient activity variable in the import function of restricted imports of commodity group j . This variable can be regarded as a proxy for expenditure on commodity group j without making the restrictive assumptions that commodity group j forms a constant share of total expenditure or that imports form a constant share of expenditure, on commodity group j . Thus, the formulation of this kind of import demand relationship can be expressed by (4.22):

$$IM_j^R = IM_j^R (P_{mj}^R / P_{dj}^R, Z_j, ER, \tau_j) \quad (4.22)$$

IM_j^R , P_{mj}^R / P_{dj}^R , and Z_j all denote restricted imports, relative prices, and expenditure on commodity group j , respectively. τ_j denotes an ad valorem rate of tariff on this commodity group.

Several commodity groups such as medical products or some manufactured goods are usually imported by the government and are not subject to any control strategy. GDP, capital formation, or exchange receipts therefore can be appropriate activity variables that influence such imports. Thus the functional form for free imports of commodity group i is defined as:

$$IM_i^F = IM_i^F (P_{mi}^F / P_{di}^F A_i ER) \quad (4.23)$$

where IM_i^F , P_{mi}^F / P_{di}^F , and A_i stand for free imports, the relative prices of commodity group i and the activity variable, respectively. The log-linear forms of the last two functions are also specified in equations (4.24) and (4.25):

$$\begin{aligned} \log IM_{jt}^R = & b_{0j}^R + b_{1j}^R \log(1 + \tau_j)(P_{mj}^R / P_{dj}^R)_t + b_{2j}^R \log Z_{jt} + b_{3j}^R \log ER_t \\ & + b_{4j}^R \log IM_{jt-1}^R + b_{5j}^R t \end{aligned} \quad (4.24)$$

and

$$\begin{aligned} \log IM_{it}^F = & b_{0i}^F + b_{1i}^F \log(P_{mi}^F / P_{di}^F)_t + b_{2i}^F \log A_{it} + b_{3i}^F \log ER_t \\ & + b_{4i}^F \log IM_{it-1}^F + b_{5i}^F t \end{aligned} \quad (4.25)$$

b_{5j}^R and b_{5i}^F are the time coefficients that can be interpreted as the effect of import substitution policy. If they are negative in sign, the import substitution policy would be successful. But there exists increasing import dependency when they are positive in sign (Weisskoff 1979).

4.4.3 Imports by Country of Origin

To investigate the economic performance of Iran's major trading partners (described in Chapter Six) on the import sector, this section formulates the demand for goods bilaterally imported by the country from a particular partner. Undoubtedly, inflationary fluctuations and changes in the exchange rate of country k will have an impact on the Iranian external sector. A comparison of the price effect between Iran and its partners can reflect a combination of differential policies in Iran and abroad through tariffs and other restrictions, and price index construction. The income effect, which will be obtained by estimating Iran's income elasticity of demand for imports from another country, can also indicate different trade relationships between Iran and each trading partner. In other words, the estimation results of the income elasticities may reveal

whether the improvement in trade balance will tend to move towards Iran or its trading partners.

A functional form of imports from country k (IM^k), can be dependent on the relative prices of exports from country k to Iranian domestic prices (P_x^k / P_d), real income (Y), and the bilateral exchange rate (ER^k):

$$IM^k = IM^k(P_x^k / P_d, Y, ER^k) \quad (4.26)$$

where P_x^k and P_d denote the export price index of country k and the domestic price of Iran, respectively. Bilateral imports are assumed to be imperfect substitutes both for domestic products and among themselves. A choice of a logarithmic formulation with a dynamic specification (lagged value of imports) is defined:

$$\log IM_t^k = d_{k0} + d_{k1} \log(P_x^k / P_d) + d_{k2} \log Y_t + d_{k3} \log ER_t^k + d_{k4} \log IM_{t-1}^k \quad (4.27)$$

The expected coefficient signs of relative prices and bilateral exchange rates are negative but positive for income. d_{k1} ($d_{k1} < 0$) is the price elasticity which captures the effect of competing prices from country k . d_{k2} ($d_{k2} > 0$) is the income elasticity which explains the trade relationship between Iran and country k . d_{k3} ($d_{k3} < 0$) stands for the coefficient of the bilateral exchange rate elasticity in each import equation. Finally, d_{k4} ($0 < d_{k4} < 1$) is the coefficient of the lagged dependent variable indicating the condition of partial adjustment in the models.

4.5 Summary and Conclusions

To meet the enormous requirements of goods, developing countries import a large number of goods in the form of consumer goods, raw materials, machinery or goods for investment. Undoubtedly changes in the determinants of the demand for imports, such as relative prices or income, have a deep effect on the import sector and then upon the whole economy.

The objective of this chapter, therefore, has been to construct the framework of an appropriate import model, recognising its structural relationships, and to specify relevant functional forms. This allows us to evaluate empirically the effects of changes in explanatory variables and some exogenous policies on the import sector and the trade balance. However, the formulation of import demand in this chapter has been based on some particular assumptions in which the import models are postulated to be data admissible and include parameter constancy. Import demand equations are specified in both linear and log-linear forms. The log-linear form is preferable to the linear one because it allows imports to react proportionally to a change in the explanatory variables. In addition, to make a dynamic form for import functions, regression specifications rely on the partial adjustment between actual and desired imports.

Among the explanatory variables of the import function, the relative price expresses the responsiveness of imports to changes in both imports and domestic prices. In practice the effect of changes in the relative price is negative while the impact of an activity variable like income is positive. The exchange rate is the other determinant of the import demand function which has a negative relationship with imports. To incorporate the exchange rate in the import function, its changes have been assumed not to be fully passed on to the import price.

Disaggregated estimates of trade elasticities are important to quantify the impact of the various determinants of import demand, and to provide an actual basis for policy decisions, specially for those related to demand restraint, devaluation, tariffs, etc. Therefore, in this chapter an attempt has been made to model Iranian import demand at the aggregate level and at the disaggregate level. Disaggregated imports appear in the form of the import composition, imported commodity groups, and imports by country of origin. Since all imported commodity groups are not necessarily restrained by government, they have been classified into free imports and restricted imports. Changes in restricted imports with respect to changes in prices are more responsive than those of

freely imported goods, implying that non-price factors can reduce the price effect on the demand for such imports.

Overall, in the next chapter, the behaviour of the aggregate import function will be considered in the framework of a macroeconomic model, so that estimation methods can assist us to interpret the results and identify applicable relationships between demand for aggregate imports and some important economic variables. To examine the variation of elasticities across import categories, Chapter Six will estimate all the disaggregated import equations.

CHAPTER FIVE

5. CONTRIBUTION OF THE AGGREGATE IMPORT FUNCTION TO A MACROECONOMIC MODEL

5.1 Introduction

The objective of the present chapter is to explore how an aggregate import function is explained by economic variables and the extent to which those variables affect import demand. Thereafter a macro-model which describes the demand side of the Iranian economy is developed, emphasising aggregate import demand. The recognition of economic relationships in the model relies on the estimates of parameters which are obtained by appropriate empirical techniques. The model obtains estimates of parameters to provide the key behavioural relationships. Hence the structural parameters are thus estimated as a system.

The present chapter is organised as follows. The conceptual framework for the analysis of the model is developed in Section 5.2. Section 5.3 documents the sources of the data and required data transformation. Section 5.4 presents the estimation procedures and results, mostly obtained by the OLS method. In this section two different categories of exchange rate regime, the official exchange rate and then its black market equivalent, affecting import patterns, are discussed. Concluding remarks are discussed briefly in Section 5.5.

5.2 The Conceptual Framework of the Macro-Model

This section develops a macroeconomic framework to evaluate, theoretically and empirically, the contribution of the aggregate import function to the Iranian economy. The specification of the following multi-equation model can also help to provide some information on the structure of the economy. The equations of the model are explained here and listed in Table 5.1.⁴²

5.2.1 Aggregate Import Demand Function

As previously indicated in Chapter Four, a log-linear equation of aggregate import demand can be specified as follows:

$$\log IM_t = \gamma_0 + \gamma_1 \log (P_m / P_d)_t + \gamma_2 \log Y_t + \gamma_3 \log ER_t + \gamma_4 \log IM_{t-1} \quad (5.1)$$

where P_m / P_d denotes the relative price, Y is real GDP , ER denotes the official real exchange rate, IM_{t-1} denotes lagged imports. The import price (P_m), the domestic price (P_d), and real income (Y) would be determined endogenously by various economic variables used in the model.

5.2.2 Import Price Equation

The changes in the prices of imports are usually affected by a change in the exchange rate (Agenor 1990). The movement of the import price (P_m) is determined by changes in the prices of the country's major trading partners (P_w) and changes in the official real exchange rate (ER). It is assumed that foreign prices (P_w) are exogenous to pricing decisions in the Iranian economy (Pesaran 1992).

$$\log P_{mt} = \phi_0 + \phi_1 \log ER_t + \phi_2 \log P_{wt} \quad (5.2)$$

⁴² The definition of each variable is given in Table 5.2.

5.2.3 Domestic Price Equation

The domestic price level, P_d , is defined as a geometric average of the price of imported goods P_m , and the price of non-traded goods P_n :

$$P_{dt} = P_{mt}^{\omega_1} P_{nt}^{\omega_2} \quad 0 < \omega_1, \omega_2 < 1 \quad \omega_1 + \omega_2 = 1 \quad (5.3)$$

where ω_i measures the share of imported goods in total expenditure. Taking log differences of equation (5.3) gives

$$\Delta \log P_{dt} = \omega_1 \Delta \log P_{mt} + \omega_2 \Delta \log P_{nt}, \quad \omega_1 + \omega_2 = 1 \quad (5.4)$$

where Δ stands for the first difference operator.⁴³

Since an excess supply of money implies an excess demand for both traded and non-traded goods, an increase in the money supply affects the demand side of the economy resulting in an excess demand for non-traded goods. There is, therefore, a positive relationship between changes in the price of non-traded goods and the excess supply of the real money stock (Khan and Knight 1991) as well as the expected inflation rate (Agenor 1990). The following equation specifies the determination of changes in the price of non-traded goods:

$$\Delta \log P_{nt} = \zeta_1 (\log m_{t-1} - \log m_t^d) + \zeta_2 \pi_t, \quad \zeta_1 > 0 \text{ and } 0 \leq \zeta_2 \leq 1 \quad (5.5)$$

where m denotes the real money stock (deflated by the domestic price index), m^d is the demand for real cash balances, and π_t is the expectation of the rate of inflation for the period t . The elasticity of non-traded goods prices with respect to the excess supply of real money balances is denoted by ζ_1 , while ζ_2 determines the proportion in which non-traded goods prices change with the expected domestic inflation rate.

Substituting equation (5.5) for $\Delta \log P_{nt}$ in equation (5.4) gives

$$\Delta \log P_{dt} = \omega_1 \Delta \log P_{mt} + \omega_2 \zeta_1 (\log m_{t-1} - \log m_t^d) + \omega_2 \zeta_2 \pi_t \quad (5.6)$$

43 Following Khan and Knight (1991), taking log difference of equation (5.4) leads us to specify correctly a log-linear form equation for the domestic price.

Expectations of inflation are assumed to be generated by Cagan's (1956) adaptive expectations model. Inflationary expectations are revised proportionally to the difference between the actual rate of inflation and its expected rate formed in the previous period:

$$\dot{\pi}_t = \lambda' \left[\left(\frac{\dot{P}_d}{P_d} \right)_{t-1} - \pi_{t-1} \right] \quad (5.7)$$

or

$$\Delta \pi_t = \lambda' [\Delta \log P_{dt-1} - \pi_{t-1}] \quad (5.8)$$

where $0 \leq \lambda' \leq 1$. Rearranging equation (5.8), the determination of the expected inflation rate in the current period, π_t , will be as follows:

$$\pi_t = \lambda' \Delta \log P_{dt-1} + (1 - \lambda') \pi_{t-1} \quad (5.9)$$

Substituting (5.9) for π_t into (5.6), the domestic price equation becomes:

$$\Delta \log P_{dt} = \psi_1 \Delta \log P_{mt} + \psi_2 (\log m_{t-1} - \log m_t^d) + \psi_3 \Delta \log P_{dt-1} + \psi_4 \pi_{t-1} \quad (5.10)$$

where $\psi_1 = \omega_1$, $\psi_2 = \omega_2 \zeta_1$, $\psi_3 = \omega_2 \zeta_2 \lambda'$ and $\psi_4 = \omega_2 \zeta_2 (1 - \lambda')$.

In the monetary sector the demand for real money balances, m^d , is assumed to depend upon real non-oil income, Yno , and the effect of lagged demand for the real stock of money, m_{t-1}^d . The effect of income and the lagged dependent variable means that money is mostly demanded for transactions purposes in the country:

$$\log m_t^d = k_0 + k_1 \log Yno_t + k_2 \log m_{t-1}^d \quad (5.11)$$

where k_1 and k_2 denote the income elasticity and the coefficient of the lagged money demand, respectively.

5.2.4 Government Expenditure Equation

The majority of government revenue comes from oil exports and is denominated in foreign exchange. The domestic spending of these revenues affects aggregate demand for traded and non-traded goods, leading to an effect on imports, domestic output, and prices. Any increase in government expenditure resulting from higher oil revenues affects imports through three channels. First, government expenditure on foreign goods increases imports directly. Second, government expenditure on non-traded goods results in an expansion of the money supply, leading to an increase in private expenditure on all goods including imports. Third, higher private expenditure leads to higher non traded prices, further increasing the demand for imports. Therefore, both real government expenditure (Ge) and real private expenditure (Pex) are the major determinants of real GDP (Y) which affects the demand for imported goods.

The government is assumed to have planned its expenditures on the basis of a balanced budget policy. Thus the authorities desire to spend all of the available revenues in the long-run. However, expenditures are adjusted, with a lag, to any changes in government total revenues (Yg). As a result real government expenditure is assumed to be a function of real government revenues (Yg) consisting of the real government oil revenues (Ygo) and real government non-oil revenues ($Ygno$). Including lagged government expenditure (Ge_{t-1}) gives a dynamic form of the equation.⁴⁴ A log-linear equation of government expenditure and the identity of total government revenues are specified respectively as below

$$\log Ge_t = \delta_0 + \delta_1 \log Ygno_t + \delta_2 \log Ygo_t + \delta_3 \log Ge_{t-1} \quad (5.12)$$

and

$$Yg \equiv Ygno + Ygo \quad (5.13)$$

⁴⁴ Some studies of Iran and other oil-exporting countries (Aghevli and Sassanpour-1982, Sassanpour-1985, and Vaez-Zadeh-1989) have shown that the level of government expenditure in each period is established in such a way as to move toward a balanced budget policy over time. The adjustment of government expenditure is thus a proportion of the change between government revenues and the lagged value of government expenditure [$Ge_t = \xi(Yg_t - Ge_{t-1})$].

Since the oil prices are determined officially outside Iran, government oil revenues (Ygo) or total oil revenues (Yo) should be exogenous (Motamed-1979 and Vaez-Zadeh-1989), whereas government domestic revenues ($Ygno$) will be related positively to non-oil income (Yno) and its lagged value. Here is a specification of the government domestic revenues (or government non-oil revenues) equation:

$$\log Ygno_t = l_0 + l_1 \log Yno_t + l_2 \log Ygno_{t-1} \quad (5.14)$$

where $Ygno_{t-1}$ denotes the lagged value of government non-oil revenues (government domestic revenues). Non-oil income, Yno , is thus defined by identity (5.15)

$$Yno \equiv Pex + Ge + (Xno - IM) \quad (5.15)$$

where Xno stands for real non-oil exports and are assumed to be exogenous.⁴⁵ As a result, an identity for real income or real GDP (Y) can be defined as follows:

$$Y \equiv Yno + Yo \quad (5.16)$$

5.2.5 Private Expenditure Equation

Real private aggregate expenditure (Pex) is postulated to vary with real non-oil income, Yno , and its lagged value of one period, Pex_{t-1} . The following equation specifies a log-linear form of the private expenditure function:

$$\log Pex = \phi_0 + \phi_1 \log Yno_t + \phi_2 \log Pex_{t-1} \quad (5.17)$$

In brief, referring to the import function specified in equation (5.1), three endogenous variables (import price, domestic price, and real income) can influence the demand for aggregate imports. Such variables may be simultaneously determined by some other variables which can be exogenous or endogenous or both.

⁴⁵ In spite of feedback effects between exports and imports discussed in Chapter Two and Chapter Three, non-oil exports are assumed to be defined as an exogenous variable. This enables us to simplify the macro-model given in Table 5.1 and also focus only on the import sector. In addition, this assumption is reasonable because, as we will discuss in Chapter Seven, in Iran the promotion of non-oil exports has been always expressed as an economic policy to affect the growth process.

Following Aghveli and Sassanpour (1982), and Khan and Knight (1991) the above structural equations containing endogenous variables are linked within the framework of a macro model. The basic framework incorporates the effects of such variables on the economy of Iran. The model contains seven behavioural equations and three identities explaining ten endogenous variables. Equations. (5.1), (5.2), (5.10), (5.11), (5.12), (5.14), and (5.17) indicate the behavioural equations while equations (5.13), (5.15), and (5.16) define the basic identities of the model. Table 5.1 provides an econometric structure of the model which, relies on a macroeconomic framework including aggregate demand, prices, the external sector, and the monetary sector.

5.3 Sources and Transformation of Data

The definition of all variables for both cases is also given in Table 5.2. All data are annual figures taken from the following sources, that cover the period 1970-1993 for Iran:

- *Source I:* International Financial Statistical Yearbook, International Monetary Fund (IMF), 1980-1995.
- *Source II:* The Yearbook of World Tables, World Bank, 1992-1995.
- *Source III:* The Annual Report of the Central Bank of Iran (CBI), 1993 and 1994.
- *Sources IV:* "Time Series of National, Financial and Monetary Accounts", The Budget and Planning Organisation of Iran (BPOI), (1994).
- *Source V:* "A Detailed Report on the Revised Indices of the Wholesale Prices in Base Year 1990", The CBI (the Central Bank of Iran), Nov. 1993.
- *Source VI:* "The Annual Report of Iran's Customs, Year-book of Foreign Trade Statistics, the Ministry of Economic Affairs and Finance", 1970-1992.
- *Source VII:* "Daily Reports on the Free Market of the Exchange Rate", Technical Information Centre of Iran (T.I.C.I.), 1985-1994.

Table 5.1: List of equations of the macroeconomic model.

Classification	Behavioural Equation	Identity
Aggregate Demand:		
$\log Ge_t = \delta_0 + \delta_1 \log Ygno_t + \delta_2 \log Ygo_t + \delta_3 \log Ge_{t-1} + \delta_4 D_2 + u_{1t}$	×	
$Yg \equiv Ygno + Ygo$		×
$\log Ygno_t = l_0 + l_1 \log Yno_t + l_2 \log Ygno_{t-1} + l_3 D_3 + u_{2t}$	×	
$Yno \equiv Pex + Ge + (Xno - IM)$		×
$Y \equiv Yno + Yo$		×
$\log Pex = \phi_0 + \phi_1 \log Yno_t + \phi_2 \log Pex_{t-1} + \phi_3 D_2 + u_{3t}$	×	
External Sector:		
$\log IM_t = \gamma_0 + \gamma_1 \log (P_m / P_d)_t + \gamma_2 \log Y_t + \gamma_3 \log ER_t + \gamma_4 \log IM_{t-1} + \gamma_5 D_2 + \gamma_6 D_3 + u_{4t}$	×	
$Xno \equiv \bar{X}no^*$		
Prices:		
$\log P_{mt} = \varphi_0 + \varphi_1 \log ER_t + \varphi_2 \log P_{wt} + \varphi_3 D_3 + u_{5t}$	×	
$\Delta \log P_{dt} = \psi_1 \Delta \log P_{mt} + \psi_2 (\log m_{t-1} - \log m_t^d) + \psi_3 \Delta \log P_{dt-1} + \psi_4 \pi_{t-1} + \psi_5 D_2 + u_{6t}$	×	
Monetary Sector:		
$\log m_t^d = k_0 + k_1 \log Yno_t + k_2 \log m_{t-1}^d + k_3 D_1 + u_{7t}$	×	

* As discussed earlier in Section 5.2.4 of the present chapter, non-oil exports are defined as an exogenous variable.

Table 5.2: List of variables.

Variable	Definition	Source
<i>Endogenous Variables</i>		
IM	total real merchandise imports, fob	<i>VII</i>
P_m	import price index	<i>V</i>
P_d	domestic price index	<i>V</i>
Y	real income (GDP)	<i>III</i> and <i>IV</i>
Y_{no}	real non-oil income	<i>III</i> and <i>IV</i>
Ge	real government expenditure	<i>III</i> and <i>IV</i>
Pex	real private expenditure	<i>III</i> and <i>IV</i>
Y_{gno}	real government non-oil revenues	<i>III</i> and <i>IV</i>
Y_g	total real government revenue	<i>III</i> and <i>IV</i>
m^d	actual level of real money balances	<i>III</i> and <i>IV</i>
BM	real black market exchange rate	<i>VII</i>
<i>Predetermined Variables</i>		
E_n	nominal (official) exchange rate	<i>II</i>
ER	real official exchange rate	calculated
P_w	the price index of major trading partners	<i>I</i> and calculated
Y_o	oil revenues	<i>III</i> and <i>IV</i>
X_{no}	real non-oil exports	<i>VI</i>
Y_{go}	real government oil revenues	<i>III</i> and <i>IV</i>
$Y_{gno_{t-1}}$	lagged real government non-oil revenues	-
Pex_{t-1}	lagged real private expenditure	-
IM_{t-1}	lagged real total imports	-
$m_{t-1} = m^d_{t-1}$	lagged real money balances	-

continued

Table: 5.2 (continued).

π_{t-1}^*	expected inflation rate formed in $t-1$	I
P_{dt-1}	lagged domestic price	-
D_1^a	dummy variable	-
D_2^b	dummy variable	-
D_3^c	dummy variable	-

* Lagged values of the rate of change of the consumer price index (CPI).

^a Dummy variable for the rise in the oil price in 1974 and 1979-1981.

^b Dummy variable for the revolution and war episodes in 1979 and 1980.

^c Dummy variable for the fall in the oil price and exchange earnings in 1986-88.

The data for the price indices including the import price (P_m) and the domestic price (P_d) indices drawn from the report of CBI, (1993), were scaled to 100 in 1990. However, they are transferred to a base year of 1982.⁴⁶ This is because much of the data used here is available with a base year of 1982 (given in Sources III, IV, and V). The index of the world price (P_w) is calculated as a weighted average of the prices of Iran's major trading partners.⁴⁷ According to Pesaran (1992), U.S., Germany, Japan, U.K., Italy, France, Turkey, Holland, and Australia were the major trading partners of Iran in 1976 and 1985. In addition, the world price index is also converted to the new base year 1982.

The official real exchange rate, ER , is defined in its general form and can be calculated as follows:

$$ER = \frac{E_n / P_d}{1 / CPI^{US}} \quad (5.18)$$

⁴⁶ To transfer indices to a base year of 1982, we used the following formula:

$$P_{t,1982} = P_{t,1990} \cdot \frac{L}{L'}$$

where $P_{t,1982}$ and $P_{t,1990}$ are price indices based on 1982 for year t and a price index based on 1990 for year t , respectively. L is the index price of the new base year (1982) with respect to the new base year (i.e. $L = 100$), and L' is the index price of the old base year (1990) in the new base year (1982).

⁴⁷ This price index can be calculated by using the following formula:

$$P_{wt} = \sum_{i=1}^9 w_i E_{it}^{US} P_{it}^*$$

where w_i is the weighted average defined as the import share of the i th partner. The weights are given in Table B.1 in Appendix B. E_{it}^{US} is the exchange rate between the U.S. dollar and the currency of partner i , defined as the number of U.S. dollars per unit of the i th partner currency. P_{it}^* is the consumer price index of the i th partner of Iran based on 1985 data (Source I).

where E_n is the nominal exchange rate expressed in units of domestic currency per U.S. dollar⁴⁸, P_d is the domestic price index, and CPI^{US} is the consumer price index of the U.S. (Dornbusch et al. 1988).

5.4 Estimation Results

The behavioural equations of the model are estimated by applying the OLS (ordinary least squares) technique, using annual data for Iran over the period 1970-1993.⁴⁹ The use of OLS, as the major estimation method conducted in this study, and comparing and contrasting the OLS against the 2SLS and 3SLS will be shortly discussed in Appendix C. Based upon the statistical tests the estimation results are mostly acceptable, and the model captures the required features of the Iranian economy. The empirical results indicate that the equations of the model perform well and consist of high values for the \bar{R}^2 (adjusted R-squared) coefficient, with two exceptions⁵⁰, as well as appropriate values of the DW and h statistics. Almost all of the coefficients have the expected signs, and are particularly similar to the findings of Aghevli and Sassanpour (1982), and Khan and Knight (1991).

Three dummy variables are introduced in the model to account for the sharp rise in the oil price in 1974 and 1979-1981 (D_1), for the revolution in 1979 and the first year of the war between Iraq and Iran in 1980 (D_2), and for the collapse of the oil price resulting in a sharp reduction in foreign exchange from 1986 to 1988 (D_3).⁵¹ The estimation results

⁴⁸ The U.S. dollar still has a dominant role in both the official and free markets for foreign exchange in Iran.

⁴⁹ The equations for government non-oil revenues and the import price have been estimated by AR1 (first-order autoregressive including maximum likelihood and Cochrane-Orcutt iterative techniques) to correct for autocorrelation of the residuals.

⁵⁰ Due to the estimation results reported in Table 5.3, the value of \bar{R}^2 for the estimated equations of the domestic price and government non-oil revenues is 0.852 and 0.691, respectively.

⁵¹ Dummy variables are particularly useful when dealing with qualitative data. By using dummy variables, we may distinguish between three different cases of a simple regression model:

Case I
$$Y_i = b_0 + b_1 X_i + b_2 D_i + u_i$$

where Y is defined as a dependent variable, X stands for an independent variable, D is a dummy variable, and u is a disturbance term. The dummy variable, for example, is equal to 1 if it is wartime and 0 otherwise. By taking expected values on both sides of the equation above (Case I), $E(Y)$ is equal to $[(b_0 + b_2) + b_1 E(X_i)]$ in wartime and $[(b_0 + b_1 E(X_i))]$ in peacetime. Thus, this can be related to the

of the entire model are reported in Table 5.3. The estimation of the model has been carried out by using the Time Series Processor (TSP) econometric package.

The estimated coefficients of the government expenditure function are of the anticipated signs. Both government non-oil revenues (Y_{gno}) and government oil revenues (Y_{go}) explain significantly government expenditure (Ge) at the 95 percent confidence levels. The lagged dependent variable (Ge_{t-1}) is also significant, with a coefficient value of about 0.5 in the equation. The dummy variable D_1 reveals the fact that a rise in the oil price in 1974 and 1979-1981 led to an increase in real government expenditure. But the significant dummy variable D_2 shows that the events of the revolution in 1979 and the first year of the Iran-Iraq war, caused real government expenditure to fall.⁵²

Government domestic revenues (government non-oil revenues) are positively sensitive to their lagged values and non-oil income (Y_{no}), while the coefficient of the latter variable is larger than that with respect to the former one. The presence of the significant dummy variable D_3 in the equation, makes clear that the collapse of the oil price, and then the sharp reduction in exchange earnings in 1986-88, affected government receipts from the oil sector.

The estimation of real private expenditure (Pex) suggests that real non-oil income (Y_{no}), with an estimated coefficient at about 0.8, is the main factor explaining variations in private expenditure at the 95 percent confidence level, while the lagged private expenditure is only significant at the 10 percent level. These results can be interpreted as

assumption that the intercept of the regression function changes during wartime but the slope parameter remains constant.

Case II
$$Y_t = b_0 + b_1 X_t + a(D_t X_t) + u_t$$

In this case, $E(Y) = b_0 + (b_1 + a)E(X_t)$ in wartime and $E(Y) = b_0 + b_1 E(X_t)$ in peacetime. Thus the intercept remains constant while the slope changes.

Case III
$$Y_t = b_0 + b_1 X_t + b_2 D_t + a(D_t X_t) + u_t$$

In this case, both the intercept and slope are allowed to change.

To simplify the use of dummy variables in this study, three dummy variables (D_1 , D_2 , and D_3) mentioned are only considered as *Case I* in the regression models, so that the intercepts of the equations change but the slopes stay constant.

⁵² In practice, because of these events, government total revenues decreased by about 22% in 1979/80 even though the oil price was increasing during the period 1979-81 (CBI). This decrease in government revenues caused government expenditure to fall.

Table 5.3: Estimated macro-model, 1970-1993 (log-log, annual data).

Equation	Variable	Parameter	t-statistic
Aggregate Demand			
Government Expenditures			
	Constant	$\delta_0 = 0.645$	2.731**
	Y_{gno}	$\delta_1 = 0.298$	6.578***
	Y_{go}	$\delta_2 = 0.121$	8.949***
	Ge_{t-1}	$\delta_3 = 0.549$	14.166***
	D_1	$\delta_4 = 0.114$	2.726**
	D_2	$\delta_5 = -0.093$	-2.658**
$\bar{R}^2 = 0.986, DW = 2.063^a$			
Government Non-Oil Revenues			
	Constant	$l_0 = -0.126$	-0.107
	Y_{no}	$l_1 = 0.498$	2.521**
	$Y_{gno,t-1}$	$l_2 = 0.377$	2.223**
	D_3	$l_3 = -0.325$	-3.031***
$\bar{R}^2 = 0.691, h = 0.379$			
Private Expenditures			
	Constant	$\phi_0 = -0.592$	-1.208
	Y_{no}	$\phi_1 = 0.797$	5.001***
	Pex_{t-1}	$\phi_2 = 0.256$	1.966*
	D_2	$\phi_3 = -0.104$	-2.5471**
$\bar{R}^2 = 0.960, h = 1.269$			
External Sector			
Aggregate Imports			
	Constant	$\gamma_0 = -3.723$	-2.915***
	P_m / P_d	$\gamma_1 = -1.382$	-1.942*
	Y	$\gamma_2 = 0.904$	1.834*
	ER	$\gamma_3 = -0.407$	-0.789
	IM_{t-1}	$\gamma_4 = 0.437$	3.077***
	D_2	$\gamma_5 = -0.249$	-1.877*
	D_3	$\gamma_6 = -0.576$	-4.451***
$\bar{R}^2 = 0.913, h = 0.052$			
Monetary Sector			
Demand for Money			
	Constant	$k_0 = -2.411$	-2.896**
	Y_{no}	$k_1 = 0.405$	3.758***
	m^d_{t-1}	$k_2 = 0.773$	16.548***
	D_1	$k_3 = 0.084$	2.665**
$\bar{R}^2 = 0.991, h = 0.626$			

(continued)

Table 5.3 (continued).

Equation	Variable	Parameter	t-statistic
<i>Prices</i>			
Domestic Price	Constant	$\psi_0 = 0.078$	3.156***
	P_m	$\psi_1 = 0.494$	4.932***
	$m_{t-1} - m^d_{t-1}$	$\psi_2 = 0.130$	1.792*
	P_{dt-1}	$\psi_3 = 0.372$	3.012**
	π_{t-1}	$\psi_4 = -0.003$	-2.543**
	D_2	$\psi_5 = 0.034$	1.917*
	$\bar{R}^2 = 0.852, h = -1.529$		
Import Price	Constant	$\phi_0 = -1.141$	-1.266
	ER	$\phi_1 = 0.008$	0.058
	P_w	$\phi_2 = 1.229$	17.94***
	D_3	$\phi_3 = 0.200$	3.153***
	$\bar{R}^2 = 0.974, DW = 1.80^b$		

* Indicates parameter significance at the 10 percent level.

** Indicates parameter significance at the 5 percent level.

*** Indicates parameter significance at the 1 percent level.

^a Corrected for autocorrelation by the Cochrane-Orcutt iterative technique.

^b Corrected for autocorrelation by the maxium likelihood iterative technique.

“habit persistence”, in which the private sector tries to continue prior expenditure patterns because of habits acquired from experiences related to consumption expenditure (Gapinski 1982). The sharp fall in the oil price and foreign exchange during 1986-1988 has also influenced significantly the private sector, even though the coefficient of the relevant dummy variable (D_3) is quite small (about 0.1)

The coefficient of the estimated money demand function are all significant and of the expected sign. Money demand (m^d) is income inelastic in the short-run with an elasticity estimated at about 0.41, whereas it is quite income elastic in the long-run with an elasticity estimated at about 1.8. This suggests that changes in non-oil income (Y_{no}) would induce substantial changes in the demand for money. The long-run estimated elasticity confirms the findings of Khan and Knight (1991) of a significant income elastic coefficient in the demand for money function of developing countries. According to them, since there are various financial substitutes for money in developed countries, the income elasticity may be less than unity. As a result, they find:

“In financially developed economies, one might expect to observe a roughly proportional relationship between real money balances and real income, but in developing countries the demand for cash balances often rises more than proportionally to the growth in income, owing to the secular process of monetisation and the absence of alternative liquid financial assets in which private savings may be held.” (Khan and Knight (1991), pages 56 and 57)

Finally, a significant dummy variable (D_1) in the equation of money demand clearly indicates that the oil price shock in 1974 and 1979-1981 affected the monetary sector.

The estimation of the price changes of domestically produced goods (P_d) indicates that changes in the import price (P_m) and monetary factors (m) significantly contribute to increases in the price of these goods. The estimated coefficient of import price changes ψ_1 is 0.49, which is highly significant at the 1 percent level. Its value in the long run is calculated at about 0.79. In principle this coefficient is the geometric average of the price of imported goods shown in identity (5.4), which measures the share of imported

goods in total expenditures. The weight of the price of non-traded goods, ω_2 , calculated from the estimated domestic price equation and identity (5.4) is 0.51.⁵³

Disequilibrium movements in the monetary sector also explain significantly changes in the price of domestic goods. Its estimated elasticity with respect to the excess supply of real money, ψ_2 , is about 0.13 in the short run and 0.21 in the long run. This means that a 1 percent increase in the growth of excess real money supply raises the rate of domestic price changes by 0.13 and 0.21 percent in both periods, respectively. The elasticity of the price of non-traded goods with respect to the excess money supply (ζ_1) in equation (5.5), can be calculated at about 0.25 by taking into account the value of the estimated ψ_2 .⁵⁴ By using the estimated coefficients of lagged domestic price changes, ψ_3 , and the inflation rate, ψ_4 , ζ_2 , and λ' shown in (5.5) and (5.7) can be calculated. ζ_2 ($\zeta_2 = 0.73$), the proportion of changes in the price of non-traded goods with respect to the expected inflation rate (π), indicates that about 73 percent of the increase in non-traded goods prices are explained by expectations of changes in the domestic inflation rate. λ' is shown to become nearly unity, which means all effects of the expected inflation rate formed in the previous period would be transferred to the current period.⁵⁵ The effects of the revolution in 1979 and the war in 1980 are significant on the domestic price equation, with the estimated coefficient, ψ_5 , at about 0.034.

5.4.1 Estimation Results for the Import Demand and Import Price Equations

The main analysis of the estimated model relies on the investigation of results obtained for the import demand and import price functions. According to Table 5.3, all of the estimated coefficients in the import demand equation have the expected sign. The coefficients of the overall import equation suggest a high and significant price elasticity, a low and significant income elasticity, and an insignificant official exchange rate elasticity. It also suggests a significant downward shift in the import function with the

⁵³ $\psi_1 = \omega_1 = 0.49$ and $\omega_2 = 1 - \omega_1 = 0.51$.

⁵⁴ As shown earlier, $\psi_2 = \omega_2 \cdot \zeta_1 = 0.13$ and $\zeta_1 = 0.25$.

⁵⁵ Solving for $\psi_3 = \omega_2 \cdot \zeta_2$, $\lambda' = 0.372$ and $\psi_4 = \omega_2 \cdot \zeta_2 (1 - \lambda') = -0.003$, we obtain: $\zeta_2 \cong 0.73$ and $\lambda' \cong 1$.

events of the revolution and the Iran-Iraq war in 1979-1980, as well as a downward shift in imports with the decrease of the oil price and exchange earnings in 1986-1988.

The estimation results of the import equation indicate that the coefficients of relative prices, lagged imports (IM_{t-1}), and dummy variable D_3 are highly significant at the 5 percent level, while the coefficient of income and the dummy variable D_2 are only significant at the 10 percent level. The elasticity of imports with respect to income is around 0.9. The long-run value of this elasticity is about 1.6, much higher than its value in the short-run period.

The variable of relative prices is quite elastic (with a value of about -1.4 in the short-run and a higher value of about -2.5 in the long-run for its coefficient) and its estimated coefficient captures a correct theoretical sign. The official real exchange rate does not capture the correct sign and its coefficient is also not significant, indicating that the demand for imports does not react to changes in the official exchange rate. This suggests that the existence of the parallel foreign currency market (black market exchange rate) in Iran may have an important effect on import demand. The effect of this is tested in the next section.

As mentioned earlier, the estimated coefficient of lagged imports is significantly different from zero at the 1 percent level, with a value of 0.44 ($\gamma_5 \cong 0.44$). However, the adjustment of actual imports to the desired level is very slow. The mean lag of adjustment is computed as $(1-\gamma_5 / \gamma_5)$, and is 15 months. In other words, the period required is 15 months to eliminate 56 percent of any disequilibrium between actual and desired demand for imports.⁵⁶

The estimation results satisfy the expected sign for the coefficient of the world price which is highly significant in the import price equation. This equation thus gives a dominant role to the world price index, P_w , in the determination of the import price during the 1970-1993 period. The coefficient of the official exchange rate in real terms

⁵⁶ The estimated partial adjustment, λ , is calculated as: $\lambda = 1 - \gamma_5 = 0.56$.

is seen to be so small, and not different from zero in the estimated import price equation. It implies that changes in the official exchange rate authorised by the CBI (Central Bank of Iran) has not influenced import price changes. However, the collapse of the oil price and then the sharp fall in foreign exchange holdings (dummy variable D_3), affected the import price during the period considered. The evidence of no significant coefficients of the official exchange rate in both the estimated aggregate import demand and import price equations is likely to arise from the existence of an important parallel foreign currency market.

5.4.1.1 The Role of the Black Market Exchange Rate

The exchange rate system consists of a dual rate regime, in which an official exchange rate exists with an illegal or semi-illegal black market for foreign exchange. The black market exchange rate is determined by the interaction between supply and demand for foreign exchange (Agenor 1990). But the official exchange rate is set by the monetary authorities and is treated as a policy instrument. The official exchange rate is not relevant for the determination of the market prices of imported goods. It only measures the rents captured by government and a small group of importers, to whom foreign exchange is made available at the official rate.

There have been two very different periods for Iran during the 1970s and 1980s, pre-revolutionary and post-revolutionary. Because of fundamental changes produced by oil price shocks, the eight year war, and the foreign exchange crisis in the post-revolutionary period, the black market has been growing. Imports have thus been priced by the black market premium (Pesaran 1992). The implication is that the coefficient of the official real exchange rate in the aggregate import equation and import price equation (as empirically noted earlier), has been close to zero and not statistically significant.

To identify the effect of the black market exchange rate (BM) on aggregate imports, we substitute the black market premium (BM / ER), for the exchange rate in the following

stochastic aggregate import demand equation. The equation is therefore re-specified as follows:

$$\log IM_t = \gamma_0 + \gamma_1 \log (P_m / P_d)_t + \gamma_2 \log Y_t + \gamma_3 \log (BM / ER)_t + \gamma_4 \log IM_{t-1} \quad (5.19)$$

$$\gamma_5 D_2 + \gamma_6 D_3 + u_{4t}$$

Table 5.4 summarises the short-run and the long-run results of testing this equation. Statistical significance is achieved at the 1 percent level for most variables, with the exception of lagged imports which is significant at the 5 percent level, using the OLS method. All explanatory variables have captured the expected signs. The estimated regression is also tested for several problems that could potentially affect the validity of the results (Maddala 1992). The Durbin *h* statistic (-0.402) does not reject the null hypothesis that there is no first-order autocorrelation. The properties of the disturbance term are also examined by applying the ARCH statistic (Engle 1982) to test for homoscedasticity. The ARCH test gives no evidence of heteroscedasticity.⁵⁷ The Jarque-Bera test (Jarque-Bera 1980) for normality indicates that there is no evidence for non-normal residuals.⁵⁸ In addition, the Ramsey RESET test (Ramsey 1969) is employed to detect any regression specification error. According to the statistic test, no evidence is found for misspecification.⁵⁹

A comparison of the results for the two estimated import equations [eq. (5.1) and eq. (5.19)] shows that the most important results are the differences in the size of the price elasticity, income elasticity, and the coefficient of lagged imports. Real income is inelastic in the short-run at about 0.9 and elastic in the long-run, with a value of 1.4, highly affecting imports. The elasticity of relative prices is roughly -1.6 in the short-run, and much higher at about -2.4 in the long-run, indicating a high price elasticity of

⁵⁷ The ARCH statistic obtained here is 0.430 which is distributed as chi-square, $\chi^2(1)$, with one degree of freedom. The 5 percent critical value for the test is 3.841.

⁵⁸ As shown in Table 5.4, the value of chi-square, $\chi^2(2)$, with 2 degrees of freedom for the Jarque-Bera test is 0.361 while the 5 percent critical value for the test is 5.991.

⁵⁹ Ramsey's RESET2 test for misspecification is distributed as *F* with (1, *n-k-1*), degrees of freedom; RESET3 with (2, *n-k-2*) degrees of freedom; RESET4 with (3, *n-k-3*) degrees of freedom. The 5 percent critical values for RESET2, RESET3, and RESET4 are 4.54, 3.47, and 3.41, respectively.

Table 5.4: Short-run and long-run results for the estimated import function including the black market exchange rate premium, 1970-1993.

Period	C	P_m / P_d	Y	BM / ER	IM_{t-1}	D_1	D_2
Short-run	-2.361 (-1.010)	-1.569 (-3.086)**	0.926 (2.814)*	-0.657 (-4.670)**	0.336 (2.638)*	-0.336 (3.354)**	-0.347 (-3.114)**
	$\bar{R}^2 = 0.948$		$h = -0.402$	$\chi^2(1)^a = 0.430$			
	$\chi^2(2)^b = 0.361$		$F(1,15)^c = 1.740$	$F(2,14)^c = 0.839$	$F(3,13)^c = 0.643$		
Long-run	-3.556	-2.363	1.395	0.989			

Figures in parenthesis are t-statistics.
 * Indicates parameter significance at the 5 percent level.
 ** Indicates significance at the 1 percent level.
^a ARCH test statistic
^b Jarque-Bera test statistic
^c Ramsey's RESET test statistic

imports in both periods. The implication is that because of the importance of oil exports the price elasticity of Iran's total exports is rather small. The high price elasticity of imports satisfies the Marshall-Lerner condition, in which a depreciation of the Iranian Rial is quite effective.

Contrary to the non-significance of the official exchange rate in the earlier import function, changes in the black market premium of foreign currency is now highly significant. The elasticity of the black market premium with respect to imports has been captured by estimation at about -0.66, indicating that a 1 percent devaluation of the exchange rate in the black market will reduce total imports by 0.7 percent. This elasticity in the long run is higher with a value of about -0.99.

A plot of estimated and actual imports shown in Figure 5.1, and Figure 5.2 compares two cases of 'the goodness of fit' where either the official exchange rate (Case A) or the black market premium (Case B) has been included in the estimated aggregate import model. Figure 5.3 also illustrates a plot of residuals from the import equation for both cases.

Figure 5.1: Estimated and actual imports, with the official real exchange rate included in the import function (Case A).

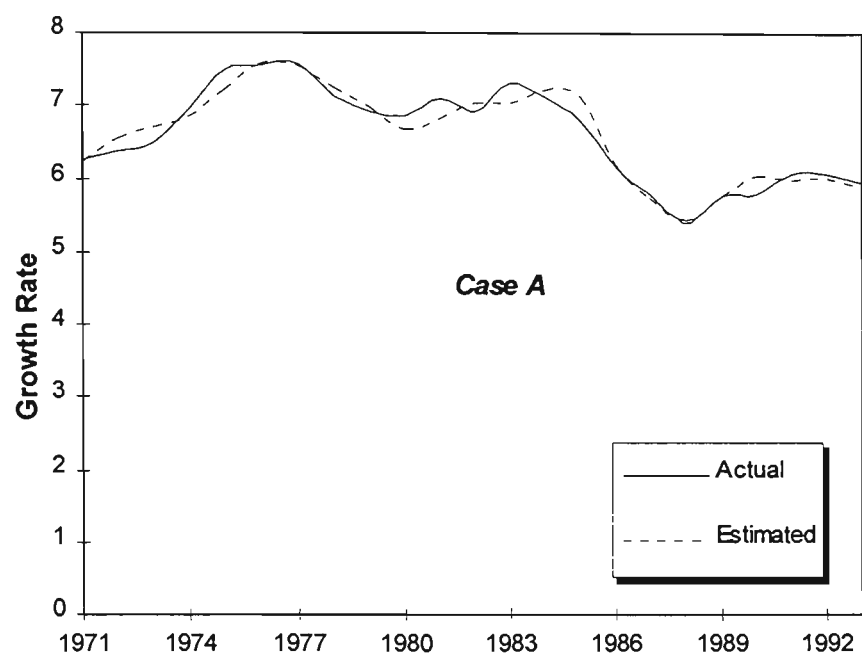


Figure 5.2: Estimated and actual imports, with the parallel (black) market exchange rate included in the import function (Case B).

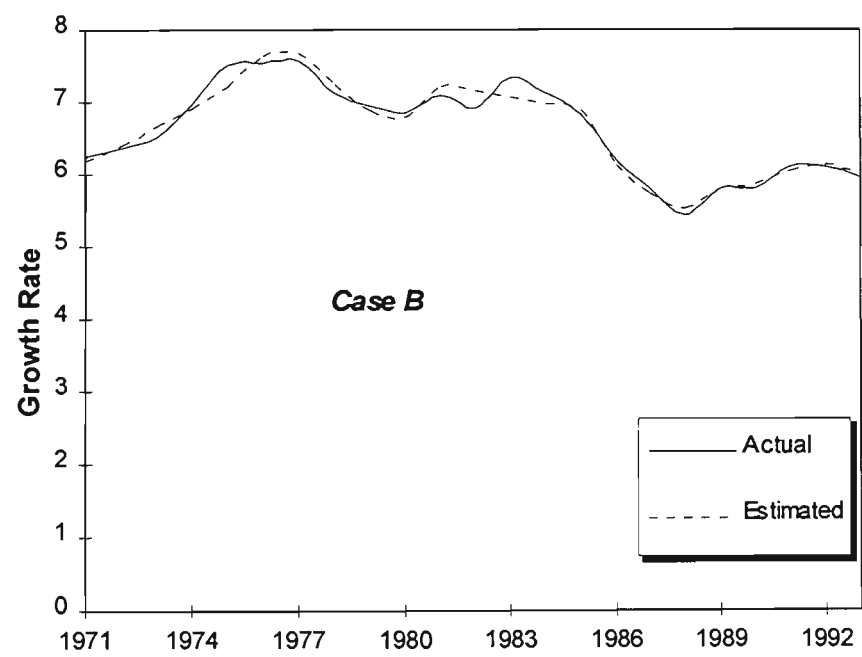
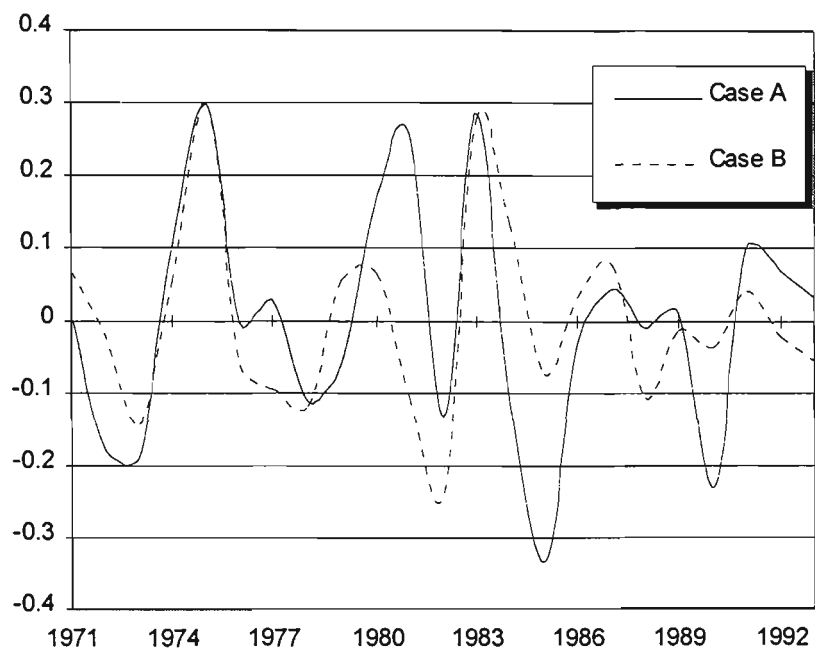


Figure 5.3: Residuals from the import equation with the inclusion of the official real exchange rate (Case A) and its parallel market premium (Case B).



As previously shown, in the import price equation, the coefficient of the official real exchange rate was small and not significant. However, the role of the parallel exchange rate is quite different in the re-specification of the import price equation. According to the estimated import price equation, changes in the parallel exchange rate is well defined statistically, although relatively small. Using data over the 1970-1993 period the following regression results were obtained:

$$\begin{aligned} \log P_{mt} &= 1.499 + 0.312 \log (BM / ER)_t + 0.825 \log P_{wt} & (5.20) \\ &\quad (2.032) \quad (2.119) \qquad \qquad (2.895) \\ \bar{R}^2 &= 0.983, \quad DW = 1.429 \end{aligned}$$

where the bracketed figures are the t-ratios. The equation passes all the above tests and still gives a dominant role to the world price index in the determination of import prices during the period. These results contradict Pesaran's findings (1992), where he could not find statistically significant effects of the black market premium in equivalent regressions using Iranian data over the 1960-87 period. A reason may be that a majority of data used by Pesaran (1992) covers the pre-revolutionary period (1960-1979), while

the equivalent data used by this study covers mostly the post-revolutionary period in which the black market exchange rate premium has been much higher than that in the pre-revolutionary period.

Following Agenor (1990), the parallel market exchange rate would be determined endogenously. The parallel (black) market rate can be, as emphasised in the literature (Lizondo 1987 and Agenor 1990), positively related to the rate of growth of the domestic money supply, real output, relative prices, the official exchange rate, and changes in the expected rate of return on foreign and domestic currency. An appropriate econometric specification of the equation can be defined here as follows:

$$\log BM_t = v_0 + v_1 \log Yno_t + v_2 \log (P_d / P_w)_t + v_3 (\log BM_{t-1} + \Delta \log m_t) + u_t \quad (5.21)$$

where Yno denotes non-oil income, P_d / P_w is the ratio of the domestic price to the world price, m is the real money supply, and BM_{t-1} is the lagged value of the parallel market rate. The following regression indicates that the black market rate equation performs well, and the results obtained are quite promising:

$$\log BM_t = 2.064 + 0.233 \log Yno_t + 0.657 \log (P_d / P_w)_t + 0.702 (\log BM_{t-1} + \Delta \log m_t) \quad (5.22)$$

(0.263) (1.932) (2.723) (4.832)

$$\bar{R}^2 = 0.929, \quad DW = 2.083, \quad \chi^2_{LM}(1) = 0.106, \quad \chi^2_{ARCH}(1) = 1.778,$$

$$\chi^2_{JB}(2) = 0.497, \quad F(1,16) = 0.165, \quad F(2,15) = 0.165 \quad F(3,14) = 1.410$$

where the bracketed figures are t -ratios. Again, the statistical results indicate that the estimated equation passes all diagnostic tests. $\chi^2_{LM}(1)$, $\chi^2_{ARCH}(1)$, $\chi^2_{JB}(2)$ are respectively chi-squared statistics (with degrees of freedom in parentheses) against residual serial correlation (LM test), heteroscedasticity (ARCH test), and non-normal errors (Jarque-Bera test). $F(1,16)$, $F(2,15)$, $F(3,14)$ are F statistics (with degrees of freedom in parentheses) for tests against regression misspecification.

Although small, the coefficient of real non-oil income is positive and significant. The coefficient of relative prices is also significant and different from zero at the 5 percent

level. The coefficient of the sum of the lagged parallel rate and money supply changes is highly significant, reflecting the importance of changes in these variables in the determination of the demand for foreign exchange in the black market.

As a result, a new version of the macro-model shown in Appendix D, Table D.1, has been re-arranged including the parallel market exchange rate premium in both the equations of aggregate import demand and of the import price. However, the black market premium is postulated to be exogenous⁶⁰, so that equation (5.22) is not included in the macro-model. 2SLS and 3SLS procedures estimate simultaneously all the identified structural equations of the model together as a set, instead of estimating the equations separately.⁶¹ Table D.2 and Table D.3 in Appendix D provide the empirical results obtained by 2SLS and 3SLS which are quite encouraging.⁶² The policy implications of the model will be identified in the following chapters, using the parameter estimates obtained in the present chapter.

Briefly, the evidence of significant coefficients for the black market exchange rate premium in the import demand and import price equations, arises from the fact that the parallel market exchange rate is an important determinant of the demand for imports and the import price. This suggests that imports are affected more seriously by changes in the black market exchange rate in comparison to those for the official real exchange rate. Moreover, the size of the elasticity of relative prices in the estimated import equation which includes the black market exchange rate, is larger than that in the estimated import equation including the official real exchange rate. This finding contradicts those of previous studies (such as Bahmani-Oskooee 1986) in which the relative prices for developing countries were found to be inelastic. Finally, the structural import equation, with the inclusion of the parallel market premium of the exchange rate

⁶⁰ As we will discuss in Chapter Seven, the black market exchange rate premium is considered as a policy variable.

⁶¹ Each equation of the model satisfies $K - k \geq g - 1$ which stands for the necessary condition of identification (Gujarati 1988). K denotes the number of predetermined variables in the model, k is the number of predetermined variables in a given equation, and g is the number of endogenous variables in the given equation.

⁶² They are only given for illustration.

(Case B), predicts the behaviour of the demand for imports better, as indicated by the higher values for \bar{R}^2 coefficients.⁶³

5.5 Summary and Conclusions

A macroeconomic model was developed to evaluate the impact of economic variables on the aggregate demand for imports. The endogenous determinants of the import function were explained by the variables included in the model. The import demand and price equations were re-specified by the inclusion of the parallel market exchange rate premium, which substituted for the official real exchange rate in the right hand side of both equations. Hence, the purpose of this chapter was to re-estimate the macro-model for Iran, with a sizeable parallel market for foreign exchange. The model satisfied several econometric tests in the analysis of the time series data for issues such as residual autocorrelation, heteroscedasticity, specification error, and normality.

In terms of the basic estimation results, the following findings are highlighted:

- (1) The results showed that the official real exchange rate is insignificant in determining the demand for imports and the import price as well. Although having a small coefficient, the black market exchange rate premium is highly significant in both estimated equations for aggregate imports and the import price.
- (2) The estimated coefficients indicate that aggregate import demand is relatively inelastic in income and relatively elastic in prices. However, this latter effect is not similar to that found in the literature for developing countries.⁶⁴
- (3) The significant coefficient of the black market exchange rate premium in the import price equation also contradicts the findings of Pesaran (1992), in which

⁶³ As can be seen in Table 4.3 and Table 4.4, \bar{R}^2 for the import equation in Case A (including the official real exchange rate) and for the import equation in Case B (including the black market exchange rate) is 0.913 and 0.948, respectively.

⁶⁴ As mentioned earlier, Bahmani-Oskooee (1986), for example, has found import demand quite inelastic in prices for several developing countries.

that coefficient was found to be not significant using Iranian data over the 1960-87 period.

(4) The non-significant official exchange rate variable may suggest that the government and a small group of importers, that officially obtain foreign exchange, are not responsive with respect to changes in the official exchange rate in demanding imports. However, the private sector is quite responsive to changes in the parallel market exchange rate.

(5) The estimates and test statistics presented above generally conform to economic studies that are available in the literature. The results, for instance, confirm findings of Khan and Knight (1991) in which the money demand function in the context of developing countries is income inelastic.

(6) The model has stressed the role of the parallel market exchange rate in the determination of the demand for imports and import prices. Thus, the model itself is innovative in that the significance of the black (parallel) market exchange rate in the aggregate import and the import price equations is treated as a structural feature of the economy that is subject to empirical estimations. This suggests that this rate should be included in designing a model for developing countries where the parallel market for foreign currency is active.

In brief, the implication of this analysis is the need to emphasise the important role of the black market exchange rate in the model. In conclusion, the significance of this rate in the aggregate import function is a useful starting point for the determination of disaggregated import functions in the forthcoming chapter. Apart from the effect of price and income, it would be of interest to explore how the demand for a variety of imported commodity groups and imports by country reacts in response to changes in the parallel market exchange rate. The policy application of the model will be discussed subsequently.

CHAPTER SIX

6. ESTIMATION OF DISAGGREGATED IMPORT DEMAND FUNCTIONS

6.1 Introduction

This chapter examines the behaviour of selected imports of Iran at a disaggregated level and provides elasticity estimates for three different categories of imports. Category one refers to the composition of imports including imports of consumer goods, raw materials and intermediate goods, and capital goods. Category two classifies imports into twenty different commodity groups in which twenty stochastic equations with unknown parameters are to be estimated from the time series data and subject to random error terms. Category three consists of imports by country of origin where fifteen of Iran's major trading partners are selected and the corresponding equations are estimated. As set out in Chapter Four, all the stochastic equations have been specified as linear relationships with a lag structure⁶⁵ of a single period.

Estimation results obtained for the composition of imports will be analysed in Section 6.2. The estimated short-run and long-run elasticities for the equation system of imported commodity groups are examined in Section 6.3. Section 6.4 is devoted to the interpretation of the estimation results obtained for the equations of imports by origin. Section 6.5 provides concluding remarks.

⁶⁵ As indicated theoretically, the demand for imports relies on the assumption of partial adjustment.

6.2 Estimation Results for the Composition of Imports

In Chapter Five, the aggregate import demand equation was estimated. It is now time to have a closer look at imports. Based on the theoretical framework developed in Chapter Four, a system of equations are estimated, in the present chapter, to derive import demand by disaggregating the composition of imports for the Iranian case. Total imports are disaggregated into three categories: imports of consumer goods, raw materials and intermediate goods, and capital goods denoted by IMC , IMR , and IMK , respectively. Annual data on the value of imports, prices, and activity variables are obtained for the Iranian economy. Data for the composition of imported goods have been collected by Iran's Customs (I.C.) and authorised by the Ministry of Economic Affairs and Finance. Consistent sets of data are available for the period 1970-1993.⁶⁶ Because of data inadequacy for relative prices of each category, aggregate relative prices (P_m / P_d) is substituted for those relative prices, and used in estimating the import equations.

However, different activity variables explain the composition of imports. To recognise the role of both the government and private sectors in spending on consumer goods, real government expenditure (Ge) and real private expenditure (Pex) are defined as appropriate activity variables in the consumer import function. Real income or real GDP (Y), as discussed in Chapter Four, is a more appropriate activity variable in the intermediate goods import function. Furthermore, the capital goods import equation is specified by following the model of Vernardakis (1978) in which investment in manufacturing (I^M) as well as other investment ($I^T - I^M$) are the relevant activity variables. In general, the inclusion of investment in the capital import function reflects the need for imports during the process of industrialisation and diversification for Iran (Shahshahani 1976 and Heiat 1987).

In addition, the import determination, according to the estimation results, fails to hold when the official real exchange rate is used, but it receives empirical support when the

⁶⁶ 1349-1372, in the Iranian Calendar.

parallel (black) market exchange rate is used. Hence the official exchange rate is dropped from the specification of equations, and a re-arranged system is defined based on the replacement of it by the parallel market premium (BM / ER). The new econometric framework for the import demand equations based on a log-log form is as follows:

$$\log IMC_t = a_{c0} + a_{c1} \log (P_m / P_d)_t + a_{c2} \log Pex_t + a_{c3} \log Ge_t + a_{c4} \log (BM / ER)_t + a_{c5} \log IMC_{t-1} + a_{c6} D_1 + a_{c7} D_2 + a_{c8} D_3 + u_{1t} \quad (6.1)$$

$$\log IMR_t = a_{r0} + a_{r1} \log (P_m / P_d)_t + a_{r2} \log Y_t + a_{r3} \log (BM / ER)_t + a_{r4} \log IMR_{t-1} + a_{r5} D_1 + a_{r6} D_2 + a_{r7} D_3 + u_{2t} \quad (6.2)$$

$$\log IMK_t = a_{k0} + a_{k1} \log (P_m / P_d)_t + a_{k2} \log I^M_t + a_{k3} \log (I^T - I^M)_t + a_{k4} \log (BM / ER)_t + a_{k5} \log IMK_{t-1} + a_{k6} D_1 + a_{k7} D_2 + a_{k8} D_3 + u_{3t} \quad (6.3)$$

where

IMC = real imports of consumer goods

P_m = import price index

P_d = domestic price index

Ge = real government expenditure

Pex = real private expenditure

BM = real black (parallel) market exchange rate

ER = official real exchange rate

IMC_{t-1} = lagged real imports of consumer goods

IMR = real imports of raw materials and intermediate goods

IMR_{t-1} = lagged real imports of raw materials and intermediate goods

Y = real income (real GDP)

IMK = real imports of capital goods

I^T = total real investment

I^M = real manufacturing investment

IMK_{t-1} = lagged real imports of capital goods

D_i^{67} = dummy variable, $i = 1, 2, 3$

u_{it} = a random disturbance term, $i = 1, 2, 3$

The equation system estimated by the OLS method is given in Table 6.1.⁶⁸ To test the significance of the estimated elasticities, the t -statistic is given in parentheses under the estimated values of the elasticities. The results overall seem to be fine because they consist of a high value of the \bar{R}^2 (adjusted R-squared) coefficient and appropriate values of the DW , the *Durbin h*, and other diagnostic statistics. The equation system also passes other diagnostic test statistics, as given in Table 6.1. With few exceptions, most elasticities have the correct signs which means they are theoretically plausible.

According to the estimation results, both imports of consumer goods and imports of raw materials and intermediate goods are elastic, while the price elasticity for consumer imports is much higher than that for intermediate imports. The price elasticity for imports of consumer goods is around -2.5 and the price elasticity for imports of raw materials and intermediate goods is estimated to be around -1.6. However, the price elasticity is not statistically significant in the capital import equation so that it has been dropped from the equation. The no significant price elasticity for imports of capital goods suggests that non-price factors have an important impact on capital import demand, reflecting the fact that capital items can not be produced locally.

Although low, all activity elasticities by composition of imports are significantly different from zero at the 5% level and have the expected positive signs. It implies that a rise in an activity variable leads to an increase in the demand for imports. Real government expenditure (Ge) and real private expenditure (Pex) are the appropriate activity variables explaining the demand for imports of consumer goods. The elasticity

⁶⁷ D_1 denotes the dummy variable of the rise in the oil price in 1974 and 1979-1981. The events of the revolution in 1979 and the beginning of the Iran- Iraq war in 1980 is denoted by D_2 . D_3 stands for the dummy variable of the fall in oil price and exchange earnings in the 1986-1988 period.

⁶⁸ The equation system for these imports which is also estimated by 3SLS is given in Table E.1 in Appendix E. The estimation results obtained are almost identical to those which are obtained by the OLS method.

Table 6.1: Estimated elasticities of the demand equations by composition of imports , 1970-1993 (log-log, annual data).

Activity Variable													
Imports	Const.	P_m / P_d	Ge	P_{ex}	Y	I^M	$I^T - I^M$	BM / ER	Lagged, Imports	D_1	D_2	D_3	\bar{R}^2
IMC	-1.703 (-0.733)	-2.547 (-5.293)	0.536 (2.364)	0.679 (2.038)				-1.029 (-7.605)					0.959
IMR	-0.758 (-0.329)	-1.577 (-3.129)			0.690 (2.169)			-0.623 (-4.472)	0.362 (2.873)		-0.378 (-3.823)	-0.394 (-3.502)	0.947
IMK	-2.892 (-2.345)					0.378 (2.283)	0.956 (3.701)	-0.418 (-8.435)			-0.358 (-2.842)		0.921

Diagnostic Test Statistics

IMC	DW = 2.419	$\chi^2_{LM}(1) = 1.003^a$	$\chi^2_{ARCH}(1) = 0.271^b$	$\chi^2_{JB}(2) = 0.176^c$	$F(1,17) = 1.922^d$	$F(2,16) = 3.011^d$	$F(3,15) = 1.887^d$
IMR	$h = -0.241$	$\chi^2_{LM}(1) = 0.028^a$	$\chi^2_{ARCH}(1) = 2.937^b$	$\chi^2_{JB}(2) = 0.704^c$	$F(1,16) = 3.016^d$	$F(2,15) = 1.960^d$	$F(3,14) = 1.215^d$
IMK	DW = 1.504	$\chi^2_{LM}(1) = 2.019^a$	$\chi^2_{ARCH}(1) = 0.363^b$	$\chi^2_{JB}(2) = 1.736^c$	$F(1,17) = 1.498^d$	$F(2,16) = 0.785^d$	$F(3,15) = 2.218^d$

Values in parentheses beneath each estimated coefficient contain the t -statistic.

^a The LM test for serial correlation.
^b The ARCH test for heteroscedasticity.
^c The Jarque-Bera test for normality of the residuals.
^d Ramsey's RESET tests for functional form misspecification.

of consumer imports with respect to government expenditure and private expenditure is about 0.5 and 0.7, respectively. It suggests that a larger proportion of private outlays (than that of government spending) goes to the importation of consumer goods. Real income (Y) as an activity variable is added to the equation for imported raw materials and intermediate goods, and produces a significant elasticity value of about 0.7. It suggests that a 1 percent increase in real GDP causes such imports to rise by 0.7 percent. The estimated equation for imports of capital goods indicates that capital imports respond strongly to investment growth. According to these results, investment in manufacturing (I^M) and other investment ($I^T - I^M$) are the main determinants of demand for capital imports. The elasticity for investment in manufacturing is estimated at 0.378, while the elasticity of the remaining investment is much higher and in the vicinity of unity (0.987).

In the equation system by composition of imports, the estimated coefficient for the parallel (black) market exchange rate premium bears the right sign and is significant at the conventional level (95% confidence level). But the size of the coefficient for each import regression is quite different. The parallel market exchange rate is fairly elastic in the consumer import regression, with a value of -1.03, while it is inelastic in the regressions for intermediate imports as well as for capital imports. The values of the elasticity for intermediate imports and capital imports are respectively about -0.62 and -0.42. Thus, these results show that consumer imports are more responsive to changes in the parallel market rate than other imports. Hence, a one percent devaluation in the black market exchange rate reduces by 1.03 percent, demand for imports of consumer goods, 0.62 percent demand for imports of raw materials and intermediate goods, and 0.42 percent demand for capital imports.

The lagged dependent variable is only significant, with the correct sign of the parameter, in the raw materials and intermediate imports equation. Regarding the low value of 0.362 for the significant coefficient of the lagged intermediate imports, the adjustment

of actual imports to the desired level is very small. In other words the mean lag of adjustment is 21 months, indicating the time required to abolish any disequilibrium between actual and desired imports.⁶⁹ Given the estimated coefficient value for lagged intermediate imports ($a_{r4} = 0.362$), the long-run coefficients for relative prices, real income, and the black market exchange rate premium are obtained by simply using $(1 - a_{ri})/a_{r4}$, ($i = 1, 2, 3$). Thus, these coefficients are respectively around -2.47, 1.1, and -1.6 for relative prices, real income, and the black market exchange rate premium, which are quite elastic in the long-run. The long-run value of the income elasticity is greater than unity (about 1.1) which suggests that imports of raw materials and intermediate goods are quite responsive to changes in real GDP in the long-run.

Finally, the significant dummy variable D_2 reveals the fact that the revolution in 1979 and the beginning of the eight-year Iran-Iraq war in 1980 led to a downward shift in imports of consumer and intermediate goods. The sharp fall in the oil price which led to a reduction in foreign exchange earnings only affected raw materials and intermediate imports. The effect was a reduction in these imports during the period 1986 -1988. The evidence for this fact is obtained from the significant coefficient of the relevant dummy variable (D_3).

Consequently, several points can be highlighted from the estimation results by composition of imports. Firstly, relative prices are more important in determining import demand for consumption goods as well as raw materials, but they have no effect on the import demand for capital goods. Secondly, the black market exchange rate premium is elastic in the consumer import equation, whereas it is inelastic in the other equations. The exchange rate coefficient is especially low in the capital import equation, for which the price parameters are not significantly different from zero. Thirdly, demand by composition of imports has a significantly positive relationship with different activity variables. The results indicate that demand for consumption imports responds directly to changes in both private and government expenditures, demand for

⁶⁹ The mean lag of adjustment is equal to $(1 - a_{r4}) / a_{r4}$.

intermediate imports rises with an increase in real income (real GDP), while demand for capital imports is affected by changes in investment.

6.3 Econometric Results for the Import Commodity Groups

In order to investigate the effect of economic relationships on the demand for imports, the import equations are estimated with imports classified as either restricted or free and divided into 20 commodity groups. The restricted category contains 13 commodity groups with the remaining classified as freely imported, as shown in Table F.1 in Appendix F.⁷⁰ Following Section 4.4.2 of Chapter Four, the econometric framework for the two categories of imports is:

$$\begin{aligned} \text{Restricted} \quad \log IM^R_{jt} = & b^R_{0j} + b^R_{1j} \log (1 + \tau_j)(P^R_{mj} / P^R_{dj})_t + b^R_{2j} \log Z_{jt} \\ & + b^R_{3j} \log (BM / ER)_t + b^R_{4j} \log IM^R_{jt-1} + b^R_{5j} t + b^R_{6j} D_1 \\ & + b^R_{7j} D_2 + b^R_{9j} D_3 + u_{jt} \end{aligned} \quad (6.4)$$

and

$$\begin{aligned} \text{Free} \quad \log IM^F_{it} = & b^F_{0i} + b^F_{1i} \log (P^F_{mi} / P^F_{di})_t + b^F_{2i} \log A_{it} + b^F_{3i} \log (BM / ER)_t \\ & + b^F_{4i} \log IM^F_{it-1} + b^F_{5i} t + b^F_{6i} D_1 + b^F_{7i} D_2 + b^F_{9i} D_3 + u_{it} \end{aligned} \quad (6.5)$$

where

IM^R_j = restricted imports of commodity group j

P^R_{mj} / P^R_{dj} = relative prices of restricted imports of commodity group j

P^R_m = price of restricted imports of commodity group j

P^R_d = domestic price of commodity group j

τ_j = an ad valorem rate of tariff on the commodity group j

Z_j = total expenditures on commodity group j

ER = official real exchange rate

BM / ER = (real) black market exchange rate premium

IM^R_{jt-1} = lagged restricted imports of commodity group j

⁷⁰ Sources and transformation of data for this section are given in Appendix F.

IM_{it}^F = freely imported goods of commodity group i

P_{mi}^F / P_{di}^F = relative prices of freely imported goods of group i

A_i = activity variable

IM_{it-1}^F = lagged free imports of commodity group i

D_1, D_2, D_3 = dummy variables as mentioned in the previous section

u_{jt} = a random disturbance term in equation (6.4)

u_{it} = a random disturbance term in equation (6.5)

Different specifications of these imports refer to the different choice of activity variables discussed in Section 4.4.2 of Chapter Four. Expenditure on commodity group j (Z_j) could be a convenient activity variable in the specification of the restricted import equation. This is because Z_j can explain the budget allocated to imports for commodity group j . But in the estimation process this variable is not significant in explaining the demand for imports of some commodity groups.⁷¹ For the case of free imports real income, capital formation, or exchange receipts (A_i) could be the appropriate activity variables, because these imports are often imported by government without any control.

All of the import demand equations are in log-log form and have been estimated annually for the period 1970 to 1993, using the OLS technique. A large number of the estimated elasticities are significant at the 5 percent level, since the t statistics are greater than 2 (Table 6.2 and Table 6.3). In several cases, there is evidence of first-order autocorrelation in the residuals. For these cases, the elasticities are re-estimated by removing the auto-correlation using the maximum likelihood or Cochrane-Orcutt iterative techniques for the first order autoregressive scheme. As a result, the fit of the equations is good in many cases and fair in the others. All equations estimated by OLS pass several diagnostic tests.

In total estimates are made for twenty commodity groups, thirteen of which belong to restricted imports and the remaining are related to free imports and are reported in Table

⁷¹ As reported in Table 6.2, real GDP substitutes for Z_j in the equation of several imported commodity groups such as coffee and tea, sugar, etc.

6.2 and Table 6.3 respectively. The import function for each commodity group is estimated in several forms to find a reasonable statistical fit. Accordingly, from a variety of activity variables one or two of them have been chosen, because they are significant and give stability to the equations.⁷² In addition, for the case of several specifications, not significant lagged variables are dropped and the relevant equations are re-estimated without them. This procedure results in the gain of an extra degree of freedom.

6.3.1 Estimated Short-Run and Long-Run Elasticities of the Relative Price

Variable

The results presented indicate that in the case of restricted imports the price elasticities have the expected sign, and the vast majority of them are significantly different from zero at the 5 percent level.⁷³ However, since the price elasticity of imports of food products (IM^R_1), sugar (IM^R_3), and leather and textile materials (IM^R_5) are not significant, they are dropped from the estimation system. The significant price elasticities for most commodity groups of restricted imports are on the upper side, and concentrated in the range of -1.159 for paper (IM^R_6) to -3.694 for transport materials (IM^R_{11}). As shown in Table 6.4 these elasticities are much higher in the long-run, ranging from -1.503 to -5.453. Import price elasticities for coffee and tea (IM^R_2) and construction material (IM^R_3) only have a value of less than one, but the elasticity for coffee and tea gets a high value of around -2 in the long-run. These results do not conform to those presented by Sarmad and Mahmood (1987) in which they estimated price elasticities for Pakistan of less than one, ranging from -0.051 to -1.151. These comparisons also contradict their view that the demand for imports in developing countries (particularly non-oil developing countries) is inelastic in comparison with that in developed countries.⁷⁴ However, the results for the price elasticities are close to those

⁷² The activity variables defined in the formulation of commodity groups of free imports are real GDP, real oil revenues (Yo), real government expenditure (Ge) and real private expenditure (Pex). Real GDP and total real expenditure on each commodity group (Z_j) are activity variables in the specification of the restricted import equations.

⁷³ However, a few coefficients are found to be only significant at the 10 % level.

⁷⁴ The difference in the estimate results may be related to the different specification of the import equations or different specific data used in the estimation process (Deyak et al. 1993).

obtained by Khan (1975) for Venezuela (an oil producer), within a range of -1.033 to -5.890.⁷⁵ As a result, the relatively high price elasticity for such restricted imports, contrary to the findings of Sarmad and Mahmood (1987), suggests that price factors are no doubt significant in raising the impact of changes in relative prices on import demand. This reveals the fact that import demand in oil-producing countries is price elastic rather than other non-oil developing countries. Given this finding, any rise in tariffs, for example, leads to a reaction from domestic buyers who are able to switch to domestic substitutes. In other words, import tariffs tend to raise the relative price of imports. This tends to shift resources out of export industries into import-competing industries (Markusen, et al. 1995). Second, the considerable responsiveness of import demand to price movements for the restricted category, reflects the fact that an increase in import prices, in conjunction with a depreciation of the domestic currency in the black market, is very substantial so that these imports are affected more seriously than free imports. This serves to reduce import demand even in cases where buyers have few alternative domestic sources of supply. Third, one reason for the difference between our findings and those of previous studies is likely to be on the basis of wide differences in tariffs, import controls and quotas, indirect taxes, and subsidies which exist in different countries (Apostolakis 1990).

Most price elasticities in the case of free imports, except cereals (IM^F_2) and mineral products (IM^F_3), are not significant, with unexpected positive signs. The estimated price elasticity of cereals is around -1.6 in the short-run and long-run (shown in Table 6.5) periods, which indicates that imports of cereals are quite responsive to changes in their relative price even though they are an essential import. Insignificant import price elasticities of some commodity groups, like chemical and pharmaceutical products (IM^F_4), fertilisers (IM^F_5), rubber (IM^F_6), and iron and steel (IM^F_7), confirm the view that Iran tends to have an inelastic demand for essential imports which are imported freely.⁷⁶

⁷⁵ This range does not include the price elasticity value of machinery which is -0.765.

⁷⁶ In practice their estimated elasticities were insignificant with a low value of less than unity. Hence they were dropped from the estimation process.

Table 6.2: Estimated elasticities of the demand equations for restricted imports, 1970-1993 (log-log, annual data).

(1)	(2)	(3)	Activity Variable					(8)	(9)	(10)	(11)	(12)	(13)	(14)
			Z_j	GDP	Other	ER	BM/ER							
Imports (IM_j^R)	Const.	$(1+\tau_j)$ (P_{mj}^R/P_{dj}^R)							$IM_{j,t-1}^R$	Time	D_1	D_2	D_3	\bar{R}^2
Food Products (IM_1^R)	-2.749 (-2.950)	-0.925 (-1.791)	1.418 (4.261)				-0.643 (-2.399)		0.379 (3.249)	0.128 (4.131)				0.947
Coffee and Tea (IM_2^R)	-4.320 (-3.982)	-0.967 (-2.304)		0.585 (3.883)					0.536 (3.964)					0.896
Sugar (IM_3^R)	-9.877 (-2.594)			2.238 (3.744)		-1.141 (-3.502)			0.446 (4.515)	0.209 (2.673)	1.516 (5.238)			0.958
Wood (IM_4^R)	2.392 (4.505)	-1.213 (-3.640)	0.951 (1.982)				-0.853 (-2.576)		0.285 (2.177)					0.969
Leather and Textile Materials (IM_5^R)	-1.699 (-1.983)			0.338 (2.047)					0.847 (8.651)			-0.523 (-2.765)	-0.727 (-3.825)	0.974
Paper (IM_6^R)	-0.365 (-0.668)	-1.159 (-2.090)	0.879 (4.175)				-0.596 (-2.804)		0.229 (1.919)			-0.259 (-2.094)	-0.477 (-3.182)	0.989
Construction Materials (IM_7^R)	-3.991 (-2.938)	-0.567 (-2.846)		0.842 (3.941)			-0.645 (-2.517)		0.328 (2.549)		-0.661 (-3.479)		-0.564 (-2.558)	0.982
Base Metals (IM_8^R)	0.482 (1.235)	-1.627 (-1.753)	0.516 (3.019)				-0.701 (-3.126)		0.629 (6.971)	0.054 (1.958)		-0.481 (-2.033)		0.972
Mechanical Machinery (IM_9^R)	-0.771 (-4.987)	-1.514 (-2.492)	1.120 (4.368)						0.383 (1.830)			-0.276 (-1.936)		0.925

Continued

Table 6.2 (continued).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Electrical Machinery (IM^R_{10})	0.842 (1.899)		0.834 (2.884)				-0.764 (-3.789)	0.427 (2.814)					0.964
Transport Materials (IM^R_{11})	-1.170 (-2.040)	-3.694 (-6.598)	0.995 (4.474)				-0.349 (-1.972)	0.506 (5.155)	0.060 (2.207)				0.970
Household Appliances (IM^R_{12})	-7.890 (-4.395)	-1.868 ^a (-3.325)		1.506 (5.871)			-0.730 (-5.318)		0.079 (2.077)			-0.250 (-1.783)	0.981
Miscellaneous Products (IM^R_{13})	-0.572 (-0.486)	-3.202 ^a (-1.877)			0.870 ^b (3.714)		-1.286 (-5.084)						0.924
Diagnostic Test Statistics													
IM^R_1	$h = 0.0031$	$\chi^2_{LM}(1) = 0.056^c$		$\chi^2_{ARCH}(1) = 0.375^d$		$\chi^2_{JB}(2) = 0.374^e$		$F(1,17) = 1.490^f$	$F(2,16) = 2.023^f$			$F(3,15) = 1.281^f$	
IM^R_2	$h = -0.008^*$												
IM^R_3	$h = -1.296^*$												
IM^R_4	$h = -1.359$	$\chi^2_{LM}(1) = 1.230^c$		$\chi^2_{ARCH}(1) = 0.282^d$		$\chi^2_{JB}(2) = 0.660^e$		$F(1,18) = 0.013^f$	$F(2,17) = 0.384^f$			$F(3,16) = 0.670^f$	
IM^R_5	$h = -0.997$	$\chi^2_{LM}(1) = 0.946^c$		$\chi^2_{ARCH}(1) = 0.257^d$		$\chi^2_{JB}(2) = 0.268^e$		$F(1,18) = 0.226^f$	$F(2,17) = 0.507^f$			$F(3,15) = 1.717^f$	
IM^R_6	$h = -1.567$	$\chi^2_{LM}(1) = 1.335^c$		$\chi^2_{ARCH}(1) = 0.100^d$		$\chi^2_{JB}(2) = 0.268^e$		$F(1,16) = 3.651^f$	$F(2,15) = 1.763^f$			$F(3,14) = 2.227^f$	
IM^R_7	$h = -1.482$	$\chi^2_{LM}(1) = 0.881^c$		$\chi^2_{ARCH}(1) = 2.819^d$		$\chi^2_{JB}(2) = 1.295^e$		$F(1,16) = 0.525^f$	$F(2,15) = 0.762^f$			$F(3,14) = 0.472^f$	
IM^R_8	$h = -0.966$	$\chi^2_{LM}(1) = 0.663^c$		$\chi^2_{ARCH}(1) = 2.761^d$		$\chi^2_{JB}(2) = 0.958^e$		$F(1,16) = 0.705^f$	$F(2,15) = 3.456^f$			$F(3,14) = 2.580^f$	
IM^R_9	$h = -0.600$	$\chi^2_{LM}(1) = 0.360^c$		$\chi^2_{ARCH}(1) = 0.616^d$		$\chi^2_{JB}(2) = 0.353^e$		$F(1,18) = 1.936^f$	$F(2,17) = 1.044^f$			$F(3,16) = 1.410^f$	

continued

Table 6.2 (continued).

IM^R_{10}	$h = -0.047$	$\chi^2_{LM}(1) = 0.081^e$	$\chi^2_{ARCH}(1) = 0.253^d$	$\chi^2_{JB}(2) = 0.632^e$	$F(1,19) = 0.284^f$	$F(2,18) = 1.233^f$	$F(3,17) = 0.809^f$
IM^R_{11}	$h = 0.6700$	$\chi^2_{LM}(1) = 0.480^e$	$\chi^2_{ARCH}(1) = 0.489^d$	$\chi^2_{JB}(2) = 0.420^e$	$F(1,17) = 2.778^f$	$F(2,16) = 2.114^f$	$F(3,15) = 1.637^f$
IM^R_{12}	$DW = 2.465$	$\chi^2_{LM}(1) = 1.187^e$	$\chi^2_{ARCH}(1) = 0.500^d$	$\chi^2_{JB}(2) = 1.823^e$	$F(1,17) = 0.056^f$	$F(2,16) = 0.783^f$	$F(3,15) = 0.520^f$
IM^R_{13}	$DW = 2.273$	$\chi^2_{LM}(1) = 1.065^e$	$\chi^2_{ARCH}(1) = 1.602^d$	$\chi^2_{JB}(2) = 1.306^e$	$F(1,19) = 0.003^f$	$F(2,18) = 0.016^f$	$F(3,15) = 0.034^f$

Values in parentheses beneath each estimated coefficient contain the *t*-statistics.

^a Because of the lack of data, the aggregate relative price has been placed by the relative prices of the relevant commodity groups.

^b The estimated value refers to the elasticity value of oil revenues.

^c The LM test for serial correlation.

^d The ARCH test for heteroscedasticity.

^e The Jarque-Bera test for normality of the residuals.

^f Ramsey's RESET tests for functional form misspecification.

* Corrected for autocorrelation by the Cochrane-Orcutt technique.

Table 6.3: Estimated elasticities of the demand equations for free imports, 1970-1993 (log-log, annual data).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Activity Variable													
Imports (IM^F_i)	Const.	P^F_{mi} / P^F_{di}	GDP	Ge	Pex	ER	BM/ER	IM^F_{it-1}	Time	D_1	D_2	D_3	\bar{R}^2
Meat (IM^F_1)	-9.164 (-1.915)	-1.383 (-1.800)	1.840 (2.402)				-1.499 (-3.525)	0.312 (1.972)	0.226 (2.397)				0.918
Cereals (IM^F_2)	-5.773 (-2.244)	-1.613 (-3.568)	1.234 (3.265)				-0.916 (-3.384)		0.103 (1.931)	0.519 (2.266)			0.945
Mineral Products (IM^F_3)	-1.532 (-2.481)	-1.110 (-2.819)	0.183 (1.932)					0.600 (4.461)			-0.648 (-2.527)		0.852
Chemical and Pha. Products (IM^F_4)	-0.943 (-2.450)		0.178 (2.071)					0.864 (6.721)					0.664
Fertilisers (IM^F_5)	-16.182 (4.252)			-2.780 (-5.278)	5.355 (5.912)		-1.807 (-4.974)	0.352 (1.832)	0.438 (4.908)	1.079 (4.403)			0.874
Rubber (IM^F_6)	-21.105 (-5.796)			-2.449 (-2.730)	6.143 (5.103)		-1.479 (-2.305)		0.396 (5.038)	1.104 (2.628)			0.782
Iron and Steel (IM^F_7)	-9.682 (-2.917)		1.828 (3.740)				-0.588 (-2.291)		0.166 (2.570)	0.471 (1.817)			0.906
Diagnostic Test Statistics													
IM^F_1	$h = -0.326$	$\chi^2_{LM}(1) = 1.086^a$	$\chi^2_{ARCH}(1) = 1.835^b$	$\chi^2_{JB}(2) = 0.168^c$	$F(1,17) = 3.251^d$	$F(2,16) = 1.646^d$	$F(3,15) = 1.233^d$						
IM^F_2	$DW = 2.243^*$												
IM^F_3	$h = -1.166$	$\chi^2_{LM}(1) = 1.223^a$	$\chi^2_{ARCH}(1) = 0.006^b$	$\chi^2_{JB}(2) = 3.151^c$	$F(1,18) = 0.226^d$	$F(2,17) = 0.106^d$	$F(3,16) = 0.188^d$						

continued

Table 6.3 (continued).

IM^F_4	$h = -0.463$	$\chi^2_{LM}(1) = 0.577^a$	$\chi^2_{ARCH}(1) = 0.495^b$	$\chi^2_{JB}(2) = 2.275^c$	$F(1,20) = 1.234^d$	$F(2,19) = 0.825^d$	$F(3,18) = 0.524^d$
IM^F_5	$h = -2.292^{**}$						
IM^F_6	$DW = 1.939$	$\chi^2_{LM}(1) = 0.020^a$	$\chi^2_{ARCH}(1) = 0.805^b$	$\chi^2_{JB}(2) = 3.036^c$	$F(1,17) = 4.291^d$	$F(2,16) = 2.284^d$	
IM^F_7	$h = 1.605$	$\chi^2_{LM}(1) = 1.427^a$	$\chi^2_{ARCH}(1) = 3.531^b$	$\chi^2_{JB}(2) = 0.678^c$	$F(1,18) = 2.112^d$	$F(2,17) = 2.519^d$	$F(3,15) = 1.577^d$

Values in parentheses beneath each estimated coefficient contain the *t*-statistic.

^a The LM test for serial correlation.

^b The ARCH test for heteroscedasticity.

^c The Jarque-Bera test for normality of the residuals.

^d Ramsey's RESET tests for functional form misspecification.

* Corrected for autocorrelation by the maximum likelihood iterative technique.

** Corrected for autocorrelation by the Cochrane-Orcutt iterative technique.

Table 6.4: Estimated long-run elasticities⁷⁷ of the demand equations for restricted imports.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Imports (IM^R_j)	Const.	$(1+\tau_j)$ (P^R_{mj}/P^R_{dj})	<i>Activity Variable</i>				BM/ER
			Z_j	GDP	Other	ER	
IM^R_1	-4.427	-1.490	2.283				-1.035
IM^R_2	-9.310	-2.084		1.261			
IM^R_3	-17.829			4.040		-2.060	
IM^R_4	3.345	-1.697	1.330				-1.193
IM^R_5	-11.108			2.209			
IM^R_6	-0.473	-1.503	1.140				-0.773
IM^R_7	-5.939	-0.844		1.253			-0.960
IM^R_8	1.299	-4.385	1.390				-1.899
IM^R_9	-1.250	-2.454	1.815				
IM^R_{10}	1.455			1.455			1.333
IM^R_{11}	-2.368	-5.453	2.014				-0.706
IM^R_{12}	-7.890	-1.868		1.506			-0.730
IM^R_{13}	-0.572	-3.202			0.870*		-1.286

Source: Table 6.2.

* Indicates the estimated long-run coefficient of real oil income (Y_o).

⁷⁷ The formula used for calculating the long-run elasticities is $\beta_{LR} = \beta_{SR} / (1 - \beta_{LAG})$, where β_{LR} is the long-run coefficient, β_{SR} is the short-run coefficient of each explanatory variable, and β_{LAG} is the coefficient of the lagged dependent variable (lagged imports).

Table 6.5: Estimated long-run elasticities of the demand equations for free imports.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Activity Variable							
Imports (IM^F_i)	Const.	P^F_{mi} / P^F_{di}	GDP	Ge	Pex	ER	BM / ER
IM^F_1	-13.320	-2.010	2.674				-2.179
IM^F_2	-5.773	-1.613	1.234				-0.916
IM^F_3	-3.83	-2.775	0.458				
IM^F_4	-6.934		1.309				
IM^F_5	-24.972			-4.290	8.264		-2.789
IM^F_6	-21.105			-2.449	6.143		-1.479
IM^F_7	-9.682		1.828				-0.588

Source: Table 6.3.

6.3.2 Estimated Short-Run and Long-Run Elasticities of the Activity Variables

As discussed in the specification of the restricted import equations, total real expenditure on each commodity group (Z_j) was assumed to be the activity variable for the relevant function. Among thirteen equations for restricted imports, seven equations are significantly affected by changes in the corresponding expenditure elasticities of the commodity groups while real GDP explained the other six equations. Instead of real expenditure and real GDP, real oil income (Yo) is the only activity variable which explains the equation for miscellaneous imports (IM^R_{13}). Its elasticity is significant at the 95 percent confidence level, with the expected positive sign and value at about 0.87 in both the short-run and long-run periods (shown in Table 6.2 and Table 6.4)

The estimated expenditure elasticities are positive and significant in the equations for imports of food products (IM^R_1), wood and articles made of wood (IM^R_4), paper (IM^R_6), base metals except iron and steel (IM^R_8), machinery (IM^R_9), and transport materials (IM^R_{11}). The estimates of the elasticities range from a high of 1.418 for food imports to a low of 0.516 for imports of base metals. The long-run expenditure elasticities range

from 2.283 for imports of meat to 1.14 for imports of paper. The estimated income (GDP) elasticities are also positive and significant in the equations for imports of coffee and tea (IM^R_2), sugar and sugar confectionery (IM^R_3), leather and textile materials (IM^R_5), construction materials (IM^R_7), electrical machinery (IM^R_{10}), and household appliances (IM^R_{12}). The estimates of these elasticities also range from a high of 2.238 for imports of sugar and confectionery sugar to a low of 0.38 for imports of leather and textiles. Relevant elasticities in the long-run period are a high of 4.040 for sugar and a low of 1.253 for imports of construction materials. In practice, the implication is that the higher expenditure and income elasticities for imported commodity groups of food, sugar, machinery, electrical machinery, and household appliances, the greater the continued import dependency which has existed for such goods. Basically, it is expected that a rise in income or expenditure will lead to an increase in imports. However, the growth rate in imports of these commodity groups is higher and more rapid than other imports, because the import-income relationship or import-expenditure relationship is stronger among these commodity groups. Consequently, with a high income elasticity Iran is gradually becoming a net importer of food products, sugar, machinery, electrical machinery, and household appliances.

The results in Table 6.3 show that with the exception of the imports of fertilisers (IM^F_5) and rubber (IM^F_6), all other equations for the freely imported goods estimate income (GDP) elasticities that are significantly different from zero at the 5% level and have the expected positive sign. These elasticities range from a low of 0.178 for imports of chemical and pharmaceutical products to a high of 1.840 for meat (IM^F_1). The lowest and highest income elasticities in the long-run belong respectively to imports of mineral products (IM^F_3), with a value of 0.458, and to imports of meat with a value of 2.674. Significant elasticities of private and government expenditure are obtained in estimating import equations for fertilisers and rubber. Private expenditure elasticities for these imports are estimated to be around 5.4 and 6.1 with correct positive signs, whereas the government expenditure elasticities are estimated to be -2.8 and -2.4 respectively with

unexpected negative signs. This could be due to the fact that as government expenditure rises the Iranian authorities prefer to substitute domestic goods for these imports, even though the demand for these imports by the private sector is quite responsive to changes in expenditure.

In general the findings in respect of the income (GDP) variable in both cases of restricted and free imports, are more consistent with the previous empirical studies of Khan (1975) and Sarmad and Mahmood (1987) than are the findings with respect to the relative price variable.⁷⁸ It reveals the fact that the import dependency of essential goods, such as intermediate and capital products, is almost equivalent in developing countries. More specifically, the demand for some of these goods in terms of import demand is highly elastic with respect to income.

6.3.3 The Official Exchange Rate and its Parallel (Black) Market Rate⁷⁹

While the parallel market premium on the exchange rate influences most commodity groups of imports, the official real exchange rate does not affect imports except for sugar. The estimated elasticity of the parallel market premium is significant with the expected negative sign in estimating fourteen equations for both restricted and free imports. In the case of restricted imports, it ranges from a high of -1.286 for miscellaneous imports to a low of -0.328 for imports of construction materials. This range in the long-run reaches a high value of around -1.9 for imports of base metals, except iron and steel, and a low value at about -0.7 for imports of transport materials. In the case of free imports the elasticity of the black market exchange rate premium ranges from a high of around -1.8 for fertilisers to a low of around -0.6 for iron and steel. It varies from about -0.6 to -2.8 for imports of iron and steel. There is only one significant elasticity of the official real exchange rate, that is for the import of sugar at about -1 in the short-run and about -2 in the long-run.

⁷⁸ Khan (1975) and Sarmad and Mahmood (1987) have estimated the import demand function for Venezuela and Pakistan, respectively.

⁷⁹ The parallel (black) market exchange rate is also known in Iran as the free exchange rate.

The official real exchange rate variable, therefore, has been dropped from the specification of the other import equations. This suggests that, unlike its parallel market rate, the official exchange rate cannot be a major determinant of Iranian import demand. According to the results obtained here, there is a reverse relationship between the demand for imports and the parallel market exchange rate premium. A fall in the premium raises imports causing a deterioration in the trade balance. But over time the trade balance tends to improve because a large number of imported inputs provides the country with additional capacity to produce more exports, so that the exports gradually exceed imports. Thus, the initial deterioration in the trade balance is halted and then reversed (Salvatore 1995). Hence the adverse effect of the parallel market exchange rate premium on imports supports the so called *J-curve* phenomenon.⁸⁰

However, because of the insignificance of the coefficient of the parallel (black) market rate, this variable has also been dropped from the equations of imports of mineral products, chemical and pharmaceutical products, machinery apparatus, coffee and tea, sugar, and leather and textile materials. This seems to be reasonable because these goods are essential, and the authorities and a small group of importers import them irrespective of any fluctuations in the free market exchange rate.

However, as seen from the statistically significant negative elasticity for the parallel market premium of the exchange rate, an increase in this rate strongly depresses most commodity groups of imports. A one percent increase in this rate, for example, leads to about a 0.9 percent decrease in demand for imports of wood in the short-run and about a 1.2 percent decrease in the long-run. This is because an increase in the premium leads to an increase in the cost of importing wood, for example, resulting in a decline in the demand for such imports.

⁸⁰ It should be noted that the preceding discussion of the *J-curve* effect focuses on export prices. The reason is that a *J-curve* effect can occur because of what happens to export prices. However, according to Arndt and Dorrance (1986), there may be departures from the small-country case also on the import side.

6.3.4 Mean Lag of Adjustment

As previously postulated in Chapter Four the specification of the import equations relies on the assumption of partial adjustment, in which the change in each imported commodity group responds partially to the difference between the desired imports of the commodity group and its past value. The mean lag of adjustment is in fact the period required for the elimination of any disequilibrium between actual and desired imports. The mean lag of adjustment for both restricted and free imports can be calculated as follows:

$$\text{mean lag of adjustment for restricted imports} = (1 - b_{4j}^R) / b_{4j}^R$$

$$\text{mean lag of adjustment for free imports} = (1 - b_{4j}^F) / b_{4j}^F$$

where b_{4j}^R and b_{4j}^F denote the estimated coefficients of lagged imports of the j th commodity group, and lagged imports of the i th commodity group.⁸¹

Table 6.6 shows the calculated mean lag of adjustment for free imports, ranging roughly from at least 2 months for imports of chemical and pharmaceutical products to 26 months for imports of meat. The mean lag of adjustment for restricted imports is also shown, with a range of about 2 months for imports of leather and textile materials to about 40 months for imports of paper. It means actual imports of chemical and pharmaceutical products and imports of leather and textile materials adjust very fast to their desired levels, while the adjustment of actual imports of meat and paper to their desired levels is very slow. This is because the periods required are 26 and 40 months to eliminate any disequilibrium between actual and desired imports for meat and paper. One explanation is that because of the importance of chemical and pharmaceutical products, as well as textile materials, the economy has planned to import these goods on the basis of a balanced policy between actual and desired levels. In addition, from an econometric point of view only the activity variable of real GDP and the lagged dependent variable were statistically significant in the relevant equations of these

⁸¹ In fact, the coefficient of partial adjustment is: $\lambda_j = 1 - b_{4j}^R$ and $\lambda_i = 1 - b_{4i}^F$.

Table 6.6: The mean lag of adjustment for imports.

Restricted Imports	$(1 - b_{4j}^R) / b_{4j}^R$ (Months)	Free Imports	$(1 - b_{4j}^F) / b_{4j}^F$ (Months)
IM_1^R	20	IM_1^F	26
IM_2^R	10	IM_2^F	-
IM_3^R	15	IM_3^F	8
IM_4^R	30	IM_4^F	2
IM_5^R	2	IM_5^F	22
IM_6^R	40	IM_6^F	-
IM_7^R	24.5	IM_7^F	-
IM_8^R	7		
IM_9^R	19		
IM_{10}^R	16		
IM_{11}^R	10		
IM_{12}^R	-		
IM_{13}^R	-		

Source: Table 6.2 and Table 6.3.

imports (chemical and pharmaceutical products, and textile materials, etc.), leading to a large value of the estimated coefficients for lagged imports.⁸²

6.3.5 Role of the Time Trend and Dummy Variables

The coefficients of the dummy variables over the period 1970-1993, are statistically significant in some of the estimated equations. For instance, the episodes of the sharp rise in the oil price in 1974 and 1979-1981 led to the expansion of four freely imported goods, consisting of cereals, fertilisers, rubber, and iron and steel as well as sugar in the group of restricted imports. However, the collapse of the oil price in 1986 depressed imports of leather and textile materials, paper, construction materials, electrical machinery, and household appliances. Furthermore, the significant coefficient, with a negative sign, of the dummy variable for the revolution and the war in 1979 and 1980, reveals that such episodes affected more seriously imports of mineral products, leather and textile materials, paper, construction materials, base metals, and machinery than the others. In practice, about 40% of imports of machinery, as an example, decreased in 1979.

⁸² The estimated coefficients of lagged imports of chemical and pharmaceutical products and textile materials, as given in Tables 6.2 and 6.3, are respectively about 0.86 and 0.85.

As a result, the significant coefficient of the dummy variable for the rise in the oil price in 1974 and 1979-1981 (D_1) suggests an upward shift in the import function. While the significant coefficients of the dummy variables for the events of the revolution in 1979 and the war in 1980 (D_2), and the sharp fall in the oil price in 1986 (D_3), suggest a downward shift in the import function.

The results of the OLS estimates of the time coefficient summarise the impact of the success or failure of the import substitution efforts. In some disaggregated sectors the positive time coefficient indicates a deepening of import dependency. This dependency for some commodity groups such as imports of fertilisers and rubber is stronger than that for others such as base metals, transport materials, and household appliances. There is no evidence of any negative coefficient of time in the estimated import equations, which suggests success of the import substitution efforts to lessen import dependency. It implies that during the period under consideration (1970-1993) the import substitution policy has not been successful.

6.4 Estimation Results for Imports by Country of Origin

In the case of imports by country of origin, Table 6.7 shows the number of countries that have been important trading partners of Iran over the period 1970-1993. Column (3) in this table indicates the average percentage of total imports by country of origin in order of their value over the period. The data for imports by country of origin have been derived from Iran's Customs, *Year-book of Foreign Trade Statistics*.

As can be seen from Table 6.7, about 55% of merchandise imports by the selected trading partners come from the major industrial countries (Germany, Japan, U.S., U.K., Italy, and, France), while the share of the developing countries and other industrialised economies is around 20%. However, the geographical composition of imports has

Table 6.7: Average percentage average of total imports by country of origin over the period 1970-1993.

(1) Countries of Origin	(2) Import Variable	(3) Percent of Value (Average) ^a , (% of Total Imports)
Germany	IM^{DUE}	18.3
Japan	IM^{JPN}	13.0
U.S.A. ^b	IM^{USA}	7.3
U.K.	IM^{UL}	7.2
Italy	IM^{ITA}	5.4
France	IM^{FRA}	3.4
Belgium	IM^{BEL}	3.0
Netherlands	IM^{NLD}	2.8
Switzerland	IM^{CHE}	2.8
Turkey	IM^{TUR}	2.6
Australia	IM^{AUS}	2.5
South Korea	IM^{KOR}	2.0
U.A.E. ^c	IM^{UAE}	1.9
Brazil	IM^{BRA}	1.6
Canada	IM^{CAN}	1.1

Source: Iran's Customs, The Ministry of Economic Affairs and Finance.

^a The average percentage of the U.S.S.R. is 2.6. Because of unavailability of data, this country is excluded from the study.

^b Although the USA has taken third place among Iran's partners, her role is very weak during the post-revolutionary period.

^c United Arab Emirates.

changed since the early 1980s (after the revolution in Iran). The share of the six major industrial countries has decreased substantially, with the largest decline in share by the United States. But other industrialised countries such as Holland, Belgium, and Australia and developing countries, particularly Turkey, have increased their share in Iran's imports after the revolution. One important reason for the increased imports from developing countries is the reduced tariffs on imports from developing countries (Pesaran 1992).

According to Section 4.4.3 of Chapter Four, the following econometric equation is estimated by the OLS method to determine the economic performance of fifteen of Iran's major trading partners on the import sector. The equation is re-specified as follows:

$$\log IM_t^k = d_{k0} + d_{k1} \log (P_m / P_d) + d_{k2} \log Y_t + d_{k3} \log (BM^k / ER^k)_t + d_{k4} D_1 + d_{k5} D_2 + d_{k6} D_3 + u_{kt} \quad (6.6)$$

where P_m / P_d is the relative price of aggregate imports,⁸³ Y is the real income of Iran, BM^k / ER^k ⁸⁴ is the premium of the bilateral parallel market exchange rate, D_i ($i = 1, 2, 3$) is a dummy variable, as defined in the previous sections, and u_{kt} is the error term for each equation.

The equations used preserve the double logarithmic form. The specification (6.6) implies a decreasing elasticity of imports with respect to relative prices, an increasing

⁸³ Except for the bilateral equation for imports from the US, the relative prices of exports from country k on Iranian domestic prices were either non-significant or had unexpected signs in the estimation process.

⁸⁴ Both the bilateral real exchange rate (ER^k) and its parallel market (BM^k) rate between Iran and country k can be respectively defined as follows:

$$ER^k = ER_{US}^k \cdot ER$$

and

$$BM^k = ER_{US}^k \cdot BM$$

where ER_{US}^k is the exchange rate between the US dollar and the currency of country k (defined as the number of U.S. dollars per unit of the k th country currency). ER is the official real exchange rate (Iranian rials per one US dollar in the official market), and BM is the real black market exchange rate (Iranian rials per US dollar in the black market). In practice, the bilateral exchange rate premium in the black (parallel) market (BM^k / ER^k) is equal to BM / ER :

$$\begin{aligned} BM^k / ER^k &= (ER_{US}^k \cdot BM) / (ER_{US}^k \cdot ER) \\ &= BM / ER \end{aligned}$$

elasticity with respect to real income, and a decreasing elasticity of imports with respect to the black market exchange rate premium. The results for the estimated import equations for fifteen countries are presented in Table 6.8. All coefficients estimated by OLS are significantly different from zero at the 5 percent level.⁸⁵ The overall results seem quite acceptable in terms of the correct sign of the coefficients, adjusted R-square (\bar{R}^2) coefficient, Durbin-Watson statistic (DW), Durbin h statistic (for those equations which have lagged dependent variables), and other diagnostic tests. As Table 6.8 shows, these equations have the same general characteristics as the aggregate import demand equation and the equations for imported commodity groups which so far have been estimated.

For all countries of origin reported, except France, where the price elasticity is not significant, relative prices are quite elastic, and the price elasticities range widely from -1.4 to -8.5, while the range of income elasticities is between 0.5 and 2. Notice that only for imports from the United States is the ratio of the U.S. export price to the domestic price (P_x^{US} / P_d) significant, while for imports from other countries the significant price variable is the ratio of the aggregate import price to the domestic price (P_m / P_d).⁸⁶ The price elasticities of imports from Iran's major trading partners (Germany, Japan, U.S., U.K., and Italy) are generally somewhat lower than those from other developed countries (Belgium, Netherlands, Switzerland, Australia, and Canada) as well as developing countries (Turkey, South Korea, U.A.E., and Brazil). This suggests that Iranian demand for imports from developing countries, and some developed nations, is more price elastic than that from its major industrialised partners. More specifically, the competition among exporters in developing and some developed countries is more

⁸⁵ According to the t-statistics, a few coefficients are only significant at the 10 percent level (see Table 6.8).

⁸⁶ As specified in Section 4.4.3 of Chapter Four, the relative price explaining imports by country of origin is the ratio of the export price of country k (P_x^k) to the domestic price (P_d). The coefficient of this variable can reflect the impact of competing prices from country k . However, this coefficient is only statistically significant for the US. As a result, the aggregate relative price (P_m/P_d) has been substituted for other equations of imports by country of origin.

Table 6.8: Estimation results for the import equations by country of origin, 1970-1993.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Country (IM^k)	Constant	P_m / P_d	Y	BM/ER	IM_{t-1}^k	D_1	D_2	D_3	\bar{R}^2
Germany (IM^{DUE})	-4.593 (-2.579)	-1.427 (-2.118)	0.713 (2.750)	-0.467 (-2.778)	0.404 (2.544)		0.361 (-2.297)	-0.410 (-3.070)	0.986
Japan (IM^{PN})	-5.619 (-2.567)	-1.915 (-2.135)	0.897 (2.783)	-0.457 (-2.100)	0.410 (2.481)		-0.423 (-2.053)	-0.464 (-2.561)	0.980
U. S. A. (IM^{USA})	2.547 (1.951)	-1.139 ^a (-1.882)		-1.467 (-1.812)	0.860 (4.876)		-0.836 (-2.672)		0.950
U. K. (IM^{UK})	-11.757 (-12.532)	-2.750 (-5.574)	1.678 (12.318)	-0.459 (-3.253)				-0.275 (-1.910)	0.987
Italy (IM^{ITA})	-6.497 (-4.648)	-1.920 (-2.725)	0.814 (4.332)	-0.413 (-1.917)	0.295 (1.965)			-0.465 (-2.826)	0.973
France (IM^{FR})	-4.864 (-3.111)		0.530 (2.502)	-1.528 (-6.304)				-0.694 (-2.837)	0.969
Belgium (IM^{BEL})	-10.929 (-10.429)	-3.183 (-5.433)	1.333 (8.752)	-0.474 (-3.051)					0.967
Netherlands (IM^{NLD})	-10.125 (-9.876)	-3.576 (-6.413)	1.318 (8.806)	-0.787 (-5.236)					0.979
Switzerland (IM^{CHE})	-8.792 (-5.618)	-4.647 (-5.459)	1.179 (5.162)	-1.028 (-4.482)					0.952
Turkey (IM^{TUR})	-13.664 (-25.689)	-6.041 (-6.955)	1.676 (13.089)			0.794 (3.271)	-0.655 (-2.770)		0.904

continued

Table 6.8 (continued).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Australia (IM^{AUS})	-15.534 (-26.215)	-5.358 (-5.493)	2.029 (14.394)						0.935
South Korea (IM^{KOR})	-6.124 (-3.674)	-8.552 (-9.756)	0.766 (3.164)	-1.317 (-5.258)				-0.483 (-1.885)	0.928
U. A. E. (IM^{UAE})	-6.962 (-3.742)	-6.087 (-6.221)	0.521 (1.929)	-0.734 (-2.627)				-0.378 (-1.835)	0.781
Brazil (IM^{BRA})	-8.318 (-4.281)	-3.542 (-1.861)	1.023 (3.597)		0.455 (3.356)				0.760
Canada (IM^{CAN})	-13.365 (-19.214)	-3.407 (-2.976)	1.374 (8.340)			0.589 (1.908)		-0.551 (-1.765)	0.878

Diagnostic Test Statistics

IM^{DUE}	$h = -1.060$	$\chi^2_{LM}(1) = 0.461^b$	$\chi^2_{ARCH}(1) = 0.256^c$	$\chi^2_{JB}(2) = 1.944^d$	$F(1,16) = 0.923^e$	$F(2,15) = 0.533^e$	$F(3,14) = 0.331^e$
IM^{JPN}	$h = -1.677$	$\chi^2_{LM}(1) = 1.037^b$	$\chi^2_{ARCH}(1) = 0.592^e$	$\chi^2_{JB}(2) = 4.359^d$	$F(1,16) = 0.718^e$	$F(2,15) = 0.504^e$	$F(3,14) = 0.314^e$
IM^{USA}	$h = 0.942$	$\chi^2_{LM}(1) = 0.376^b$	$\chi^2_{ARCH}(1) = 0.079^e$	$\chi^2_{JB}(2) = 0.027^d$	$F(1,18) = 0.313^e$		
IM^{UK}	$DW = 2.346$	$\chi^2_{LM}(1) = 0.815^b$	$\chi^2_{ARCH}(1) = 0.194^c$	$\chi^2_{JB}(2) = 0.681^d$	$F(1,18) = 0.720^e$	$F(2,17) = 1.591^e$	$F(3,16) = 1.077^e$
IM^{ITA}	$h = 1.050$	$\chi^2_{LM}(1) = 0.648^b$	$\chi^2_{ARCH}(1) = 1.016^c$	$\chi^2_{JB}(2) = 0.983^d$	$F(1,17) = 3.910^e$		
IM^{FRA}	$DW = 1.545$	$\chi^2_{LM}(1) = 1.503^b$	$\chi^2_{ARCH}(1) = 0.024^c$	$\chi^2_{JB}(2) = 0.815^d$	$F(1,19) = 2.954^e$	$F(2,18) = 1.914^e$	$F(3,17) = 1.201^e$
IM^{BEL}	$DW = 1.887^*$						

continued

Table 6.8: (continued).

IM^{NLD}	$DW = 1.616$	$\chi^2_{LM}(1) = 0.703^b$	$\chi^2_{ARCH}(1) = 0.372^c$	$\chi^2_{JB}(2) = 0.487^d$	
IM^{CHE}	$DW = 1.910$	$\chi^2_{LM}(1) = 0.202^b$	$\chi^2_{ARCH}(1) = 0.043^c$		
IM^{TUR}	$DW = 1.949$	$\chi^2_{LM}(1) = 0.227^b$	$\chi^2_{ARCH}(1) = 0.748^c$	$F(1, 18) = 0.122^c$	$F(3, 17) = 0.195^c$
IM^{4US}	$DW = 2.095^*$			$\chi^2_{JB}(2) = 1.042^d$	
IM^{KOR}	$DW = 1.788$	$\chi^2_{LM}(1) = 0.810^b$	$\chi^2_{ARCH}(1) = 1.635^c$	$\chi^2_{JB}(2) = 0.143^d$	$F(3, 17) = 0.137^c$
IM^{JAE}	$DW = 2.299$	$\chi^2_{LM}(1) = 418^b$	$\chi^2_{ARCH}(1) = 1.695^c$	$\chi^2_{JB}(2) = 0.521^d$	$F(3, 17) = 3.063^c$
IM^{BRA}	$h = -1.049$			$\chi^2_{JB}(2) = 0.256^d$	$F(3, 17) = 0.932^c$
IM^{CAN}	$DW = 2.044$	$\chi^2_{LM}(1) = 0.036^b$	$\chi^2_{ARCH}(1) = 0.359^c$	$\chi^2_{JB}(2) = 0.170^d$	$F(3, 16) = 1.376^c$

Values in parentheses beneath each estimated coefficient contain the t -statistic.

^a The relative price is defined as the U. S. export price index (P_x^{US}) divided by the domestic price index (P_d). P_x^{US} is readily available from the IMF, Yearbook of International Financial Statistics.

^b The LM test for serial correlation.

^c The ARCH test for heteroscedasticity.

^d The Jarque-Bera test for normality of the residuals.

^d Ramsey's RESET tests for functional form misspecification.

* Corrected for autocorrelation of residuals by applying the maximum likelihood iterative technique.

important than the competition among exporters in the major industrialised countries in the exporting of goods to Iran.

There are significant differences among the income elasticities of demand for imports from Iran's trading partners. Imports from Germany, Japan, Italy, South Korea, and U.A.E. are income inelastic, where the income elasticities are less than unity. However, imports from other countries are income elastic in which the elasticities exceed unity. These differences in elasticities have important implications for understanding the trade relationship between Iran and its major trading partners. The elasticities show how the demand for imports from these countries is sensitive to changes in Iranian economic activity. For example, a low income elasticity for imports from Japan or Germany, where capital goods are often imported, suggests that changes in income do not affect the Iran-Japan or Iran-Germany trade relationship.

The non-significant official real exchange rate, has been replaced by the significant real black market exchange rate premium in most equations for imports by country of origin. In the case of Turkey, Australia, Brazil, and Canada, both the official exchange rate and its black market premium have not affected the demand for imports over the period under consideration (1970-1993). The real black market exchange rate premium has generally had an adverse influence on the demand for imports, and its elasticity ranges from a high value of about -1.5 for the case of France to a low value of about -0.4 for the case of Italy. As can be seen from Table 6.8, the equations for imports from Germany, Japan, U.K., Italy, and Belgium are inelastic with respect to changes in the black market exchange rate premium, where the relevant elasticities capture a value of about 0.5. It implies that the responsiveness of Iranian demand for exports from these countries with respect to changes in the exchange rate in the black market, is less sensitive than that for exports of other countries. The high value of the exchange rate elasticity for the case of the United States and France, may arise from the absence of income and relative price variables in the equation. Another reason could be the

existence of an uncertain economic relationship between Iran and these countries over the post-revolutionary (1980s) period.

According to the significant lagged dependent variable, only five equations for imports by country of origin appear in a dynamic form. This supports the assumption in which the Iranian demand for imported goods from Germany, Japan, U.S., Italy, and Brazil is adjusted partially between actual and desired imports, as previously discussed in the formulation of the import demand equation. Finally, the dummy variable for a rise in the oil price in 1974 and 1979-1981 (D_1) has had a positive effect on Iranian demand for the exports of Turkey and Canada. The dummy variable for the episodes of the revolution in 1979 and the beginning of the Iran-Iraq war in 1980 (D_2), has affected adversely the demand for imports from some major trading partners such as Germany, Japan, U.S., and Turkey. Because of the revolution and war, total merchandise imports declined by around 25 percent from 1977 to 1980. This decreased dramatically the share of Germany, Japan, and U.S., as the major trade partners of Iran, from 51 percent to 26 percent. Another reason for the decline in imports from the U.S., appears to be due to the political crisis between Iran and this country. In addition, the demand for imports by Iran from most countries has been suffering from a sharp fall in the oil price and foreign exchange earnings during the period 1986-1988 (D_3).

6.5 Summary and Conclusions

Iranian imports have been disaggregated into three different categories: the composition of imports, imports of commodity groups, and imports by country of origin. This gives evidence of an attempt to recognise how import demand reacts with respect to changes in some important economic variables such as prices, activity variables (income, expenditure, etc.), and exchange rates. The equations in all categories have almost the same structure, in which imports have a decreasing relationship with relative prices, an increasing relationship with an activity variable, and a decreasing relationship with the exchange rate. They rely dynamically on the assumption of partial adjustment as well.

In the case of the disaggregated composition of imports, consumer goods imports and imports of raw materials and intermediate goods, they are found to be elastic in the price effect in the relevant estimated equations. However, the price elasticity in the capital import equation is not statistically significant. In addition, significant activity variables are different in the equation system. Government and private expenditures explain consumer imports well, imports of raw materials and intermediate goods are a function of real income, and investment is an appropriate activity variable in the equation for capital imports. The black market (parallel market) exchange rate premium has a significant effect on the demand for the composition of imports, while consumer goods are more sensitive with respect to the premium than imports of raw materials and intermediate goods and capital goods. However, the impact of the official exchange rate is statistically insignificant.

The major conclusions from the results are, firstly, that the restricted imports have been more responsive to changes in relative prices than free imports during the period. Changes in the two categories of imports display nearly similar responses to changes in activity variables, especially to that of real GDP. Secondly, the results for the price elasticities are not consistent with some previous studies which have been conducted for developing countries. Thirdly, the official exchange rate does not contribute significantly to the import functions whereas the effect of the parallel market exchange rate is nearly similar to the price effects, which means changes in both the relative price and the parallel (black) market exchange rate influence adversely the demand for imports. However, it takes longer for the change in the black market exchange rate to affect imports than it does for a change in the relative prices variable. Finally there has been an increasing dependency upon some imports such as imports of fertilisers, rubber, and transport materials during this period.

Iranian demand for imports from all its major trading partners are price elastic. However, price elasticities of demand for imports from developing countries, and some developed nations, are higher than those from its major industrialised partners (like

Germany, Japan). The demand for imports is elastic with respect to income for some countries (such as the U.K., Belgium, and Turkey), and is inelastic for others (such as Germany, Japan, South Korea, and U.A.E.). Differences in the income elasticity suggest different trade relationships between Iran and its trading partners. Similar to those results for import equations obtained in previous sections, the black market premium plays a significant role in explaining imports by country of origin.

Overall, the models confirm that disaggregated imports for the three categories (composition of imports, imports of commodity groups, and imports by country of origin) respond more effectively, and to a greater extent, to a change in relative prices than to a change in activity variables and the exchange rate. We will apply the estimation results obtained for the composition of imports in the next chapter to investigate the effect of some policy shocks on the import sector.

CHAPTER SEVEN

7. DYNAMIC HISTORICAL SIMULATION TEST AND POLICY EXPERIMENTS

7.1 Introduction

In this chapter the impact of various policy shocks on the Iranian economy will be considered, using the parameters estimates presented in earlier chapters. In Chapter Five a macro-model was developed, including an aggregate import demand function. In Chapter Six disaggregate imports were modelled in three categories: the composition of imports, imported commodity groups, and imports by country of origin. However, to concentrate briefly on the use of simulation techniques, we focus only on the macro model reviewed in Chapter Five and then the model for the composition of imports (consumer imports, intermediate imports, and capital imports) estimated in Chapter Six. In order to test the reliability of these models for predicting the changes of the dependent variables, dynamic simulations of the models are conducted over the period 1970-1993. The primary purpose of which is to interpret the resulting policy implications arising from the dynamic properties of these models.

The chapter is organised as follows. Section 7.2 outlines the dynamic simulation tests to evaluate historical simulations of the macro-model, using the relevant techniques. Section 7.3 describes four scenarios and explains why they are selected in particular. Since a shock to the black market exchange rate premium is a major policy parameter in this chapter, alternative options to change the parallel (black) market exchange rate

premium are discussed in this section. The interpretation of the simulation results for the macro-model conducted for several scenarios is a significant feature of Section 7.4. Section 7.5 evaluates the dynamic simulation tests and continues the interpretation of the simulation results for the composition of imports including consumer, intermediate imports, and capital imports. The final section presents a summary of the major conclusions from this chapter.

7.2 Dynamic Simulation Tests of the Iranian Macro-Model

Each equation of the macro-model shown in Chapter Five, indicates the partial effect of exogenous variables on endogenous variables such as real imports, real income, import prices, domestic prices, etc. The impact of changes in the exogenous variables, including the policy instruments, depends upon the behavioural equations of the model. For example, a shift in import demand arising from an exogenous shock has an effect on income and other endogenous variables due to the underlying dynamic structure of the model. Hence, to peruse how the model as a whole behaves in response to different shocks, it is of interest to carry out a simulation analysis. With the existence of lagged endogenous variables at time $t-1$ (in the import equation, for instance), dynamic simulations are most appropriately conducted. These simulations are preferred to static ones, because they provide a better test of model stability than do static simulations, since dynamic simulation errors accumulate over time while in static simulations actual values of the lagged dependent variables are used (Vaez-Zadeh 1989).

The estimation results of the coefficients obtained in Chapter Five, are used in conjunction with TSP (Time Series Processor), to obtain the historical simulated values as well as shocked values of the endogenous variables.⁸⁷ The method employed to solve the model is the Newton technique with an analytic Jacobian (Hall et al. 1995a). Given the new set of values, the model is solved iteratively each time generating a new set of

⁸⁷ Note that the behavioural equations have been specified in log-linear form and the identities are in the actual level.

values. Thus, the system iterates until convergence of the successive values is achieved within some denoted tolerance level (Murinde 1993).

A criterion that is used by Fair (1984) and Murinde (1993) to evaluate a simulation model is the fit of the individual variables in a simulation context. One may perform a historical simulation and investigate how each endogenous variable follows the historical data. Following Fair (1984), the three most common measures of predictive accuracy that have been used to evaluate *ex ante* and *ex post* forecasts are *root mean squared error (RMSE)*, *mean absolute error (MAE)*, and *Theil's inequality coefficient (TIC)*.⁸⁸ The *RMSE* is a measure of the deviation of the simulated variable from its actual time path. The size of this error should be evaluated by comparing it with the mean of the relevant dependent variable (Pindyck and Rubinfeld 1991). The *MAE* measure penalises large errors less than the *RMSE* does, while a value of *TIC* greater than one means that the simulation is less correct than the simple simulation of no change (Fair 1984). Furthermore, the proportions U^M (the bias proportion), U^S (the variance proportion), and U^C (the covariance proportion) are useful as a means of breaking the simulation error down into its characteristic sources (Pindyck and Rubinfeld 1991).⁸⁹ A large value of U^M or U^S (above 0.2) is troubling, because it means

⁸⁸ The formula used for calculating these quantitative measures, as shown in Fair (1984, p. 261), are as follows:

$$RMSE = \sqrt{\frac{1}{T} \sum_{t=1}^T (Y_t^a - Y_t^s)^2},$$

$$MAE = \frac{1}{T} \sum_{t=1}^T |Y_t^a - Y_t^s|,$$

$$TIC = \frac{\sqrt{\frac{1}{T} \sum_{t=1}^T (\Delta Y_t^a - \Delta Y_t^s)^2}}{\sqrt{\frac{1}{T} \sum_{t=1}^T (\Delta Y_t^a)^2}}$$

where Y^a and Y^s denote actual and simulated values of a dependent variable. T is the number of periods in the simulation. Δ denotes either absolute or percentage change.

⁸⁹ The formula used for these proportions are as follows:

$$U^M = \frac{(\bar{Y}^s - \bar{Y}^a)^2}{(1/T) \sum_{t=1}^T (Y_t^s - Y_t^a)^2}$$

$$U^S = \frac{(\sigma_s - \sigma_a)^2}{(1/T) \sum_{t=1}^T (Y_t^s - Y_t^a)^2}$$

$$U^C = \frac{2(1 - \rho) \sigma_s \sigma_a}{(1/T) \sum_{t=1}^T (Y_t^s - Y_t^a)^2}$$

that a systematic bias is present or the actual series has fluctuated notably while the simulated series indicates little fluctuation, or vice versa.

Table 7.1 reports all the statistics, including $RMSE$, MAE , TIC , U^M , U^S , and U^C with respect to the simulation conducted for the macro-model, as represented in Chapter Five. Dependent variables of the model are government expenditure, private expenditure, government non-oil revenues, government revenues (total), imports, non-oil income, total income (oil and non-oil income), real money balances, import price, and domestic price.

Overall, the model is reliable and can be used to perform several policy scenarios. $RMSE$ and MAE values relative to the corresponding mean values of the dependent variables are quite small, and TIC is less than one and close to zero in all cases. The value of the proportions U^M and U^S for all the endogenous variables of the model is low (less than 0.2), and the sum of U^M , U^S , U^C is quite close to one ($U^M + U^S + U^C = 1$).⁹⁰ Again, Figures 7.1-7.30 on the following pages confirm reliable simulation results, that is, they indicate that the model tracks the actual movements of the endogenous variables over the period remarkably well.

where \bar{Y}^s , \bar{Y}^a , σ_s and σ_a are the means and standard deviations of the series Y_t^s and Y_t^a , respectively. ρ is their correlation coefficient.

⁹⁰ Pindyck and Rubinfeld (1991) derive these proportions from Theil's inequality coefficient and then indicate that $U^M + U^S + U^C = 1$.

Table 7.1: Results of the dynamic simulation test for the macro-model of Iran, 1970-1993.

Endogenous Variables	Statistics					
	Mean	Root Mean Squared Error (<i>RMSE</i>)	Mean Absolute Error (<i>MAE</i>)	Theil's Inequality Coefficient (<i>TIC</i>)	U^M	U^S
Imports (<i>IM</i>)	909.553 ^a	28.682	23.692	0.121	0.0349	0.0253
Import Price (P_m)	189.609 ^b	12.232	4.616	0.253	0.0241	0.0028
Domestic price (P_d)	181.557 ^b	5.808	2.259	0.131	0.0190	0.1030
Government expenditure (<i>Ge</i>)	2690.718 ^a	19.586	12.336	0.054	0.0013	0.1740
Private expenditure (<i>Pex</i>)	7460.564 ^a	39.934	33.287	0.063	0.0013	0.1450
Government non-oil revenues (<i>Y_{no}</i>)	1091.155 ^a	8.199	6.862	0.042	0.0332	0.0231
Government revenues (<i>Y_g</i>)	2584.040 ^a	8.199	6.550	0.014	0.0361	0.0323
Non-oil income (<i>Y_{no}</i>)	8905.714 ^a	75.394	41.200	0.132	0.0290	0.0501
Income (GDP) (<i>Y</i>)	11555.37 ^a	75.539	41.200	0.094	0.0297	0.01910
Real money balances (<i>m</i>)	55.003 ^a	0.778	0.290	0.230	0.0233	0.09600

^a Billion Rials.^b Index.

7.3 Policy Simulation Scenarios

The procedure adopted here to conduct policy experiments involves considering the dynamic historical simulation for the period 1970-1993, using the parameter estimates obtained in the previous chapters and the actual values of the exogenous variables. Alternative policies can affect the model when they are formulated as a shock to the system.

7.3.1 A Description of the Policy Scenarios

Four scenarios are selected so that the relevant policy variables are manipulated to generate the relevant simulation results. These scenarios are concerned with the shocks to the black market exchange rate premium and non-oil exports. The unification of foreign exchange markets, in which the premium declines and the black and official rates come closer to a unique exchange rate, is a key policy issue for many developing countries. In the case of Iran, it is evident that the country has been experiencing a severe rate of inflation since the early 1980s. Bahmani-Oskooee (1995a) indicates that a monetary phenomenon is not the only source of inflation, but also the depreciation of the Iranian rial in the black market and imported inflation are the other significant determinants of inflation. An argument in favor of fighting inflation can be conducted by the elimination, or reduction, of the black market premium. One of the key government goals is to unify the exchange rate system, or reduce the gap between the official exchange rate and its black market equivalent in order to stabilise the economy. As a result Scenario One, Scenario Two, as well as Scenario Three, described in the following, are chosen to identify the effect of the exchange rate policy on the economy.

In addition, to avoid a foreign exchange crisis arising from oil related disturbances, the authorities have always expressed the promotion of non-oil exports. A different policy, Scenario Four, is also chosen to examine the effect of the promotion of non-oil exports on the economic growth process.

As specified by the macro-model in Chapter Five and the import model in Chapter Six, the black market premium and non-oil exports have been assumed to be exogenous, affecting both models significantly. A key objective is to identify qualitatively and quantitatively the dynamic response of the model to changes in such policy variables. Overall, the selected scenarios are highlighted as follows:

Scenario One: elimination of the black market exchange rate premium

Scenario Two: 50% decrease in the black market exchange rate premium

Scenario Three: 50% increase in the black market exchange rate premium

Scenario Four: 50% increase in real non-oil exports

In Scenario One, the black market exchange rate premium is assumed to capture a value of unity ($BM / ER = 1$) for the whole period, indicating a policy of unification of the exchange rates. As a result, the log- value of the premium, in the import equation [eq. (4.22)] and import price equation [eq. (4.23)], is therefore equal to zero.⁹¹ This scenario unifies the exchange rates, and eliminates the black market premium in practice. We will investigate here the impact of this policy on the macro-model of the Iranian economy, which was developed in Chapter Five, as well as on the model of the composition of imports presented in Chapter Six.

The black market exchange rate premium is assumed to decrease by 50% under Scenario Two, equivalent to examining the effect of a 50% reduction in the black market premium on the economy. Since the unification of the exchange rates in 1993 has not been successful, the gap between the official exchange rate and its black market rate has widened in response to the continuation of the balance of payments deficits and the presence of the external debt. Hence Scenario Two considers only a 50% decrease in the black market premium obtained by foreign exchange controls. Contrary to Scenario Two, Scenario Three postulates a 50% increase in the black market exchange rate premium. In this scenario the effect of a shock rise in the premium can be analysed. A

⁹¹ $\log (BM / ER) = 0$.

rise in the black market exchange rate has often happened and especially during 1980-1995. These last two policy options (Scenario Two and Scenario Three) are conducted from 1980 until the end of the simulation, 1993. The reason is that the events of the revolution in 1979, followed by the beginning of the Iran-Iraq war in 1980, led to the widening gap between the black market exchange rate and its official rate.

Finally, Scenario Four will impose a 50 % increase in real non-oil exports covering the whole period, because one of Iran's major economic goals, as mentioned earlier, has been to promote non-oil exports.⁹² What is required for Iran's future economic development is the regeneration of private investment and the promotion of non-oil exports. Accordingly, in order to bring a structural change in the external sector, an increase in the country's non-oil exports is required. Table 7.2 summarises all the above scenarios, denoting them in the figures given in the following pages. The historical simulations (baseline solutions) are also denoted as 'baseline' in the figures.

Table 7.2: Selected simulation scenarios.

Policy Experiment	Scenario	Denotation
elimination of the black market exchange rate premium*	Scenario One	Scen. 1
50% decrease in the black market exchange rate premium	Scenario Two	Scen. 2
50% increase in the black market exchange rate premium	Scenario Three	Scen. 3
50% increase in real non-oil exports	Scenario Four	Scen. 4
Historical simulation (baseline solution)	—	Baseline

* The black market exchange rate premium is defined as the ratio of the black market exchange rate to the official exchange rate.

To conduct policy scenarios relative to the black market exchange rate premium, the next section examines alternative options regarding eliminating, or reducing, this premium.

⁹² The promotion of non-oil exports was one of the major objectives of the First Five-Year Economic, Social and Cultural Development Plan (1989/90-1993/94) of Iran approved by Majlis (the Consultative Assembly of the Islamic Republic of Iran). The promotion of such exports resulted in an increase from US\$1 billion in 1988/90 to US\$3.7 billions in 1993/94 (Pesaran 1995).

7.3.1.1 Alternative Options to Eliminate, or Reduce, the Black Market Exchange Rate Premium

The unification policy of the exchange rates, or the elimination of the black market exchange rate premium, can be conducted under a devaluation of the official exchange rate, an appreciation of the black market equivalent, or a combination of these policies. In the first case, the official exchange rate is depreciated to the black market rate. In the second case the black (parallel) market rate is appreciated to the official rate while the fixed official exchange rate is assumed to be kept unchanged. In the third case, a combination of devaluing the official rate, on the one hand, and simultaneously appreciating the black market exchange rate, on the other hand, can contribute to the unification of the exchange rate, or eliminate the black market premium. Changes in the foreign reserves of the banking system assist to equate the supply and demand for foreign currency, resulting in the appreciation of the domestic currency in the black market.

In Scenario One, by which the black market exchange rate premium is eliminated, the simulation results indicate a substantial increase in imports as well as a fall in import and domestic prices. However, the above mentioned policy cases of eliminating the premium can affect these variables differently. Hence this section identifies the effects of Scenario One on import demand and evaluates the results obtained by using the simulation process.

(1) To bring a significant reduction in the black market premium, as a first step towards the unification of the exchange rate system, one option available to the government is to conduct a nominal devaluation of the official exchange rate, assuming the black market exchange rate remains unchanged. A once-and-for-all devaluation may permanently reduce the level of the premium. This leads to an increase in import costs and domestic prices, which have an adverse welfare effect. In addition, the volume of essential imports, which are likely to be price inelastic and financed by the official rate, does not

change but their cost rises based upon the depreciation of the domestic currency. Hence a higher import price makes imports more expensive, resulting in an increase in overall import costs.

As a result, an official exchange rate devaluation will increase import costs if demand is inelastic which confirms the simulation results under Scenario One in terms of overall import costs, but is not consistent with a fall in the price of imports observed in the simulation. Furthermore, devaluation can have harmful effects if it is not accompanied by appropriate demand-management policies. Agenor (1992) indicates that the long-run effect of such a policy on the premium is ambiguous. Because the effect will depend on the degree to which illegal transactions react to changes in the premium, and the elasticity of exports with respect to changes in relative prices.

In practice, it is evident that the official exchange rate devaluation has not been successful in Iran. The reason is that after devaluing the rial (the domestic currency) in 1993 the Iranian government fixed again the exchange rate to control the black market and smuggling in this market in early 1995. The reform of the exchange rate led relative prices to change sharply, and some groups experienced a decline in their real income as a result of the huge sudden jump in the overall cost of living (Farzin 1995). This adversely affected all consumers' economic well-being. To offset the negative welfare effect of the exchange rate unification, the government allocated 324 billion rials for salary increases to state employees, and raised the minimum daily wage rate from 2267 to 2994 rials in 1994 (Farzin 1995, p. 993).

(2) The second alternative option to eliminate the black market premium can be conducted by the appreciation of the black market exchange rate relative to the unchanged official rate. Apart from essential imported goods, as concluded in the earlier chapters, imports are significantly affected by the black market premium. The unification of the exchange rate by an appreciation of the black market exchange rate, for a given official rate, raises import demand because it makes overseas goods cheaper.

Hence if the elimination of the premium is conducted by this option, our simulation results can be supported under the performance of Scenario One, that is, imports increase substantially and the import price considerably falls.

However, from the economic point of view, a complete appreciation of the black market rate to closer to the official rate is not sensible from a policy perspective. Firstly, if the exchange rate is determined by the interaction of the supply of and demand for foreign exchange in the illegal parallel (black) market, how can government intervene to stop the action of this market? Secondly, if for the near future the likelihood of a substantial rise in world oil prices or in non-oil exports is remote, and if under current economic and political problems the prospects for attracting large flows of foreign capital are poor, there is very little that can be done to raise Iran's hard currency earnings by which the domestic currency is appreciated in the black currency market.

(3) A wise policy would therefore seek to eliminate the existing black market exchange rate premium by assuming a combination of appreciating the black market rate and devaluing the official rate. The appreciation of the domestic currency in the parallel market reduces the cost of imports which leads to an increase in import demand. On the contrary, the devaluation of the official exchange rate raises the cost of essential imports, which are financed by the official market, leading to an increase in such imports because demand for such imports is inelastic. When the black market plays a significant role in import financing, the result of such a combined policy in the unification of the exchange rates is increased imports and reduced import and domestic prices.

There are several possibilities that can be implemented to eliminate, or reduce, the premium by choosing the third option. Firstly, what is important in fact is the credibility of the Central Bank's policy as perceived by people. With a mistaken policy (for example, if the Central Bank insists on keeping the announced official rate constant after the devaluation), the Central Bank may lose its credibility which results in

expanding currency speculation motives, and then disequilibrium in the foreign exchange market. Secondly, the most desirable time for taking this policy would be when the macroeconomic stabilising policies are active. Since liquidity controls and fiscal deficits are important to the process for stabilising expectations, prices, and parallel exchange rates, unification must be accompanied by supportive fiscal and monetary policies. A tightening of the money supply can control liquidity and hence the inflationary pressures which are a significant source of the widening gap between the official exchange rate and its black market equivalent (Farzin 1995). Finally, another thing that can be done in this respect is to create correct expectations by making realistic development projections and rescheduling the external debt, leading to a decrease in the demand for foreign exchange on the black market.

7.4 Impacts of Policy Simulation Scenarios on the Macro-Model

To investigate the impact of four *ex post* policy experiments, as described in the previous section, on the dependent variables included in the macro-model, the shocked value of each variable after each scenario is compared to its baseline solution. The value of the baseline solution is in fact the historical simulation of the model (Valadkhani 1995b). To this end, the index of the Percentage Deviation from the Control Solution (PDCS) for each endogenous variable is obtained as follows:

$$PDCS = 100 \cdot [(Y^{sc}_t - Y^s_t) / Y^s_t] \quad (7.1)$$

where Y^{sc} denotes the shocked value of an endogenous variable, and Y^s is the baseline solution (historical simulation) of the variable in the model. Table G.1 (given in Appendix G) reports the PDCS for the endogenous variables of the macro-model over the period. Table 7.3 also summarises the average growth rates of all dependent variables included in the model.

Table 7.3: Annual average percentage deviation from the control solution (PDCS) for the endogenous variables of the macro-model (%).

Endogenous Variable	Scenario One	Scenario Two	Scenario Three	Scenario Four
Imports (IM)	47.463	31.923	-17.977	10.311
Import Price (P_m)	-14.697	-8.775	2.203	1.839
Domestic price (P_d)	-8.240	-4.709	1.190	2.132
Government expenditure (Ge)	-0.769	-0.768	0.103	4.136
Private expenditure (Pex)	-3.519	-1.574	0.364	10.204
Government non-oil revenues (Y_{gno})	-1.922	0.114	0.466	6.463
Government revenues (Y_g)	-1.052	-0.123	0.234	3.385
Non-oil income (Y_{no})	-4.246	-2.008	0.484	8.497
Income (GDP) (Y)	-3.336	-1.727	0.419	6.588
Real Money (m)	-1.400	-1.002	-0.051	15.375

Source: Table G.1.

7.4.1 Impact of Scenario One

Adopting a combination of an official exchange rate devaluation and an appreciation of the black market rate to bring about an elimination of the premium, this section examines the impact of Scenario One on the macro-model developed in Chapter Five. A value of unity for the black market exchange rate premium ($BM/ER=1$) means that this variable can be dropped from the model. This shock results in an immediate increase of 47 % per annum in imports directly and a decrease of about 15 % per annum in the import price on average. Figure 7.1 and Figure 7.2 also depict the results of this simulation on imports and the import price, respectively. A greater change for both variables occurs after 1986 to the end of the period, while the gap between the baseline (historical) solutions and the simulation values narrows over the 1974-1985 period.⁹³

⁹³ According to Table G.1 (given in Appendix G), there is an annual increase of about 13% for imports and an annual decrease of about 11% for the import price from 1974 to 1985. More importantly, there is an increase of about 99 % per annum for imports and a decrease of around 22% per annum for the import price, on average, from 1986 to 1993.

The reason is that, as mentioned earlier, the Iranian currency dramatically depreciated in the parallel foreign exchange market after a sharp decline in the oil price caused by a sharp decrease in foreign receipts after 1986. The performance of this policy suggests that the economy will be able to import a large number of various goods, used in the development process. Since the availability of foreign exchange is limited in the official market, the demand for a majority of imports (including intermediate and capital goods) is met in the black (parallel) market. The elimination of the premium makes the costs of imports lower, and hence importers are enabled to import more required goods. Although the elimination of the black market premium increases imports and is likely to lead to a deterioration in the trade balance, the increased imports could assist the economy by expanding the limited capacity of non-oil exports and improving the trade balance in the long-run. In addition, because of this policy, imported inputs are now less costly in real terms, causing production costs to fall. Thus, domestic prices tend to decrease on impact.

The import effect associated with the exclusion of the black market exchange rate premium from the model results in a decrease of about 4.2% per annum on average in real non-oil income (Table 7.3 and Figure 7.8). The change is followed thereafter by an annual average decreased rate of about 3.3% in GDP (Table 7.3 and Figure 7.9). In fact, the unification of the exchange rates conducted by this policy has led to a fall in the standard of living. Due to a loss of competitiveness which adversely affects exports, the decreased pricing of imports not only encourages importers to import further but also exporters switch their goods to the domestic market. As a result non-oil income and total income decline, and hence the economy could become worse off under this policy. But, as noted above, the importation of a large number of intermediate and capital goods should expand the limited capacity of both tradeable and non-tradeable goods, in which the economy improves in the long term.

Figure 7.1: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on imports.

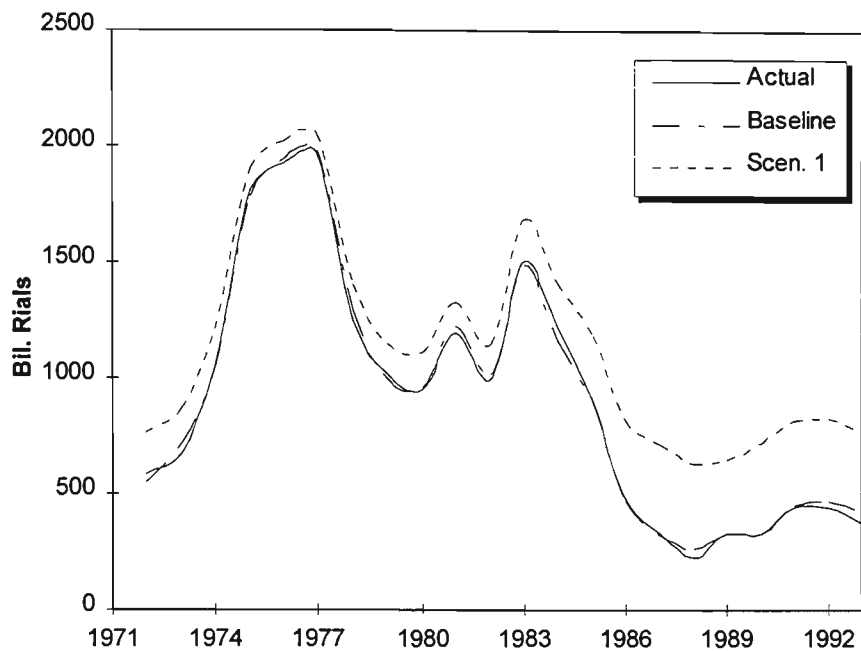


Figure 7.2: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on the import price.

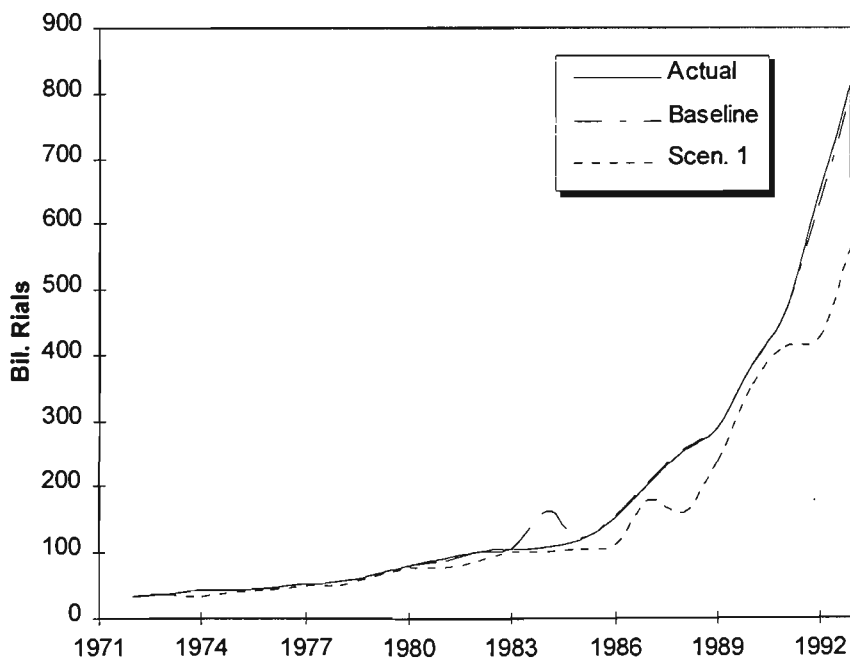


Figure 7.3: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on the domestic price.

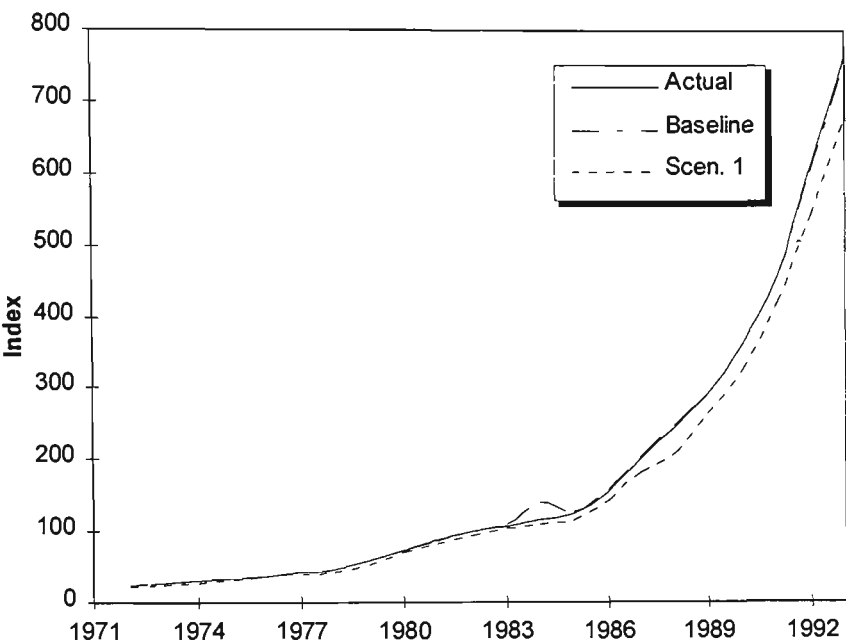


Figure 7.4: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on government expenditure.

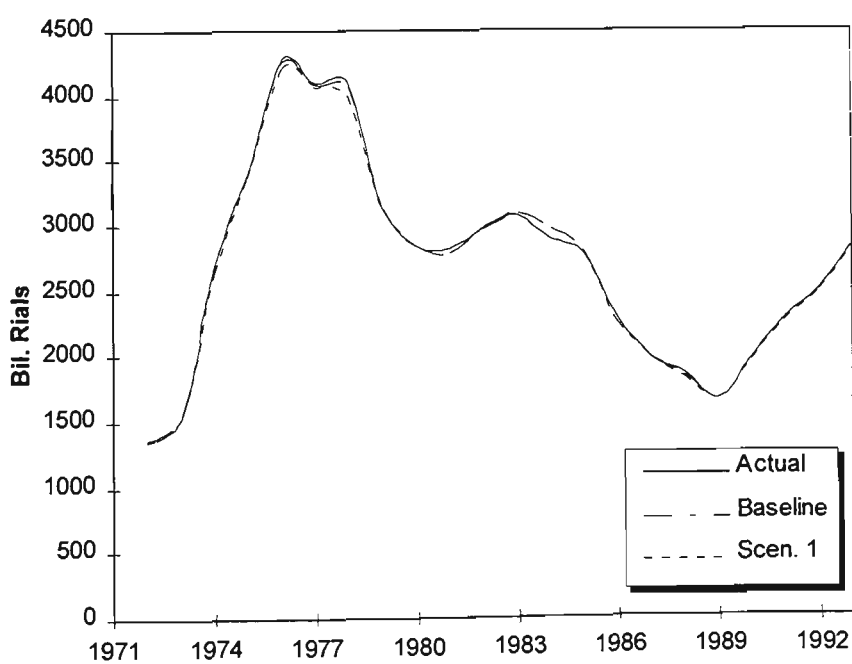


Figure 7.5 : Impact of the elimination of the black market exchange rate premium policy (Scenario One) on private expenditure.

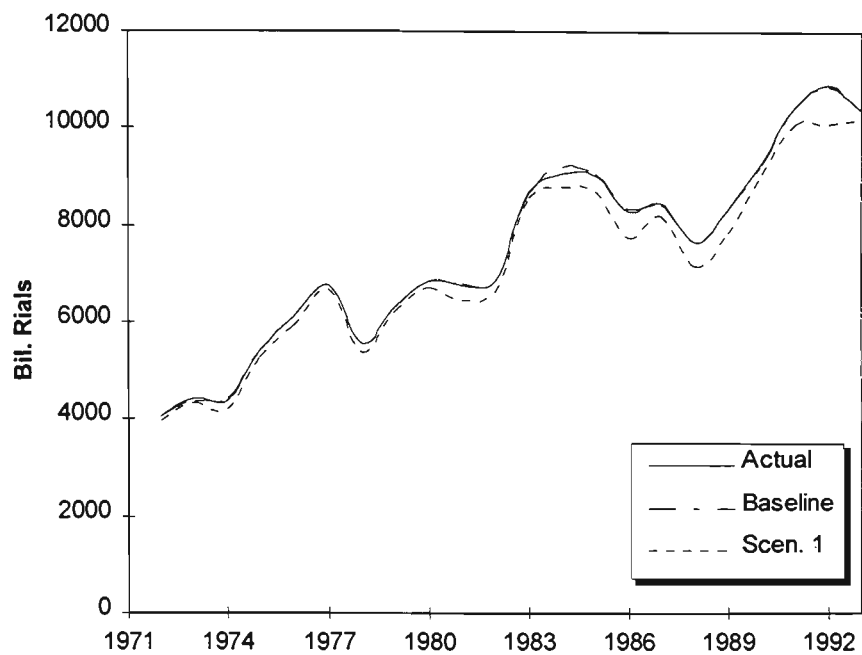


Figure 7.6: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on government non-oil revenues.

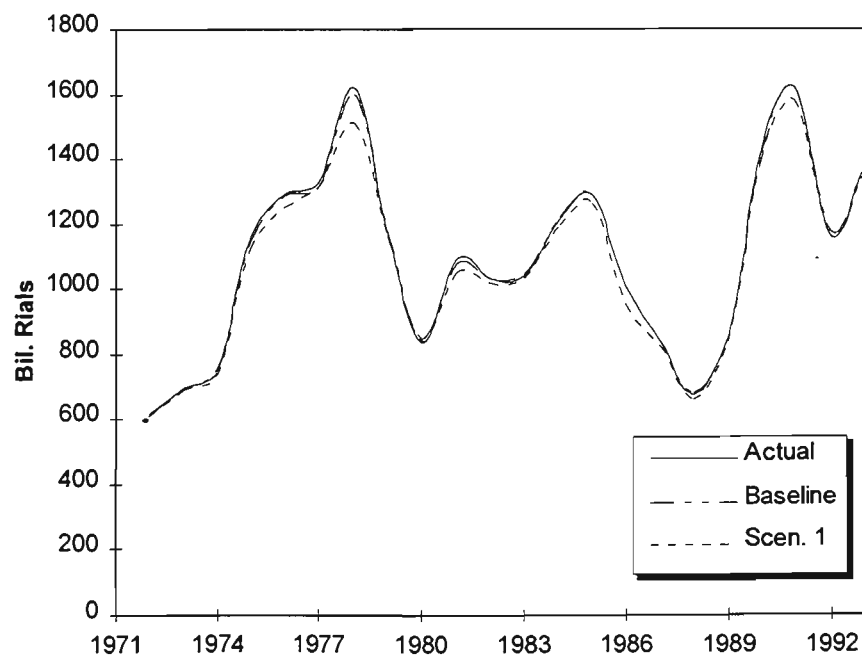


Figure 7.7: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on government (total) revenues.

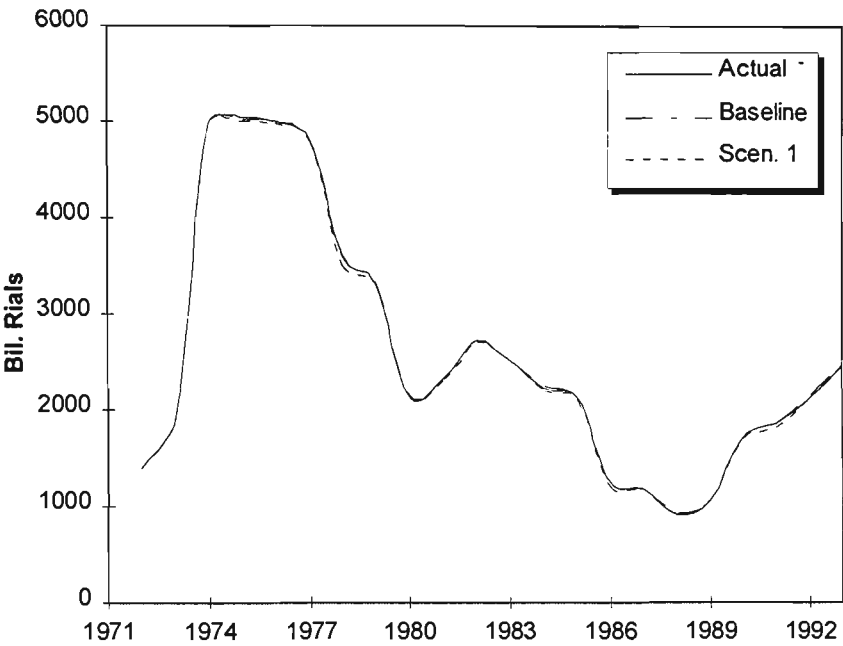


Figure 7.8: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on real non-oil income.

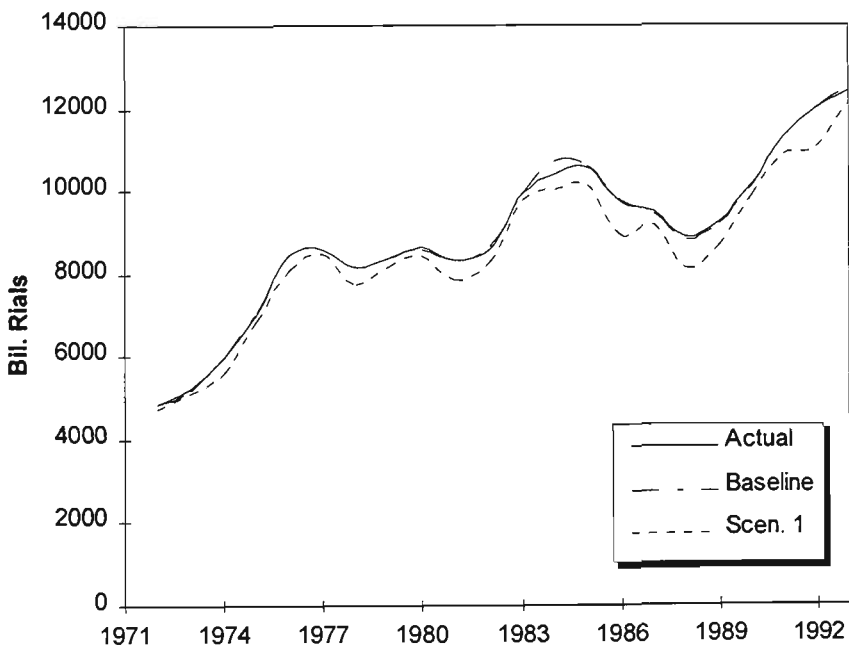


Figure 7.9: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on real income (GDP).

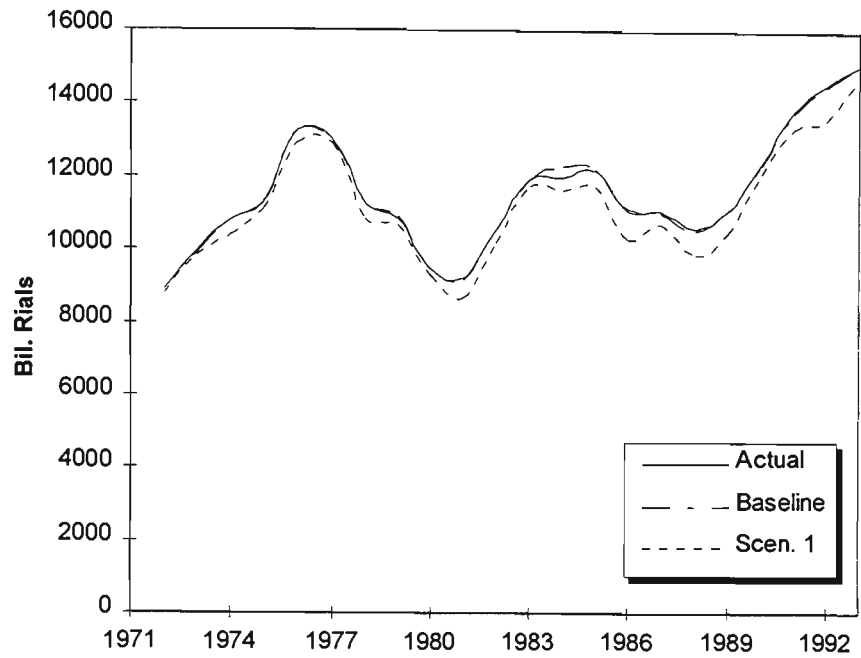
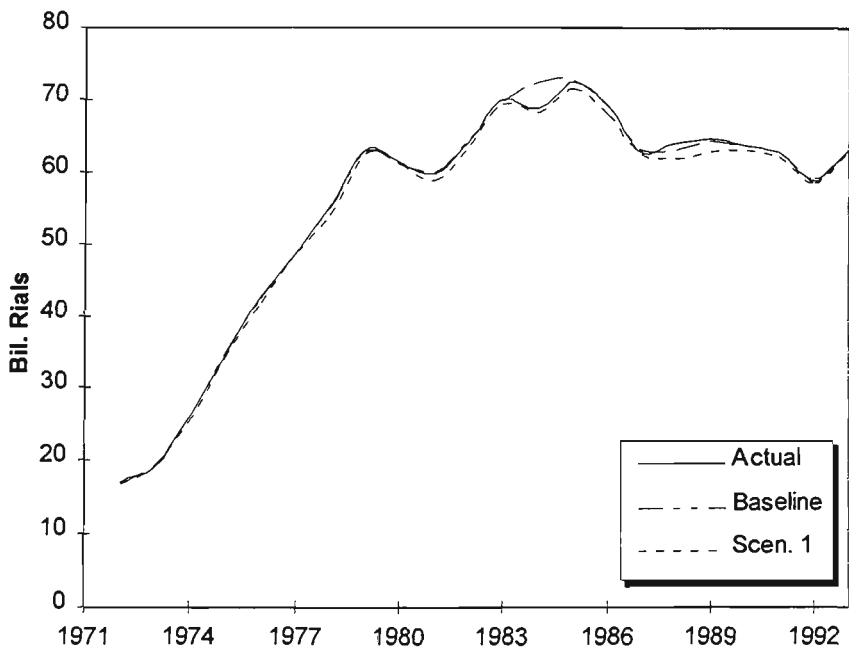


Figure 7.10: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on real money balances.



The simulation results suggest that the impact of the domestic currency appreciation in the black market can be considered to have two different effects. Firstly, as already indicated, the appreciation causes demand for imports to rise directly, which worsens the trade balance. The deterioration in net exports (the trade balance) leads to a decrease in real non-oil income and, hence, in real income (the demand for domestic goods).⁹⁴ Secondly, the elimination of the black market exchange rate premium reduces the import price which leads to a fall in the domestic price (Figure 7.2 and Figure 7.3). A decrease of about 8.2% per annum (Table 7. 3) in the domestic price improves the trade balance, causing an increase in income. This occurs when imports and exports are responsive to prices (Dornbusch and Fischer 1994). Consequently, the price effect compensates a proportion of the contraction of real non-oil income or real income (demand), caused by the import effect. However, overall, income remains below the control solution (baseline) values.

Government expenditure responds neutrally to the shock of the black market exchange rate premium (Figure 7.4) and is only affected by a decrease of about 0.8% on average per annum. The reason is that real government expenditure responds indirectly to the shock experiment and is only directly affected by changes in government non-oil revenues (Y_{gno}). This can be seen from the specification of the government expenditure equation included in the macro-model (as presented in Chapter Five). Real government expenditure is a positive function of government non-oil revenues, with a small estimated coefficient of about 0.3⁹⁵, which is explained by real non-oil income. The policy simulation decreases real non-oil income by an annual rate of about 4.2%, on average, affecting real government non-oil revenues. The decreased real non-oil income

⁹⁴ As given in Chapter Five, two identities define real non-oil income Y_{no} (demand) and real income Y (demand), respectively:

$$Y_{no} \equiv Ge + Pex + (X_{no} - IM)$$

and

$$Y \equiv Y_{no} + Y_o$$

where Ge denotes real government expenditure, Pex denotes real private expenditure, X is real non-oil exports, IM denotes real imports, and Y_o is real oil-income. $(X_{no} - IM)$ stands for net exports.

⁹⁵ See Table 5.3 in Chapter Five.

affects government non-oil revenues which falls slightly by an annual average rate of 1.9%. As a consequence, this reflects a decreased effect on government expenditure, only with a small annual average rate of 0.8%.⁹⁶

Next the impact of the unification policy (i.e. eliminating the black market premium) on real private expenditure is considered. The elimination of the black market exchange rate premium would reduce real private expenditure by an annual average rate of 3.5% (Table 7.3). The annual average decrease of about 4.2% per annum in real non-oil income contributes to the decrease in real private expenditure. This change is particularly high from the period 1983 onwards following the shock. Overall, private expenditure remains below the control level for the whole period (Figure 7.5). Briefly, a comparison of the government expenditure effect and the private expenditure effect reveals the fact that any change of the black market exchange rate premium influences primarily the behaviour of the private sector. This implies that, under the price effect of Scenario One, consumers would spend a lower share of their budget on necessities because inflation is reduced by a decrease in the premium.

There are two different effects of Scenario One on real money balances. First, the impact of this policy is disinflationary, as both domestic and import prices decrease, the real money supply (M / P) rises. Second, on the contrary, since real non-oil income decreases as a result of this policy, the income effect results in a decrease in real money demand. This offsets the price effect and leads overall to a decline in demand for real money balances by a low average rate of 1.4% per annum (Table 7.3). As Figure 7.10 depicts, the time path of the shocked values of real money balances is very close to the historical simulation (baseline).

⁹⁶ There is a similar case for total government revenues (Y_g) which is the sum of government non-oil income (Y_{gno}) and government oil income (Y_{go}); $Y_g = Y_{gno} + Y_{go}$. Y_g is also lowered annually by a rate of about 1.1%, as a result of the first experiment (Figure 7.7).

7.4.2 Alternative Policy Shocks Relating to the Black Market Exchange Rate

Premium

In the second experiment (Scenario Two) the black market exchange rate premium assumes its historical value until 1979, but then a 50% decrease in the premium is conducted from 1980 and continues until the end of the simulation.⁹⁷ On the contrary, the third experiment (Scenario Three) assumes a 50% increase in this variable over the same period. The objective here is to compare the different responses of the model to disturbances arising from these two policies. What is important to explain here is that these scenarios are selected, as discussed earlier, not only because the unification of the exchange rates in 1993 was not particularly successful but also because the gap between the official exchange rate and the black market rate has been widened. The results of these experiments are reported in Figures 7.11-7.20, which record the difference between the values of the endogenous variables after the shock and those before the shock (historical simulation values).

In the second scenario decreasing the black market exchange rate premium has the effect of increasing imports by a value of about 31% on average per annum (Figure 7.11 and Table 7.3). This is of course followed by a deterioration in the balance of trade, reflecting the effect of import growth.⁹⁸ But the decrease in the premium makes imports cheaper, causing the importation of intermediate and capital goods to increase. In the third experiment since the real black market exchange rate premium increases by 50%, imports fall by an average annual rate of about 18%, improving immediately the trade balance (Figure 7.11 and Table 7.3). But this may lead to a deterioration in the trade balance in the long-run because a fall in imports would avoid expanding the limited capacity of non-oil exports through importing essential goods. The effect of both

⁹⁷ The revolution occurred in 1979, while 1980 is the first year of the eight-year Iran-Iraq war. The black market exchange rate has drastically increased since 1980.

⁹⁸ Note that in Scenario One the premium is excluded from the model, while it declined by 50% under Scenario Two. This implies that import growth obtained by Scenario One should be higher than that obtained from the second scenario.

Figure 7.11: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on imports.

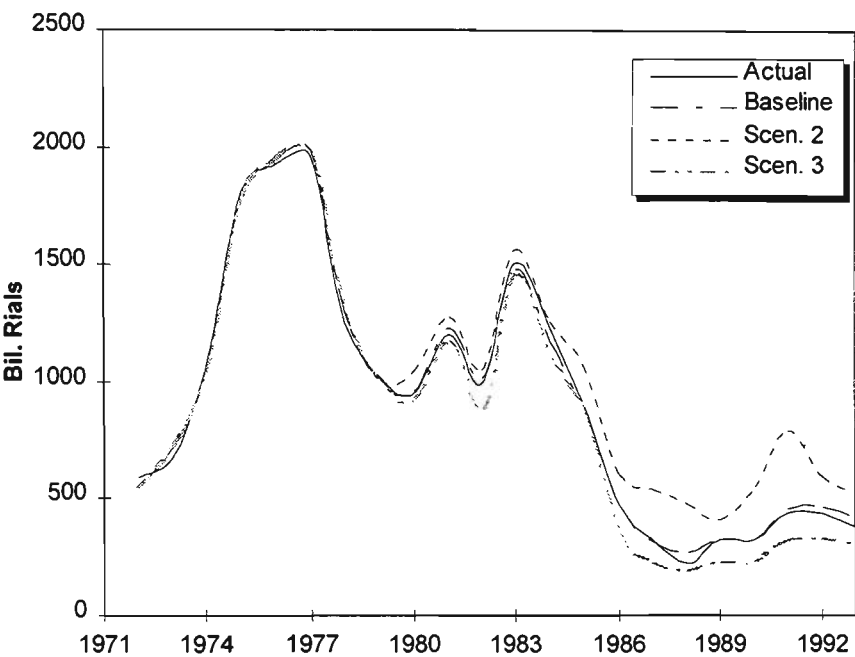


Figure 7.12: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on the import price.

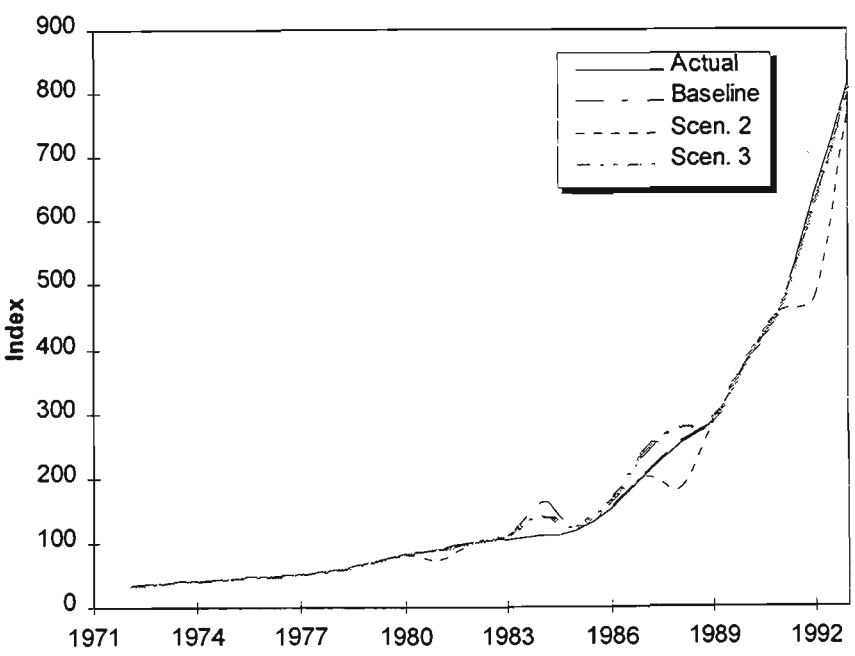


Figure 7.13: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on the domestic price.

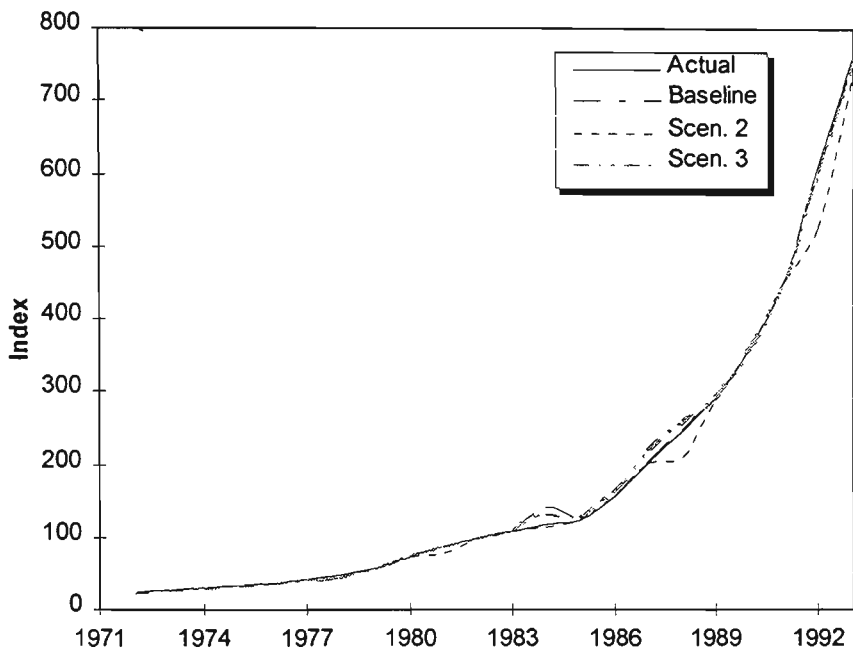


Figure 7.14: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on government expenditure.

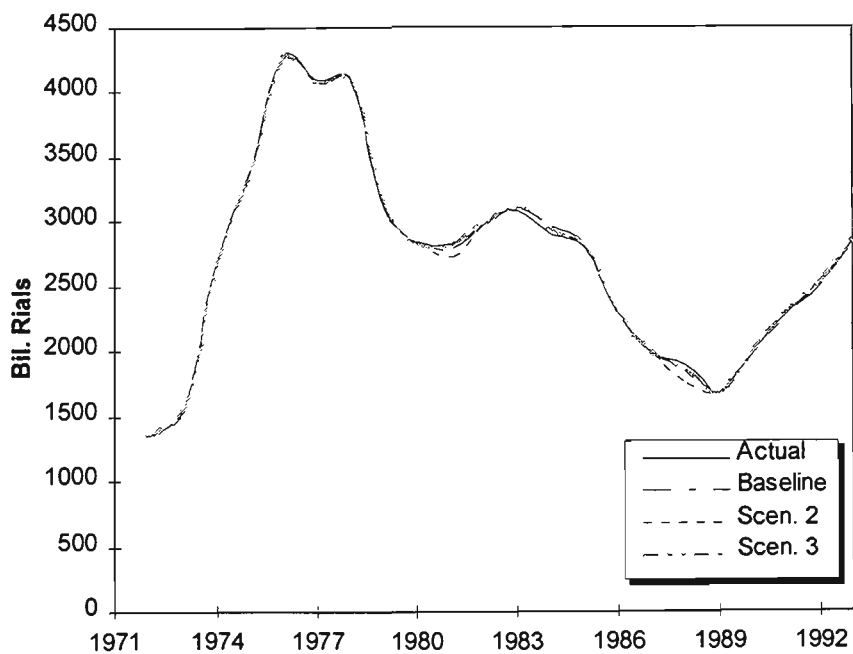


Figure 7.15: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on private expenditure.

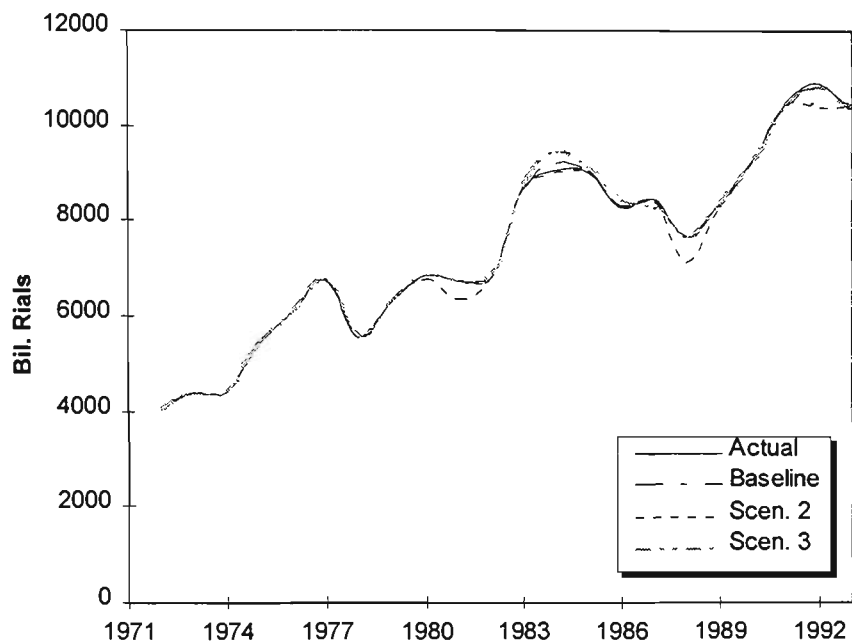


Figure 7.16: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on government non-oil revenues.

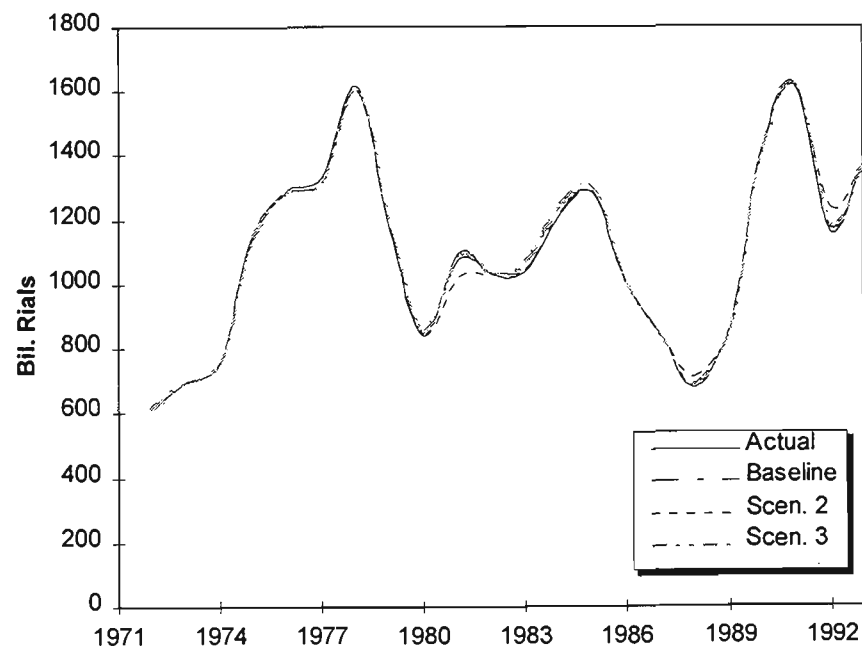


Figure 7.17: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on government (total) revenues.

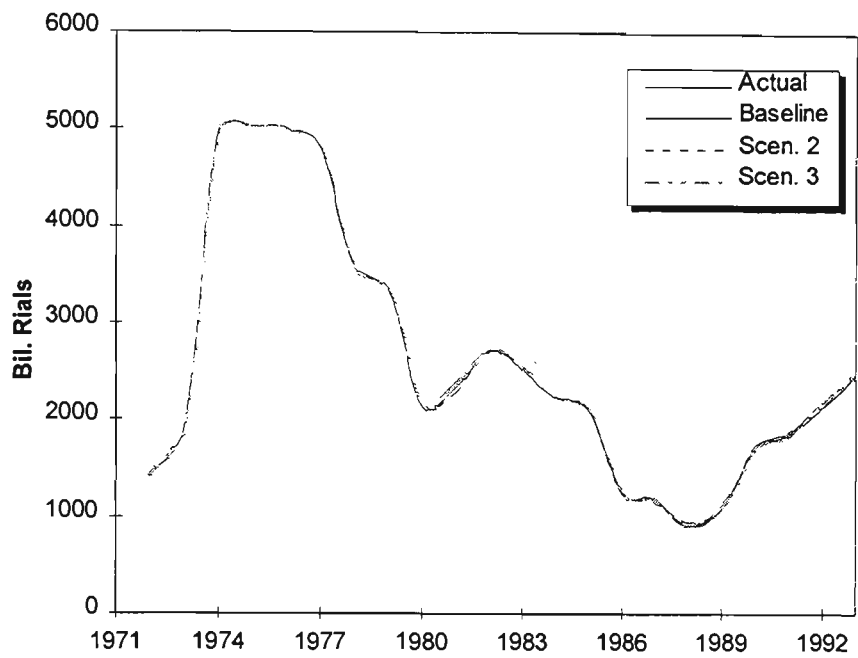


Figure 7.18: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on real non-oil income.

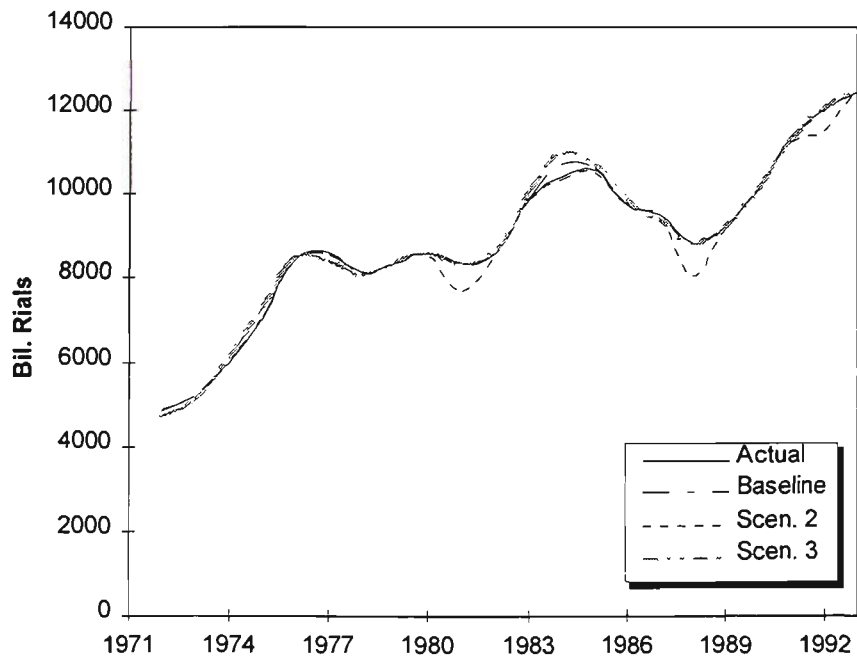


Figure 7.19: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on real income (GDP).

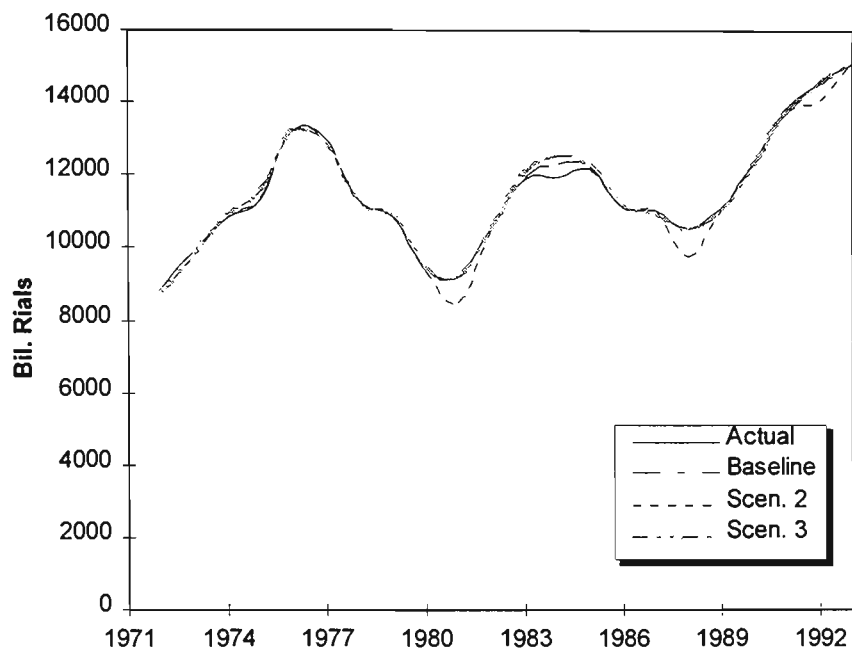
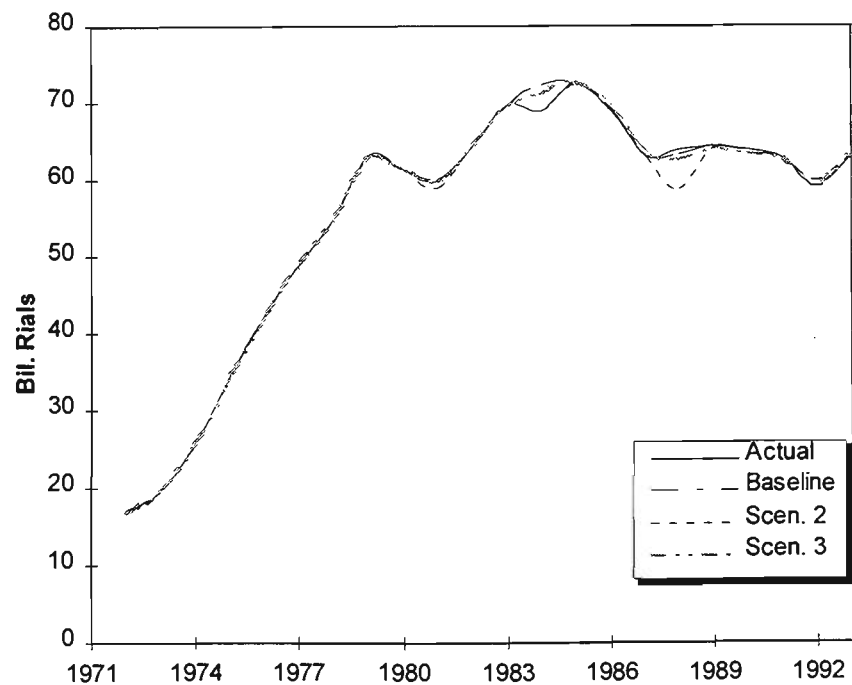


Figure 7.20: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on real money balances.



experiments on prices is interesting. The decrease of 50% in the black market exchange rate premium (Scenario Two) results in downward pressure on the import price level at a rate of about 9% a year on average (Figure 7.13). Because of the import price effect, the domestic price effect is also disinflationary at a rate of about 5% a year on average. Contrary to Scenario Two, the 50% rise in the black market exchange rate premium (Scenario Three) leads to an upward effect on the import price level at a rate of 2.2% a year, on average. Similarly, domestic inflation goes up at a rate of about 1.2% per annum on average.⁹⁹ But, the size of these simulation rates are much smaller than that obtained for Scenario Two. This suggests that the imposition of a 50% decrease in the premium has a more serious effect than that of an increase in the premium on these economic variables.

In general, according to Table 7.3 and Figures 7.14, 7.16, 7.17, and 7.20, in both Scenario Two and Scenario Three, differences in the simulation results for government expenditure, government revenue, and real money balances are not substantial. Changes in these variables are very small throughout the simulation, irrespective of the black market exchange rate shock. Corresponding figures show clearly that the shocked values for government expenditure, government revenue, and real money balances track closely the baseline solutions. Thus, the impact of these experiments on such variables appears to be negligible. One reason is that, according to the structure of the macro-model, the black market premium is not a key determinant of government expenditure, government revenue, and real money balances. These variables are slightly affected by changes in non-oil income and income which are responsive to changes in imports.

The second policy, a 50% decrease in the black market exchange rate premium, confirms those findings for real private expenditure obtained by Scenario One. The second experiment shows that the impact of a decrease in the black market exchange

⁹⁹ According to Table G. 1 (given in Appendix G), it should be noted that in 1984 the growth rate for the import price and the domestic price becomes negative. In a linear model this is allowable, but it points out the inadequacies of the linearity (Pindyck 1973).

rate premium produces an annual decrease of about 1.6% on real private expenditure. While the impact of the third experiment, in which the shock consists of a 50% increase in the premium, there is an increase in private expenditure which is quite small. Based on the latter experiment, real private expenditure rises by only 0.36% on average annually (Figure 7.15). This implies that the smaller increase in growth of income would also result in a lower increase in expenditure.

Overall, the simulation results obtained by the second experiment are qualitatively similar to those obtained in the case of the first experiment for an elimination of the black market premium. There are, however, differences in the size of change and in the time path of some endogenous variables (Table G.1, Appendix G). A comparison of Scenario One and Scenario Two reveals that under the first scenario changes in imports, prices, and income are much higher, while changes in real money and government revenues are almost the same, in both scenarios.

Since the black market exchange rate premium decreases on impact, the effect of the contraction in demand on domestic economic activity is offset to some extent by a decrease of the domestic price level. However, real non-oil income and GDP (demand) remain below the control solution by about 2% and 1.7% per annum, on average (Figures 7.18 and 6.19).

7.4.3 Dynamic Response to a Non-Oil Export Shock (Scenario Four)

As discussed in Section 5.2.4 of Chapter Five, the real non-oil export variable is assumed to remain exogenous. Thus, it may be useful, because of the significant role of non-oil exports in the development process and the need by Iran for the foreign exchange earned by such exports, to verify the reaction of the endogenous variables by examining the imposition of an increase in non-oil exports. Consider the impact of a 50% increase of real non-oil exports. Actually, this change covers the whole simulation period, 1970-1993. The results of Scenario Four are shown graphically in Figures 7.21-7.30. The simulation results indicate that the increase in non-oil exports has a

pronounced effect on the economy. The significance of this experiment is more pronounced in the case of its impact on government and private expenditures, real money balances and income than the effect of the free market exchange rate premium.

Overall, this policy will increase real non-oil income (Y_{no}) and real GDP (Y) considerably by a rate of about 8.5% and 6.6% a year on average, respectively. This also leads to a rise in private expenditure at an annual rate of about 10% a year. Since government non-oil revenue is affected by changes in real non-oil income, it increases at a rate of 6.5% a year with respect to its historical simulation. Furthermore, the increase in government revenues, based on the model, provides a change in government expenditure, by growing at a rate of 4.1% a year.

The rise in real non-oil exports provides a monetary stimulus and creates excess demand for real money balances through changes in income (demand) and prices. The impact of a permanent increase of 50% in non-oil exports on real money balances is much more substantial, with an annual average growth rate of about 15.4% (Table 7.3). As a result of this experiment, real GDP increases, followed by an increase in demand for imports by an average rate of about 10.3%. This causes the trade balance to worsen. In addition, the import price is affected by the increase in demand for traded goods and rises at a rate of 1.8% on average per annum. The domestic price is also influenced by the rise in demand for goods and monetary expansion, producing an annual average growth rate of about 2%. Hence, because of the rise in the import price and the dominant role of the oil price in affecting the export price, the growth rate of the import price is often higher than that of the export price. This can lead to a deterioration in the terms of trade in which again the trade balance deteriorates, implying the HLM effect (Harberger 1950, Laursen and Metzler 1950).¹⁰⁰

¹⁰⁰ The HLM effect implies that the current account will deteriorate (improve) in conjunction with the terms of trade deterioration (improvement).

Figure 7.21: Impact of a 50% increase in non-oil exports policy on imports.

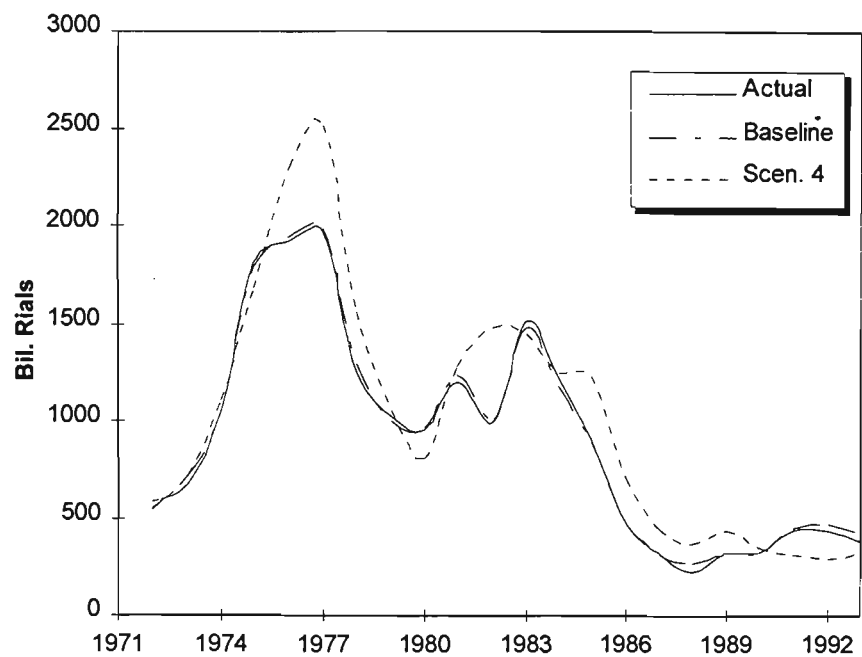


Figure 7.22: Impact of a 50% increase in non-oil exports policy on the import price.

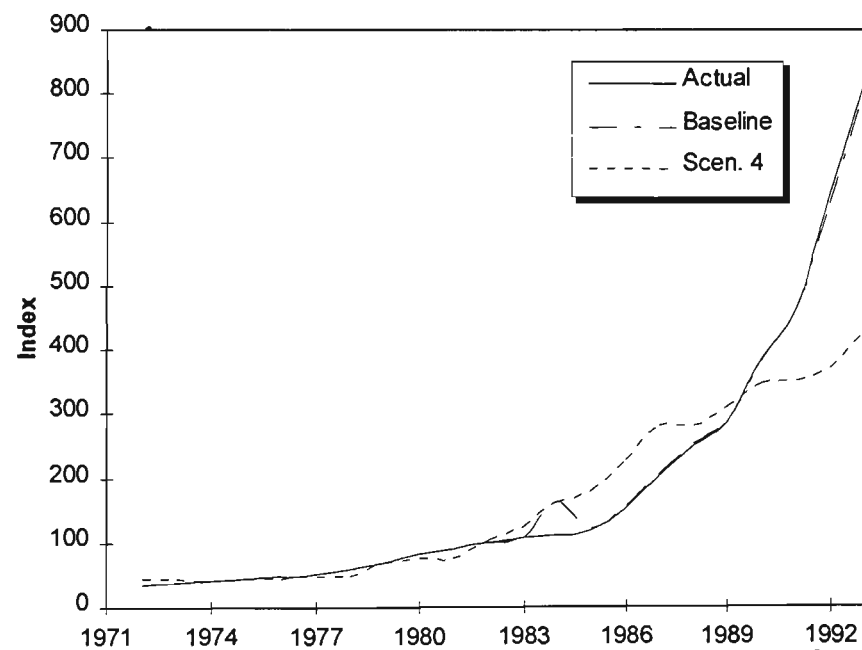


Figure 7.23: Impact of a 50% increase in non-oil exports policy on the domestic price.

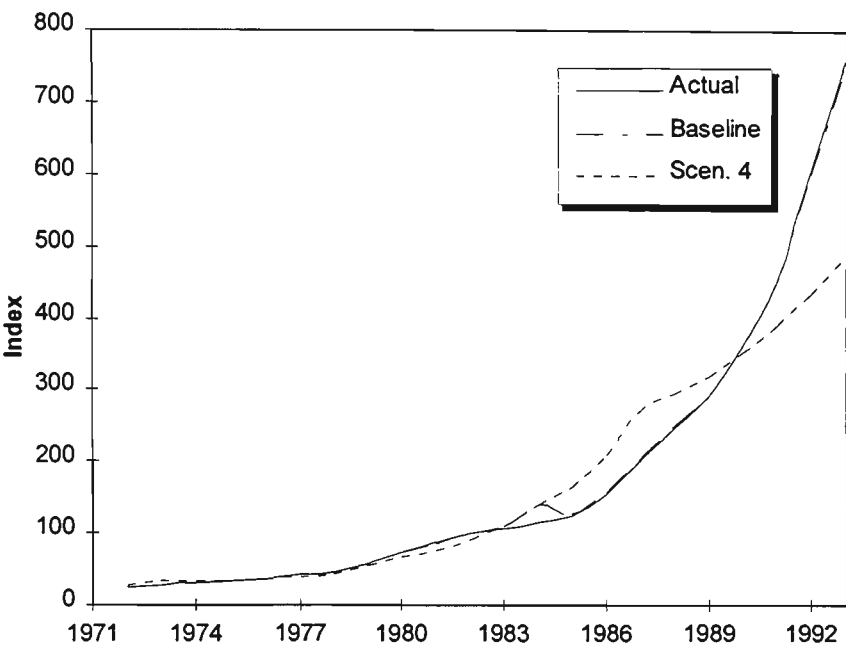


Figure 7.24: Impact of a 50% increase in non-oil exports policy on government expenditure.

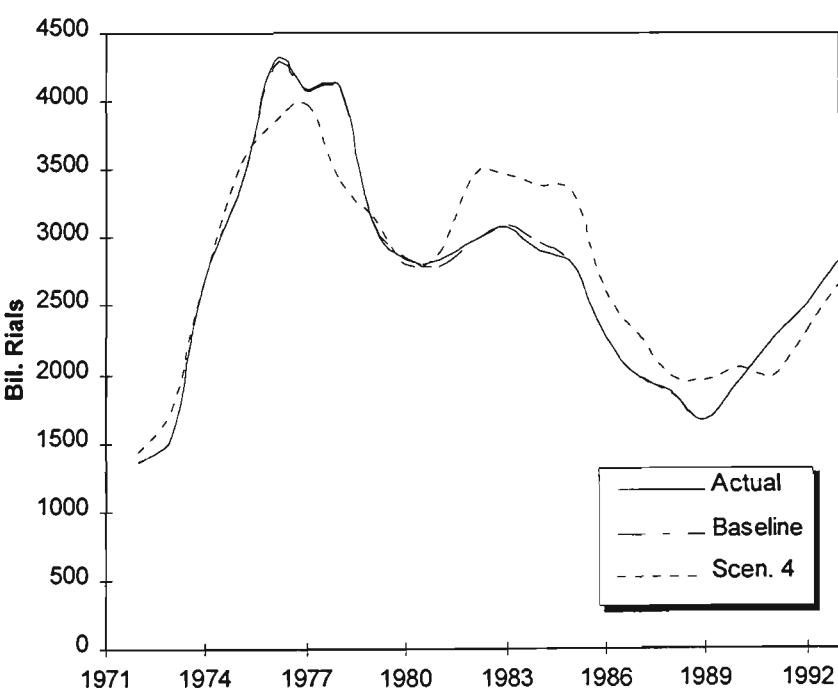


Figure 7.25: Impact of a 50% increase in non-oil exports policy on private expenditure.

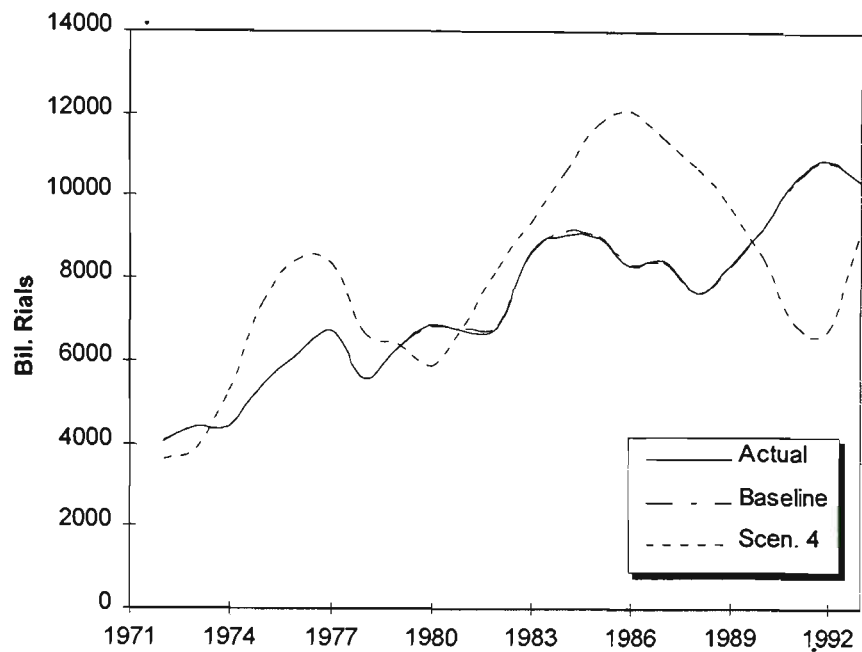


Figure 7.26: Impact of a 50% increase in non-oil exports policy on government non-oil revenues.

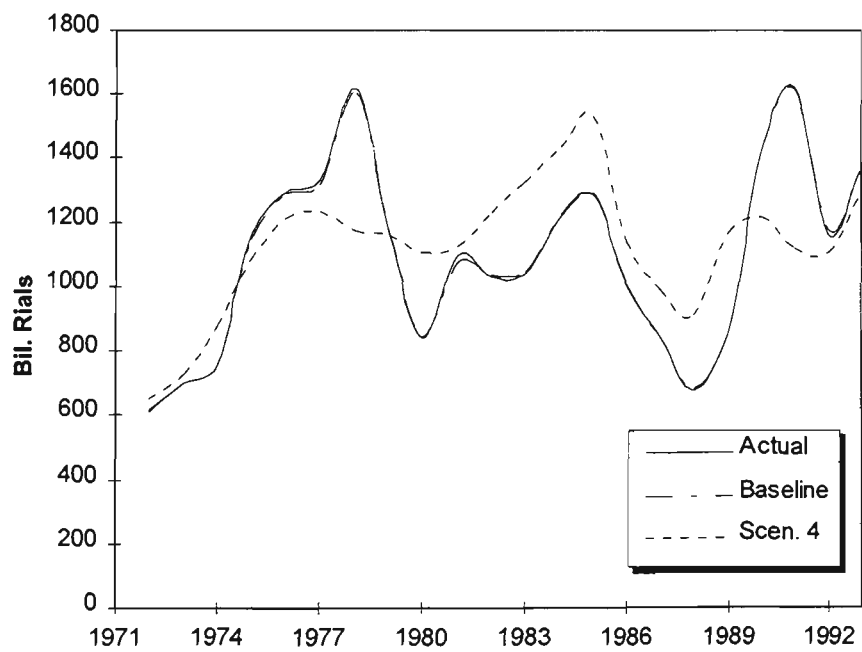


Figure 7.27: Impact of a 50% increase in non-oil exports policy on government (total) revenues.

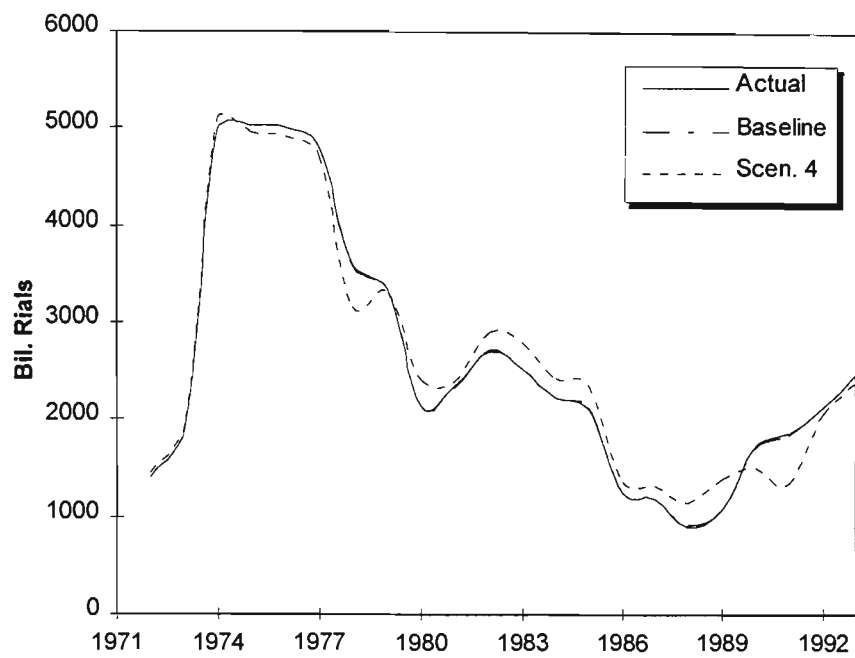


Figure 7.28: Impact of a 50% increase in non-oil exports policy on real non-oil income.

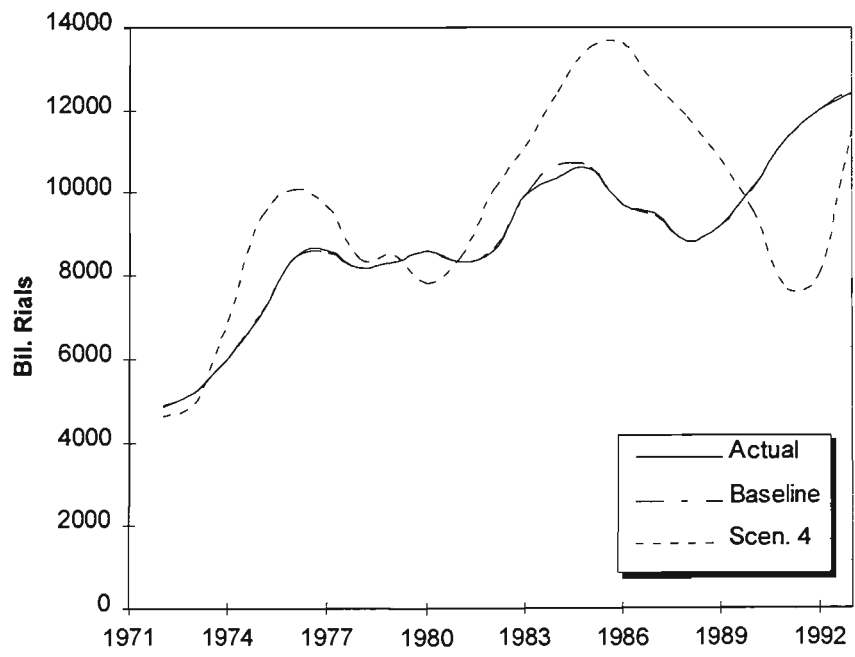


Figure 7.29: Impact of a 50% increase in non-oil exports policy on real income (GDP).

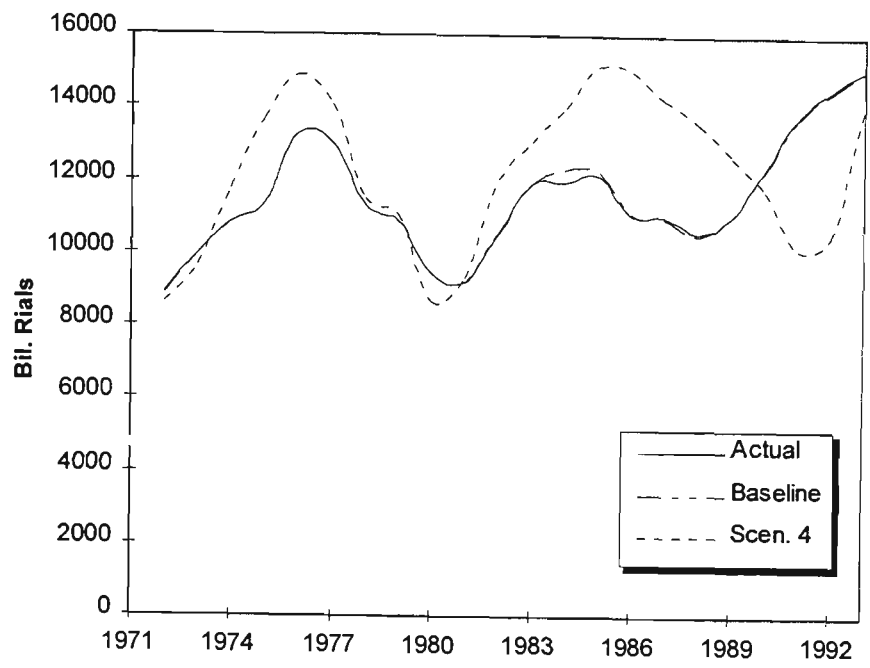
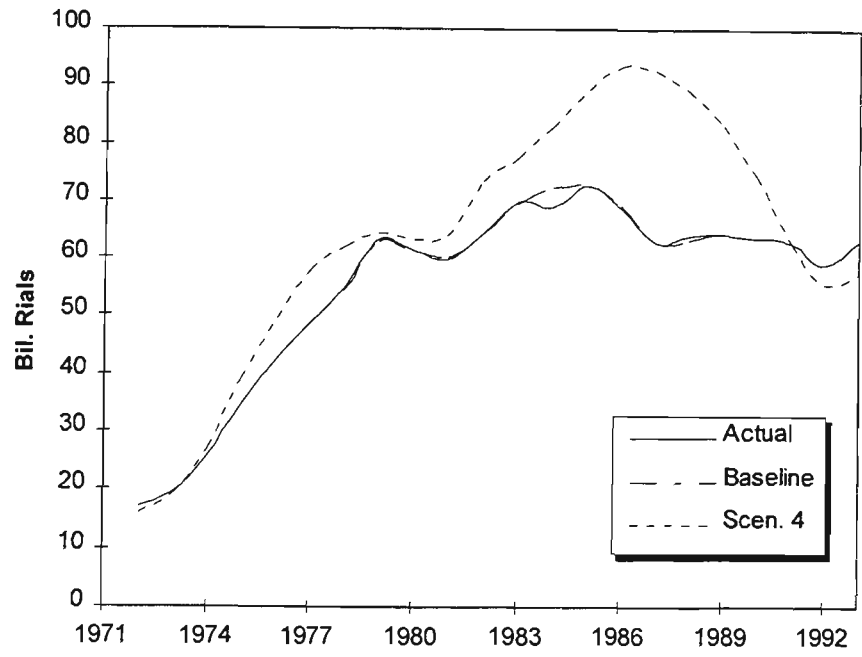


Figure 7.30: Impact of a 50% increase in non-oil exports policy on real money balances.



In brief, as indicated by the simulation results plotted in the above figures, after the shock the values for most endogenous variables of the model fluctuate over the period. For example, movements in real non-oil income increase during the periods 1974-79 and 1981-89, and decrease for other periods. The reason for this contradiction refers to the fact that following such a policy, the promotion of non-oil exports in practice has been very unstable over the period (1970-1993). According to Pesaran (1992), the overall picture of Iran's exports is one of continued dependence on oil export earnings even though important steps have been taken recently to encourage non-oil exports. The downward trend in the share of oil exports over the period 1986-88 led Iran to place more attention on non-oil exports.

7.5 Policy Simulation Experiments on the Composition of Imports

The estimated results for the import model including three equations for consumer imports, intermediate imports, and capital imports, were obtained by applying the OLS method as given in Chapter Six. We use here estimates of the model to carry out dynamic historical simulations and to perform some policy experiments. In order to test the reliability of the import model for predicting the movements of the endogenous variables, a dynamic simulation of the model is conducted over the period 1970-93 (Table 7.4). A comparison of the simulated values for the endogenous variables with their actual values provides a useful test of *Theil's inequality coefficient (TIC)* being close to zero. The values for U^M and U^S are quite small (less than 0.1) which shows that revision of the model is not necessary (Pindyck and Rubinfeld 1991). Hence, these statistical results reveal the fact that the import model is appropriate for simulating the aforementioned policy experiments.

Table 7.4: Results of the dynamic simulation for the composition of imports, 1970-1993.

Endogenous Variables	Statistics					
	Mean	Root Mean Squared Error (RMSE)	Mean Absolute Error (MAE)	Theil's inequality coefficient (TIC)	U^M	U^S
Consumer imports (IMC)	154.759 ^a	7.621	5.763	0.249	0.0130	0.0062
Intermediate imports (IMR)	514.048 ^a	15.756	14.054	0.113	0.0019	0.0271
Capital imports (IMK)	223.649 ^a	15.976	11.176	0.176	0.0012	0.0014

^a Billion Rials.

7.5.1 The Effect of Scenario One on the Composition of Imports

The effect of the elimination of the black market exchange rate premium (Scenario One) on imports of consumer, intermediate, and capital goods is examined here. According to Table 7.5, the simulation results clearly show that the performance of this policy has a serious effect on the composition of imports. As Figures 7.31-7.33 indicate all three import variables follow the same path tracking the control solutions, but there is a rise of about 75.8% in consumer imports, a rise of about 51.1% in intermediate imports, and an increase of 23.1 % in capital imports (Table 7.5).

More specifically, the growth rates for these imports are much higher from 1986 until the end of the period. The average rates of growth with respect to the baseline for consumer imports, intermediate imports, and capital imports are 164.4%, 108.4%, and 44.2%, respectively. It reveals the fact that the disaggregated composition of imports have been significantly affected by the widening gap between the exchange rates in the parallel market and the official market during this period. However, as shown in Table G.2 in Appendix G, there is a negative effect for capital imports in 1980 with a rate of about 5% relative to the control solution. This adverse development may refer to the beginning of the Iran-Iraq war in that year.

Table 7.5: Annual average percentage deviation from the control solution (PDCS) for the composition of imports (%).

Endogenous Variable	Scenario One	Scenario Two	Scenario Three
Consumer Imports (<i>IMC</i>)	75.844	46.104	-23.805
Intermediate Imports (<i>IMR</i>)	51.134	36.396	-19.418
Capital imports (<i>IMK</i>)	23.061	14.161	-11.244

Source: Table G.2.

7.5.2 Scenario Two versus Scenario Three

Figures 7.33-7.36 depict the substantial rise in imports in conjunction with the 50% fall in the black market exchange rate premium (Scenario Two), while imports will decrease on impact in relation to the 50% increase in the premium (Scenario Three). These changes are imposed during the period 1980-93. The simulation results provided in Table 7.5 indicate that changes in imports obtained by the second experiment are larger than those obtained by the performance of the third experiment, while the rate of change in the policy variable imposed by the two experiments is the same.

In the second experiment consumer imports increase by more, with an average rate of about 46.1% per annum. The average growth rate for imports of intermediate goods and raw materials is about 36.4%, and for capital imports is about 14.2%, less than the former rates. On the contrary, in the third experiment the decrease in the rate of consumer imports is about -23.8% a year, on average. Moreover intermediate imports and capital imports decrease by a rate of about -19.4% and -11.2% a year, respectively. Hence, the results suggest that any shock which decreases the black market exchange rate premium is more effective than a shock which will increase the premium. This is because the rate of change of such imports as a result of decreasing the premium (Scenario Two) is higher than that with respect to Scenario Three in which the black market premium is assumed to increase.

Therefore, a comparison of both experiments intimates the fact that in the second experiment, with lower real costs of imported capital and intermediate goods, investment increases, causing the capital stock to rise. Whereas the third experiment provides higher costs of imported capital and intermediate goods and in which investment falls, leading to a decrease in the capital stock. This implies that attempts towards reducing, or eliminating, the black market premium and unifying the exchange rates are required, assisting the country in achieving its economic development objectives.

Figure 7.31: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on consumer imports.

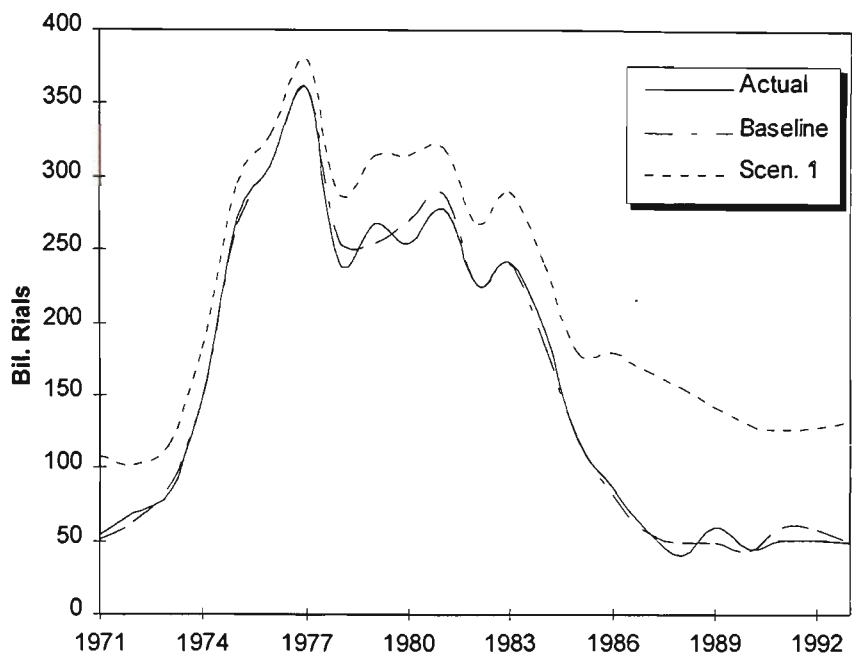


Figure 7.32: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on consumer imports.

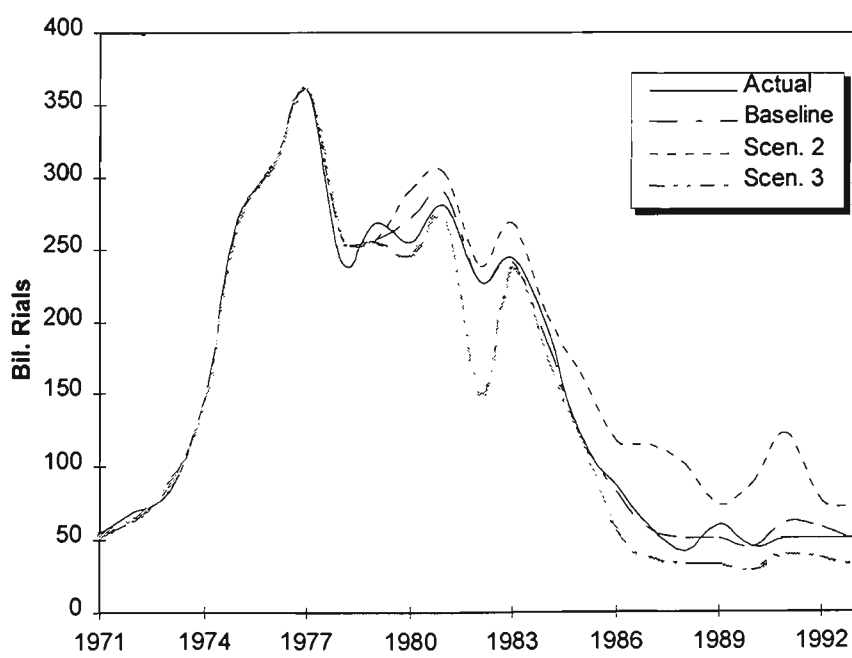


Figure 7.33: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on intermediate imports.

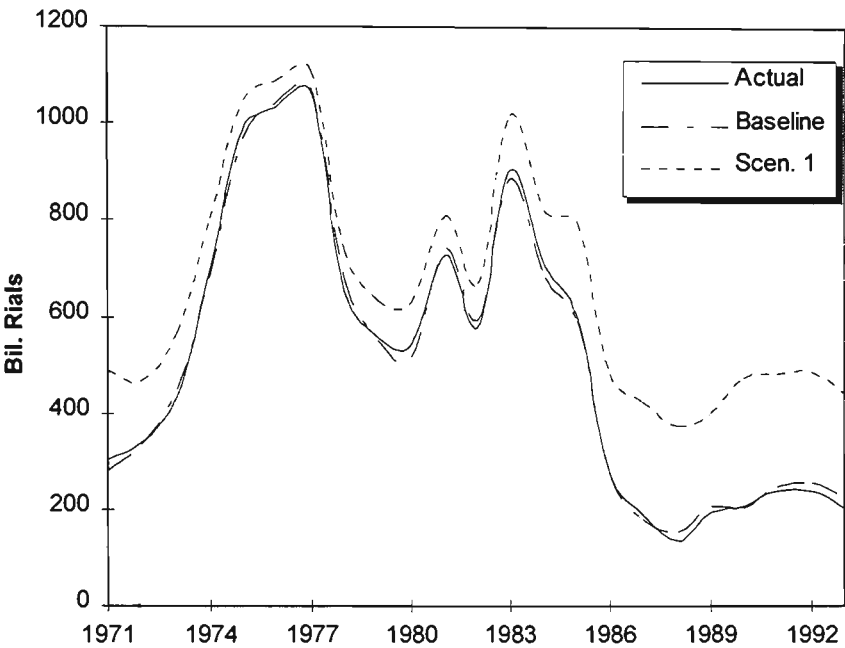


Figure 7.34: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on intermediate imports.

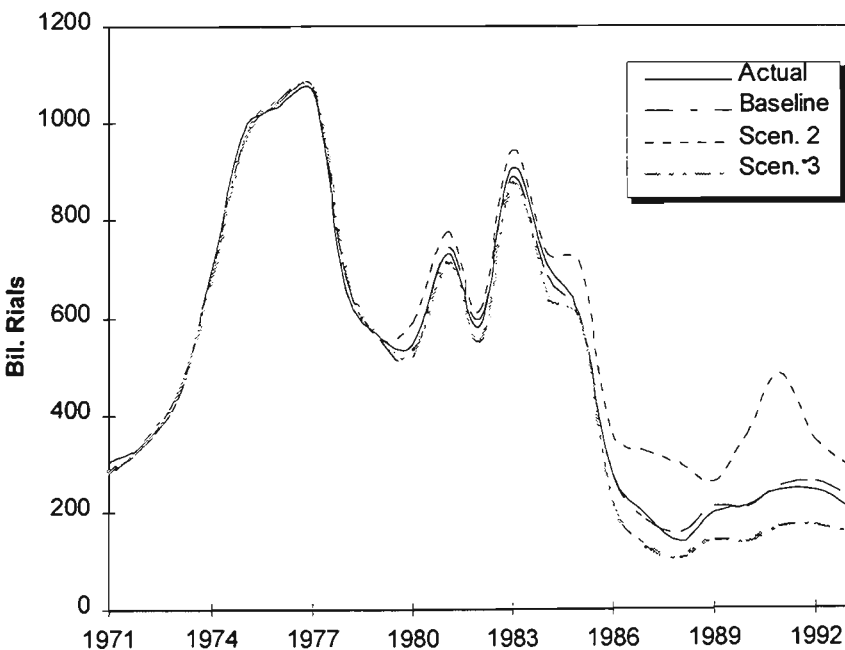


Figure 7.35: Impact of the elimination of the black market exchange rate premium policy (Scenario One) on capital imports.

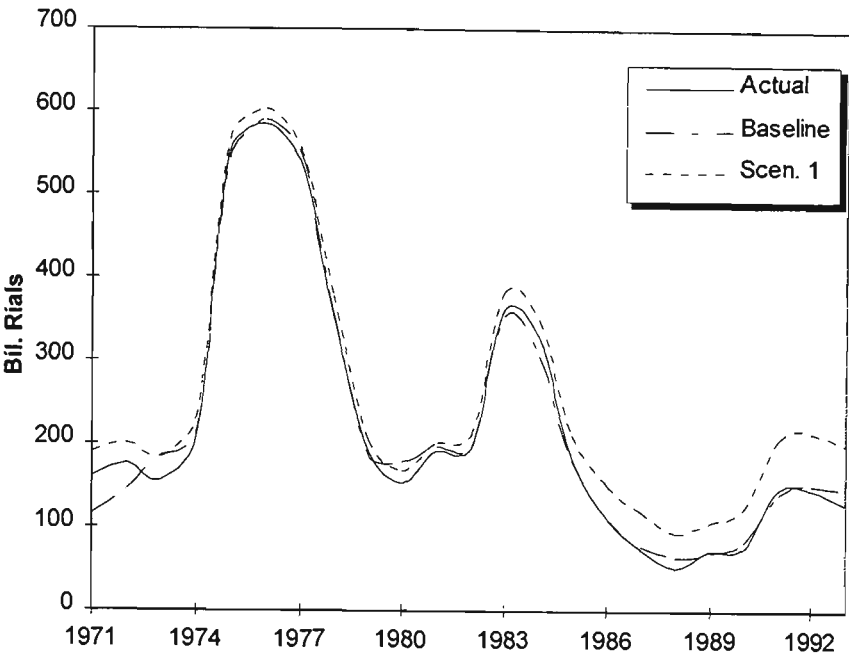
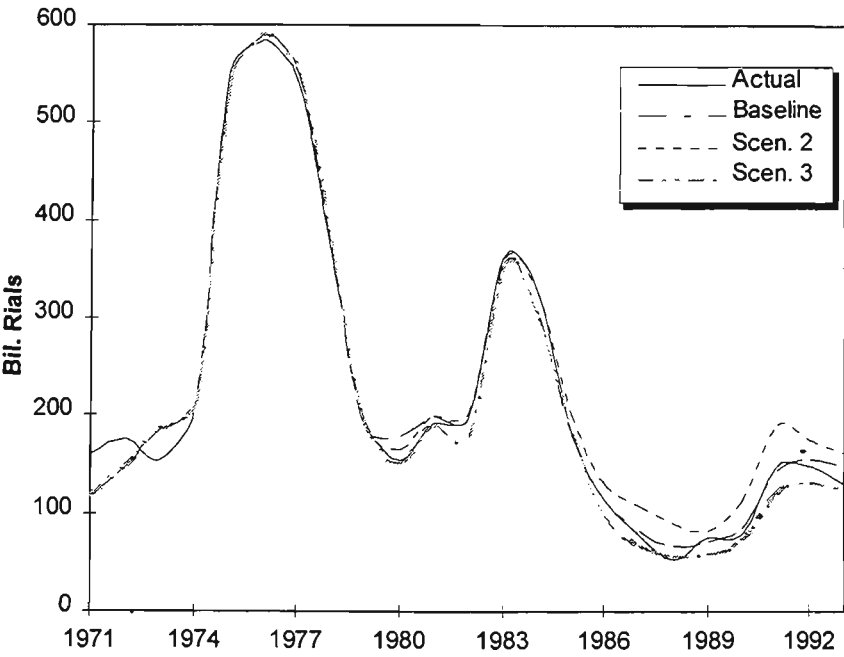


Figure 7.36: Impact of a 50% decrease/increase in the black market exchange rate premium policy (Scenario Two/Scenario Three) on capital imports.



Overall, to compare the effectiveness of each policy experiment, as conducted in this chapter, in favour of fighting inflation or achieving economic growth, Table 7.6 summarises the annual average values for PDCS (the Percentage Deviation from the Control Solution) for two major endogenous variables including real income (Y), and the domestic price (P_d). If the economy's major objective is a reduction in inflation and changes in prices are a serious problem, Scenario One is the best because the domestic price falls at a rate of -8.24 percent per annum on average. But the economy has to accept a decrease in its economic growth with an annual average rate of -3.34%. On the contrary, according to Table 7.6, if economic growth is the most important goal in the economy, Scenario Four should be preferred, while the country will face an increase in the domestic price at an annual average of 2.13%. To achieve both important objectives, the optimal solution, of course, relies on the combination of Scenario One and Scenario Four.

Table 7.6: The effectiveness of the policy experiments.

Variable	Scenario One: Elimination of BM / ER^*	Scenario Two: 50% Decrease in BM / ER^*	Scenario Three: 50% Increase in BM / ER^*	Scenario Four: 50% Increase in Xno^{**}
Y	-3.34	-1.78	0.42	6.59
P_d	-8.24	-4.71	1.19	2.13

Source: Table 7.3.

* The black market exchange rate premium

** Non-oil exports

7.6 Summary and Conclusions

The purpose of this chapter has been to simulate outcomes from a macro-model and then from an import model for the case of Iran. The parameter estimates identified in earlier chapters were used in this process. A dynamic simulation test within the estimation period, indicated that these models have a good tracking ability. The models seem to be useful for studying some policy issues. Therefore, the purpose of the experiments used here has been to show the dynamic response of each model to changes

in policy variables, arising from alternative developments in the black market premium as well as a shock to non-oil exports, and hence to enable the evaluation of these alternative policies. The simulation results have highlighted the important role played by the black market exchange rate premium. Accordingly, this chapter has realised the scope and nature of the parallel (black) currency markets, and briefly discussed the reasons as to why such markets exist. Agenor (1992) concludes that black markets in developing countries typically emerge out of restrictions on foreign trade and capital flows.

The black market exchange rate premium can be eliminated, or reduced, by three available options: a once-and-for-all devaluation of the official exchange rate, an appreciation of the black market rate while the official rate remains unchanged, or a combination of these options. Of these options to unify exchange rates, the third one, as discussed in this chapter, seems to be more appropriate than others. Hence the exchange rate policy has been conducted as a result of this option which depends on the public credibility of the Central Bank, active macroeconomic stabilising policies, correct expectations of development projections, etc.

In terms of the exchange rate and export policy effects, the key implications can be summarised as follows. First, the elimination, or reduction, of the black market exchange rate premium increases imports substantially. Although the import effect leads to a deterioration in the trade balance, it would remove many obstacles in the import sector for the importation of a large number of required inputs essential for the expansion of capacity in production of traded and non-traded goods and improving the trade balance in the long-run. The policy reduces the domestic price due to a decrease in the import price, which is significantly affected by the parallel market exchange rate. The demand effect produces a decrease in real GDP and real non-oil income which helps reduce excess real money balances through a decrease in the transactions demand

for money.¹⁰¹ The private sector is also influenced by the performance of the policies arising from alternative developments in the black market premium. Private expenditure is affected by a shock to the premium. However the effect of the black market exchange rate on the public sector is rather small, because government expenditure and government revenues decrease slightly at a low rate. As a consequence, this conclusion may have implications for the design of stabilisation policy in the country.

The second major implication from both the macro-model and the import model relates to a rise in the black market exchange rate premium (the third experiment). Contrary to the second experiment (a decrease in the premium), there are reverse effects on economic targets. The important result is that the size of changes in the endogenous variables is relatively smaller than that obtained by the second policy, even though the shock measure imposed in the two policies is the same but in the opposite direction (a 50% decrease in the premium under Scenario Two, and a 50% increase in the premium under Scenario Three). The third policy causes imports to decrease, with a rise in import and domestic prices. Although there is an improvement in the trade balance, the increased costs of intermediate and capital imports reduces investment and decreases the capital stock.

Third, the policy experiment of a rise in non-oil exports demonstrates that in general its impact on government and private expenditures, government revenues, and real money is more pronounced than the effect of the exchange rate policy. The demand side of the economy as well as real money balances are shown to be expansionary. The price effect is generally inflationary in response to the shock in non-oil exports.

In conclusion, as indicated in Table 7.6, of the four policies discussed in this chapter, the policy of eliminating the black market exchange rate premium (Scenario One) seems to be more effective than the others if the country's major objective is a reduction in prices. On the contrary, if the country emphasises economic growth, the promotion of

¹⁰¹ Theoretically, the transactions motive lies behind the transactions demand for money which is related to the level of income (Branson 1989 p. 335).

non-oil export policy is more effective. An optimal solution would arise from a combination of both policies.

CHAPTER EIGHT

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

The primary objective of the thesis has been to develop and estimate an econometric model explaining the determinants of import demand for a developing country. The country chosen as a case study is that of Iran. The study has examined the relationship between diverse variables and the demand for imports at both the aggregate and disaggregate levels. Three hypotheses have been tested in this study: (1) that there is a strong negative relationship between import demand and the relative price of imports to domestically produced goods, (2) that unlike the official exchange rate, the black market exchange rate premium has a significantly negative effect on Iranian import demand. The inclusion of this latter variable in the structural form of the import function is a major innovation of the study, and (3) that there is a positive relationship between imports and an activity variable such as income, expenditure, or investment.

In Section 8.2 a summary of the previous chapters and major conclusions derivable from each of them is presented. The major policy implications arising from this study are presented in Section 8.3. Finally, suggestions for future work are given in Section 8.4.

8.2 Summary and Conclusions of the Study

An overview of the Iranian economy was conducted in Chapter Two, investigating developments in this economy over the period 1970-1993. Actually this period was broken down into two distinct phases: pre-revolutionary and post-revolutionary periods. This chapter indicated that as a result of rapid growth in oil exports, the economy grew at an average annual rate of about 8.2 percent during the pre-revolutionary period. Over the post-revolutionary period, the pace of economic growth slowed down considerably, so that the annual average growth rate of GDP was reported at about 1.8 percent (BPOI 1994). However, higher growth achieved in recent years (since 1990) reflected the initial effects of trade and foreign exchange liberalisations and the utilisation of unused capacities in the economy. Chapter Two also showed that the share of the agricultural sector to GDP fell during the pre-revolutionary period, while this share increased substantially during the post-revolutionary period.

As a result of the most striking episodes such as the revolution of 1979, the eight-year war with Iraq and the oil crisis in 1986, the economy experienced higher rates of inflation, and increased budget and trade deficits and foreign debt. The fluctuations in the level of foreign exchange receipts was a major factor for the sharp fall in capacity utilisation in the industrial sector, particularly during the 1980s. Although non-oil exports increased substantially during the 1980s, the most significant development arising from these exports was the emergence of the need for foreign exchange receipts, as the value of oil exports declined. The extreme collapse of the oil price and then exchange earnings after 1984 especially, led to sharp falls in imports and total expenditure. The black market exchange rate premium rose dramatically from the early 1980s and then reached phenomenal rates of over 2000 percent by the end of the 1980s. The sharp fall in foreign exchange receipts was again the major factor behind the widening gap between the official and black market exchange rates after the oil crisis in 1986. In recent years the government has made attempts to reduce this gap and to

stabilise the economy by decreasing foreign exchange expenditure, increasing foreign exchange receipts by increasing non-oil exports and moderating public expenditures.

In general, the main features of the Iranian economy was explained in Chapter Two, highlighting the underlying economic reasons behind the structural characteristics to be modelled (particularly for the foreign sector) in the other chapters.

To survey the relevant literature on the topic, we firstly reviewed the theoretical literature relating to open economy macroeconomic modelling (Mundell-Fleming type) in Chapter Three. We then analysed the structural form of the external sector within the framework of such macroeconomic models. We then examined the importance of the external sector, with particular emphasis on its effects in a developing economy. If the behaviour of the sector in terms of importing intermediate and capital goods is managed well by developing countries, for instance, the requirements for the growth process will be provided through imports of such goods (Fishlow 1994). In addition, imports are capable of contributing to productivity and competitiveness improvements in domestic economic activities, as well as in increasing exportable goods. A knowledge of import elasticities is significant for the enactment of changes in tariffs and currency depreciation. Hence, imports have been of paramount importance for developing economies in the process of attaining economic development and thus were given emphasis in the second part of Chapter Three.

Chapter Three is also concerned with the structure of an import demand model and focusing upon the key determinants to be included in import functions. In addition, the chapter also focused upon the literature relating to alternative theoretical ways of deriving import demand functions. Basically, the aggregate demand function for imports can be derived from the assumption of profit maximisation, cost minimisation, and/or utility maximisation (Kohli 1991). In this regard, an example of deriving an import function from a C.E.S. (Constant Elasticity of Substitution) type of function was obtained by maximising society's preferences.

Finally, the findings of previous studies are highlighted to compare the results of significant explanatory variables from estimated import functions, in the context of both developed and developing countries. Many studies, such as Bahmani-Oskooee (1986) and Sarmad and Mahmood (1987), show that the estimated price and exchange rate elasticities are generally low, indicating that relative prices and the exchange rate do not have a significant effect on the imports of developing countries. There is a limited literature, concerned with the study of imports for Iran. In recent years, a few import demand models have been determined through macro-models, such as that developed by Heiat (1987), Johary (1993), and Noferesti and Arabmazar (1994), for the Iranian economy. Hence to recognise the structure and determination of Iranian import demand, Chapter Four formulated and classified Iranian demand for imports at both the aggregate and disaggregate levels.

Constructing the import model framework, and specifying its functional form, allows us to evaluate empirically the effects of changes in explanatory variables and some economic policies, on the import sector and the trade balance. The formulation of import demand in Chapter Four is associated with assumptions in which the import models are supposed to be data admissible and include parameter constancy. The specification of equations is based on the logarithmic form. The log-linear form of the import demand equations is preferable to the linear one because of the assumption of constant elasticity. According to Goldstein and Khan (1976), the logarithmic form avoids changes in the elasticities as import quantity changes.

The responsiveness of imports to changes in the import price and the domestic price is discussed in Chapter Four. Theoretically, the effect of changes in the ratio of the import price to the domestic price is negative, whereas an activity variable such as income or expenditure affects imports directly. This chapter is also concerned with the effect of changes in the exchange rate on import demand. To avoid any correlation of the exchange rate and the import price in the import function, changes in the exchange rate are assumed not to be fully passed on to the import price.

The major objective of Chapter Four was to model Iranian import demand at both the aggregate and disaggregate levels. The key determinants of the aggregate import demand function are relative prices, real income (GDP), and the exchange rate (the black market rate). Imports are disaggregated in the form of import composition, imported commodity groups, and imports by country of origin. The composition of imports includes consumer goods, raw materials and intermediate goods, and capital goods. The relative price and the exchange rate explain demand for these imports, while government and private expenditures, income, and investment are considered respectively as activity variables for imports of consumer goods, intermediate goods, and capital goods. Since all imported commodity groups are not necessarily restrained by government, they are classified into free imports and restricted imports. Of twenty commodity groups thirteen groups are devoted to restricted imports, and the rest are included in the category of freely imported goods. Each imported commodity group comprising these two categories is explained by relative prices, activity variables (income for free imports and expenditure on each commodity group for restricted imports), and the exchange rate. Fifteen of Iran's major partners are considered, to construct the structure of the Iranian demand for imports.

To identify applicable relationships between demand for aggregate imports, formulated in Chapter Four, and some important economic variables, Chapter Five incorporated the aggregate import function within the framework of a macro-model developed for the Iranian economy. The macro-model formulated in Chapter Five consists of equations for aggregate demand (including government and private expenditures, government non-oil revenues, and non-oil income), the external sector, the monetary sector, and prices. The model incorporates a number of considerations such as the import sector, the role of the exchange rates (in the official and black markets), and the assumption of partial adjustment. In principle, the endogenous determinants of the import function, such as prices (the import price and the domestic price), and real income are explained

by the variables included in the macro-model. The model consists of seven behavioural equations and three identities.¹⁰²

The estimation results for the behavioural equations were obtained by applying OLS and AR1 (first order regressive technique), using annual data over the period 1970-1993. The presence of three dummy variables in the model explained the effects of different events on the Iranian economy over this period. Dummy variables were used for the sharp increase in the oil price in 1974 and 1979-1981, for the revolution in 1979 and the commencement of the eight-year Iran-Iraq war in 1980, as well as for the oil crisis in 1986. These dummy variables were conducted only for changes in the intercepts of equations in this study.

The most important conclusions obtained from the estimation results relied on the re-specification of the aggregate import demand and import price equations. This was done by the inclusion of the parallel (black) market exchange rate premium, which substituted for the official real exchange rate on the right hand side of both equations. Aggregate import demand and the import price were found to be significantly affected by changes in the black market premium, while their responsiveness with respect to changes in the official rate was statistically insignificant. The estimation results indicated that a 1 percent increase in the premium leads to a 1 percent decrease in Iranian import demand in the long-run. As a result, one of the major objectives of Chapter Five was to estimate the macro-model for Iran, incorporating a sizeable parallel market for foreign exchange.

Another important conclusion referred to the impact of relative prices and income changes on aggregate import demand. Based upon the estimation results, aggregate imports have been inelastic with respect to income, but quite elastic with respect to prices. However, as mentioned earlier, the price effect identified is not similar to that

¹⁰² As specified in Chapter Five, the behavioural equations belong to government expenditure, private expenditure, government non-oil revenues, aggregate import demand, the import price, the domestic price, and real money demand. The identities belong to government total revenue, real non-oil income, and real income.

found in the literature for other non-oil developing countries. The value of the price elasticity in the estimated aggregate import equation was found to be higher than unity, about -2.4 in the long-run. As found in the literature, the price elasticity of imports is less than unity for many developing countries. In addition the significant coefficient of the black market exchange rate premium in the import price equation, has also contradicted findings of Pesaran (1992) in which the equivalent coefficient was found to be not significant.

Apart from aggregate imports and the import price, the estimates for the other endogenous variables of the macro-model presented in Chapter Five have generally conformed to those from other economic studies in the literature. The results, for example, have confirmed the findings of Khan and Knight (1991) that the money demand function in the context of developing countries is income inelastic. Moreover, the significant lagged dependent variable in the estimated private expenditure equation has revealed the fact of 'habit persistence', in which the private sector continues its prior expenditure pattern due to habits obtained from past consumption expenditure.

The results obtained for aggregate imports in Chapter Five allow us to examine the variation of elasticities across import categories, through estimating disaggregated import equations. The significance of the black market exchange rate in the aggregate import function provides a useful starting point for the determination of disaggregated import functions derived in Chapter Six. Iranian demand for various imports disaggregated into three categories (including the composition of imports, imports of commodity groups, and imports by country of origin) are assumed to respond with respect to changes in prices, activity variables (income, expenditure, investment), and exchange rates. Equations for all the categories presented in Chapter Six have almost the equivalent structure, in which imports have a decreasing relationship with prices, an

increasing relationship with an activity variable, and a decreasing relationship with exchange rates, with a few exceptions.¹⁰³

Various econometric import models designed and appraised in Chapter Six (involved in the above mentioned categories) were in log-log form. Conventionally, import elasticities are estimated by the multivariate OLS method, concerned with the choice of variables, specification, and the handling of lags. Because of evidence of first-order autocorrelation in the residuals for a few of the equations, the elasticities have been re-estimated by the maximum likelihood or Cochrane-Orcutt iterative technique.

In the case of the composition of imports, imports of consumer goods and intermediate goods have been price elastic, while the price elasticity of capital imports was not statistically significant. Accordingly, Chapter Six has concluded that non-price effects have a significant impact on capital import demand. Demand for consumer imports was explained by government and private sector expenditures, to show the proportion of government and the private sector in the importation of consumer goods. Real GDP, as an activity variable, affected the demand for raw materials and intermediate goods, while the relevant activity variable contained in the capital import equation was investment reflecting the needs of imports for industrialisation and diversification in Iran. Unlike the non-significance of the official exchange rate, the black market exchange rate premium influenced significantly the demand for the composition of imports. Imports of consumer goods, however, are more sensitive to changes in the premium than imports of raw materials and intermediate goods and imports of capital goods.

The disaggregated import equations have also been estimated with imports classified as either restricted or free, consisting of twenty commodity groups.¹⁰⁴ Major conclusions

¹⁰³ For instance, as obtained in Chapter Six, the official exchange rate has only been significant in the equation for imported sugar, while the black market exchange rate has had a significantly negative effect on a large number of disaggregated imports.

¹⁰⁴ Remember that thirteen imported commodity groups have been defined as restricted imports, and seven commodity groups as freely imported goods.

from the estimation results can be summarised here. First, restricted imports are more responsive to changes in relative prices than free imports during the period. But changes in both restricted and free imports displayed almost similar responses to changes in activity variables. Second, the results for the price elasticities contradict some previous studies for developing countries. A number of the estimated price elasticities for restricted imports in this study have captured a value of more than unity. However imports of chemical and pharmaceutical products, fertilisers, rubber, iron and steel were not significantly affected by the price effect, indicating such essential goods are imported freely. Third, the official exchange rate did not contribute significantly to the disaggregated import functions, whereas the parallel market exchange rate premium influenced significantly and negatively the demand for most imports included in both the restricted and free classifications. Fourth, there has been an increasing dependency upon some imports such as imports of fertilisers and transport materials during this period. Fifth, due to the mean lag of adjustment described in Chapter Six, essential imports like chemical and pharmaceutical products adjust very fast to their desired levels, tending to remove the imbalance between actual and desired levels.

In the context of Iran's major trading partners, fifteen countries were chosen to explore the trade relationship between Iran and these countries. About 55% of imports by the selected trading partners were exported by the major industrial countries, while the share of the developing countries and other developed countries was about 22%. The most important results obtained by estimating the equations of imports from these trading partners, refer to the fact that the price elasticities of demand for imports from developing countries, and some developed nations, are higher than those from its major industrialised partners (like Germany, Japan, etc.). Similar to the previous import classification, the black market exchange rate premium played a significant role in explaining the Iranian demand for imports from its major trading partners.

In Chapter Seven the macroeconomic model developed in Chapter Five, as well as the three-equation import model (including imports of consumer goods, imports of

intermediate goods, and imports of capital goods) developed in Chapter Six were linked to conduct a dynamic simulation analysis. Several dynamic simulation tests indicated that the model had a good tracking ability, and would be a useful framework for studying the economic implications of various policy experiments. The objective of the chapter was to show the dynamic response of each model to changes in key policy variables and hence to enable the evaluation of these alternative policies.

Four alternative scenarios were conducted, using the parameter estimates obtained and the actual values of the exogenous variables. Three of these scenarios were associated with eliminating, reducing, or increasing the black market exchange rate premium. A combination of the official exchange rate devaluation and an appreciation of the black market equivalent was assumed to be the best in eliminating, or reducing, the black market exchange rate premium. The fourth policy imposed an increase in non-oil exports. The simulation results highlighted the important role played by the black market exchange rate premium. Based upon the simulation results obtained, under Scenario One (the elimination of the black market premium) and Scenario Two (a decrease in the black market premium) imports increased substantially while the import price and the domestic price decreased sharply. The effect of the third scenario (an increase imposed on the premium) on these variables produced the opposite results to those of Scenario One and Scenario Two. However, the impact of these experiments, either reduction or increase in the premium, on the public sector is negligible. The imposition of an increase in non-oil exports (Scenario Four) had a positive impact on government and private expenditures, government revenues, and real money and was more pronounced than the effect of the exchange rate policy.

Overall, Chapter Seven concluded that if the serious problem in the country is inflation, the choice of Scenario One is more suitable than the others. But the fourth scenario is more effective than the others if the major economic goal is a substantial growth in income. The combination of these scenarios is the optimal solution in the current conditions of the Iranian economy.

8.3 Policy Implications from the Major Results

(1) The high price elasticity for imports has several implications:

- (a) Although the results are derived for the Iranian case, they may be applied to economies having similar characteristics (such as other oil-producing countries). Because of a high price elasticity for many imported goods, if trade restrictions and obstacles are removed developing countries should be able to compete by optimising their imports.
- (b) A high price elasticity of imports implies that price factors (such as tariffs) are important in raising the impact of prices on import demand. An increase in tariffs can lead to domestic buyers switching significantly to domestic substitutes if they are available. This tends to shift resources out of the non-oil export sector and into import-competing industries.
- (c) Since the price elasticity of total exports is small (because oil exports still represent the majority of Iran's total exports), the high price elasticity of imports should satisfy the Marshall-Lerner condition.
- (d) The insignificance of the price elasticity in the capital import equation implies that they are of essential imports, which can not be produced domestically. Needless to say, a large part of investment in Iran has to take place through the import of capital goods, particularly mechanical and electrical machinery, required for the industrial sector. To import capital goods, the country should finance such imports by foreign exchange earnings obtained through oil exports. Alternatively, if there is a lack of oil revenues, or even foreign receipts from non-oil exports, there may be another opportunity for organising demand for capital imports. This can be achieved by accelerating the privatisation program through speeding up the direct sales of inefficient government-owned enterprises, by foreign direct investment, and by promoting the activities of the Tehran stock exchange. This policy can tighten the money supply by reducing the budget deficit. This should lead to the control of liquidity and consequently inflation, which would have been

an important reason for the establishment of the parallel currency market. In general, a choice of the relevant combined fiscal and monetary policy can provide the appreciation of the Iranian currency in the black market.

(2) For Iran it appears that aggregate imports are quite income elastic in the long-run. Assuming a low income elasticity for other countries' demand for Iranian exports, the Iranian trade balance would tend to deteriorate in the long-run. In the case of disaggregated imports, essential goods, such as capital imports, are particularly income elastic in both periods. This implies that an increase in income should increase the import dependency of Iran for these goods.

On the other hand, differences in the income elasticity of imports from countries of origin describe the trade relationship between Iran and its trading partners. Changes in income, for instance, cannot affect the Iran-Japan or Iran-Germany trade relationship, where the income elasticity of imports from these countries are low.

(3) The insignificance of the official exchange rate in both the import demand and import price functions, is likely to have arisen from the existence of the black foreign currency market. A negative effect explains the economic relationship between import demand and the black market exchange rate premium, while the black market premium has a positive impact on the import price.

The macro-model developed (in Chapter Five) was used to simulate the impact of a number of alternative policy experiments for the Iranian economy. In terms of the exchange rate policy effect, the key implications can be summarised as follows:

(i) The elimination, or reduction, of the black market exchange rate premium increases imports substantially. Although the import effect worsens the trade balance, the country should be able to import a large number of required inputs enabling an expansion of its limited capacity in producing traded and non-traded goods. This can improve the trade balance in the long run.

(ii) The price effect of Scenario One or Scenario Two, in which the black market exchange rate premium is respectively eliminated or reduced, is disinflationary. Under these policy scenarios the domestic price falls through a fall in the import price, which is significantly affected by the black market exchange rate premium.

(iii) The private sector responds to changes in the black foreign currency market by reducing its real expenditure with respect to the elimination, or reduction, of the black market premium. However the simulation results indicate that the impact of developments in the premium on the public sector is negligible. The reason is that government expenditure and government revenues react only marginally with respect to changes in the black market premium.

(4) The black market exchange rate can be eliminated by a once-and-for-all official exchange rate devaluation, a complete appreciation of the black market exchange rate relative to the unchanged official exchange rate, or a combination of these options. A devaluation raises costs of essential imports which are price inelastic, but its effect is not consistent with the simulation results observed by Scenario One, conducted in this study, in which import and domestic prices decrease. Moreover, the second option, an appreciation of the black market exchange rate, to unify the official and black market exchange rates is not sensible from an economic policy point of view. In reality, the government may not be able to control the action of the black market if the exchange rate is determined by the reaction of the supply of and demand for foreign exchange in this market. Therefore, the unification of the official and black market exchange rates can be achieved by the combination of an official exchange rate devaluation and an appreciation of the domestic currency in the parallel (black) market, which should be accompanied by the public credibility of the country's banking system, the macroeconomic stabilising policies, etc.

(5) A stabilisation policy can be accompanied by control of foreign expenditures, foreign exchange transactions, and public expenditures. However, this control may result in the loss of production and increased unemployment without necessarily causing

a reduction of inflation. In practice, the government has returned to centralised policies by restricting imports, fixing the exchange rate (US\$1 = 3000 Rials for exporters), and banning foreign currency transactions outside of the banking system since May 1995. This new policy has led to decreases of 9.4% and 24% in non-oil exports in terms of weight and value, respectively, since 21 March 1995.¹⁰⁵

(6) The promotion of non-oil exports should have substantial effects on the economy. A policy of promoting these exports indicates that in general the demand side of the economy will be expansionary. Increased non-oil exports increase income, which contributes to a rise in imports. The income effect of this policy expands money balances. The impact of this policy is generally inflationary because an increase in non-oil exports raises the demand for these goods, resulting in an increase in aggregate demand. Increased aggregate demand leads to an increase in the prices of both tradeable and non-tradeable goods. But the policy can change the workings of the industrial sector from an import substitute sector to a net exporter in the long-run.

8.4 Suggestions for Future Work

(1) The results presented are based on, and limited by, a short data time series. Data, especially for prices of some of the commodity groups, are inadequate. A dynamic import model should be used for a quarterly model of Iranian import demand. More recently developed econometric techniques could be applied to the empirical investigation of imports and its patterns. A cointegration test would provide relevant results for the long-run relationship between import demand and its key determinants.

(2) The import functions analysed in this study can be applied to other developing countries. A developing country might draw on some of the relationships used in our import models in formulating a mathematical model of its import activity, but the

¹⁰⁵ An Iranian official reported that the volume of non-oil exports was predicted to drop by 30% following the implementation of new economic policies adopted by the government since May 1995. [Kayhan Havai, the International Weekly for Iranians Abroad, February 14, 1996 (Bahman 25, 1374) No. 1169, Iran].

structure of equations and definitions of variables should reflect local institutions and behavioural characteristics. Hence the standard import model should be reconsidered to reflect a better picture of the development process.

(3) A significant dummy variable revealed the fact that the episode of the collapse of the oil price seriously affected imports. This shows the important role of oil revenues in demand for imports. Two points are important: the paramount importance of oil revenues in financing imports, and the imbalance between imports and non-oil exports. It should be reflected in building a more developed general equilibrium model of the external sector, relying on both the non-oil export and oil export sectors.

(4) In addition, dummy variables in this study were used to compensate for changing oil prices. However, oil prices can be included directly in the regression models. Dummies can be used to test for changing slopes and hence elasticities to test for the structural stability of the equations for the two different periods: pre-revolutionary and post-revolutionary periods. This could be accomplished with multiplicative dummies and various Chow tests in equations estimated by OLS.

(5) Not only does openness increase competition, it also permits the realisation of comparative advantage, providing a means for realising economies of scale, and increasing living standards and economic growth (Krueger 1990). Apart from the effect of price, income, and exchange rate changes, it would be of interest to explore how the demand for a variety of imports reacts in response to changes in quantitative restrictions, and to identify the impact of the liberalisation policy on the economy.

(6) Our macro-model has stressed the role of the parallel market exchange rate premium in the determination of the demand for imports and import prices. The significance of the premium in the aggregate import and import price equations is treated as a structural feature of the economy, that is subject to empirical estimations. This suggests that the parallel (black) market exchange rate must necessarily be included in the design of a macro-model for developing countries where a parallel market for foreign currency is

active. Thus the macro-model developed in Chapter Five can be re-specified and then re-estimated by the inclusion of the parallel market exchange rate equation.

(7) As discussed earlier (in Chapter Two), modelling import demand with the inclusion of the impacts of external debt and debt-service payments can be suggested for future work.

APPENDICES

Appendix A¹⁰⁶

The problem is to maximise the following utility function with respect to a budget constraint:

$$\max U(Y_d, IM) = [\alpha(Y_d)^{-\rho} + \beta(IM)^{-\rho}]^{1-\rho}, \alpha, \beta > 0, -1 < \rho < \infty \quad (\text{A.1})$$

subject to

$$P_d Y_d + P_m IM = I \quad (\text{A.2})$$

A Lagrangian function for this problem can be obtained as follows:

$$L = [\alpha(Y_d)^{-\rho} + \beta(IM)^{-\rho}]^{1-\rho} + \lambda(I - P_d Y_d - P_m IM) \quad (\text{A.3})$$

The necessary condition for a solution to this problem is that the partial derivatives of L with respect to Y_d , IM , and λ (Lagrangian coefficient) satisfy the following:

$$\frac{\partial L}{\partial Y_d} = (1-\rho)\alpha(-\rho)(Y_d)^{-\rho-1}[\alpha(Y_d)^{-\rho} + \beta(IM)^{-\rho}]^{1-\rho} - \lambda P_d = 0 \quad (\text{A.4})$$

$$\frac{\partial L}{\partial IM} = (1-\rho)\beta(-\rho)(IM)^{-\rho-1}[\alpha(Y_d)^{-\rho} + \beta(IM)^{-\rho}]^{1-\rho} - \lambda P_m = 0 \quad (\text{A.5})$$

$$\frac{\partial L}{\partial \lambda} = I - P_d Y_d - P_m IM = 0 \quad (\text{A.6})$$

By simplifying (A.4) and (A.5), we conclude:

$$\frac{\alpha(Y_d)^{-1-\rho}}{\beta(IM)^{-1-\rho}} = \left(\frac{\alpha}{\beta}\right)\left(\frac{IM}{Y_d}\right)^{1+\rho} = \frac{P_d}{P_m} \quad (\text{A.7})$$

or

$$\left(\frac{\alpha}{\beta}\right)^{\frac{1}{1+\rho}} \left(\frac{IM}{Y_d}\right) = \left(\frac{P_d}{P_m}\right)^{\frac{1}{1+\rho}} \quad (\text{A.8})$$

or

¹⁰⁶ Appendix A refers to Chapter Three.

$$\frac{IM}{Y_d} = \left(\frac{\alpha}{\beta} \right)^{\sigma} \left(\frac{P_d}{P_m} \right)^{\sigma} \quad (\text{A.9})$$

where σ is the constant elasticity of substitution and is equal to $\frac{1}{1+\rho}$. Taking the

logarithm of both sides and then simplifying (A.9), we have:

$$\ln IM = \alpha_0 + \alpha_1 \ln \left(\frac{P_m}{P_d} \right) + \ln Y_d \quad (\text{A.10})$$

Appendix B¹⁰⁷

Table B.1: The weights used in the calculation of the world price index (%).

Partner	1976	1985
U.S.	32.1	22.7
Germany	21.4	21.2
Japan	19.5	17.5
U.K	9.2	8.7
Italy	6.3	7.9
France	5.9	2.0
Turkey	0.4	13.8
Holland	3.7	3.5
Australia	1.6	2.7
Total	100.1	100.0

Source: Pesaran (1992), "The Iranian Foreign exchange Policy and the Black Market for Dollars, International Journal of Middle Eastern Studies, Vol. 24, pp. 101-125.

¹⁰⁷ Appendix B refers to Chapter Five.

Appendix C¹⁰⁸

Theory of Ordinary Least Squares (OLS) and its Properties

We can define a regression model in matrix notation as follows

$$y = X\beta + u, \quad (C.1)$$

where y (y_1, y_2, \dots, y_T) is a $T \times 1$ vector of the dependent variable, β ($\beta_1, \beta_2, \dots, \beta_k$) is a $K \times 1$ vector of the regression parameters, X is a $T \times K$ matrix of the known and fixed explanatory variables. The elements of the matrix X are described as

$$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1k} \\ x_{21} & x_{22} & \dots & x_{2k} \\ \vdots & \vdots & & \vdots \\ x_{T1} & x_{T2} & \dots & x_{Tk} \end{bmatrix}$$

where $X'X$ is nonsingular which is equivalent to the rank of X if $T \geq k$. The vector u (u_1, u_2, \dots, u_T) is the error term with $E(u) = 0$, and $\text{var}(u) = E(uu') = \sigma^2 I$. The model also relies on the assumption of linearity of $E(y|X)$.

The OLS estimator $\hat{\beta}$ of the regression parameters in (C.1) is defined to be the value of β that minimises the sum of squared residuals (RSS)

$$\text{RSS} = (y - X\hat{\beta})'(y - X\hat{\beta}), \text{ giving the result}$$

$$\delta \text{RSS} / \delta \beta = -2X'y + 2X'X\hat{\beta} = 0$$

and

$$\hat{\beta} = (X'X)^{-1} X'y \quad (C.2)$$

We consider the matrix $(X'X)^{-1}X' = A$, which is fixed. This implies that $\hat{\beta}$ is a linear function of y . It concludes that $\hat{\beta}$ is also linear in β and u , since from (C.2) we can obtain

¹⁰⁸ Appendix C refers to Chapter Five.

$$\begin{aligned}\hat{\beta} &= (X'X)^{-1}X'(X\beta + u) \\ &= \beta + (X'X)^{-1}X'u\end{aligned}\tag{C.3}.$$

It is clear that $\hat{\beta}$ is an unbiased estimator of β , since by assumption $E(X'u) = 0$

$$E(\hat{\beta}) = E_X[E(\hat{\beta} | X)] = \beta.\tag{C.4}$$

If the regressors and disturbances are not correlated, the unbiasedness of $\hat{\beta}$ is not influenced by a violation of the assumption $E(uu') = \sigma^2 I$. The estimator $\hat{\beta}$ is said to be best (or efficient) in a class if it is better than any other estimator in the class (Amemiya 1985). It implies that amongst the group of linear unbiased estimators, the OLS estimator has the smallest variance. In another words if β^* is another estimator of β it can be proved that its variance is not smaller than the variance of $\hat{\beta}$, that is $\text{var}(\beta^*) > \text{var}(\hat{\beta})$. Thus, under the assumptions of the classical linear model, the OLS estimator $\hat{\beta}$ is the best linear unbiased estimator (BLUE). If there exists some other information which has not been taken into account, the OLS method cannot be BLUE.

Two-Stage Least Squares (2SLS) and Three-Stage Least squares (3SLS)

The 2SLS method is an approach used in the single equation estimation of a simultaneous equation model. The 2SLS estimators are asymptotically unbiased and efficient under the usual assumptions about the distribution of disturbances. The use of the 2SLS method of estimation is determined by the correlation of the error terms across the equations. If it is assumed that there are inter-correlations among the error terms across the equations, then this system of estimation is recommended. If no inter-correlations are postulated, then the single equation estimation is recommended (Kalirajan 1995).

In the 2SLS method, the inter-correlation between the explanatory variables and disturbances are taken into account while estimating the parameters of the model for one equation at a time. If the disturbances are correlated between the equations, then it implies that the 2SLS is not efficient. In this case, it is necessary to use a system

estimation procedure such as the 3SLS in which the parameters of a model are estimated as a whole rather than for one equation at a time. Actually, the 3SLS is an extension of the 2SLS method. In general, the 3SLS estimators are biased but consistent. They are more efficient than the 2SLS estimators because the 3SLS estimation uses more information than that of the 2SLS estimation.

Comparing and Contrasting the OLS against the 2SLS and 3SLS

Because of their simplicity and asymptotic efficiency, the 2SLS and 3SLS approaches are used for the estimation of simultaneous-equation models.¹⁰⁹ Nonetheless, it is often found that the OLS estimator is surprisingly close to the structural estimator. In some cases, the OLS has a smaller variance about its mean than does the 2SLS. This indicates the fact that the OLS might be more accurate in a mean squared error sense. An analysis conducted by Goldberger (1964) suggests that for small samples the second moments of the OLS estimators (about the true parameter values) may be less than those of the 2SLS estimators. But as the sample size increases, the variances of both OLS and 2SLS go to zero, but the bias of OLS persists. However, the results of many Monte Carlo studies, such as Basmann (1958) and Waelbrock (1976), conform to the dominance of the OLS over all other methods used in the estimation of econometric models. Of the 17 models summarised, a study conducted by Waelbrock (1976) for 17 developed and developing countries, the OLS is used in 15, the FIML (Full-Information Maximum Likelihood) is applied in only one model, and a combination of LIML (Limited-Information Maximum Likelihood) and the 2SLS in the remaining model.¹¹⁰ Thus, the OLS appears to be the most frequently used estimator in finite samples. Although the 2SLS and 3SLS asymptotically dominate the OLS, our applications are based on rather small or moderate-sized samples. Thus, the proper way is to use the single-equation OLS instead of the 2SLS and 3SLS. In addition, the system method is better only if all of the equations in the system are correctly specified.

¹⁰⁹ A system of equations describing the joint dependence of the endogenous variables is called a system of simultaneous-equations model.

¹¹⁰ See Waelbrock (1976) for more details.

In a special type of simultaneous-equation models called a *Recursive Model*, the OLS is also valid. This is a model in which the disturbances from the different equations are independent and the parameters of the endogenous variables indicate a triangular pattern. We consider the following three-equation system which includes three endogenous variables (Y_1 , Y_2 and Y_3) and two exogenous variables (X_1 , and X_2):

$$Y_1 + \alpha_{10} + \beta_{11}X_1 + \beta_{12}X_2 = U_1 \quad (C.5)$$

$$Y_2 + \alpha_{20} + \alpha_{21}Y_1 + \beta_{21}X_1 + \beta_{22}X_2 = U_2 \quad (C.6)$$

$$Y_3 + \alpha_{30} + \alpha_{31}Y_1 + \alpha_{32}Y_2 + \beta_{31}X_1 + \beta_{32}X_2 = U_3 \quad (C.7)$$

where the error terms are independent or $E(U_1, U_2) = E(U_1, U_3) = E(U_2, U_3) = 0$. Thus, OLS can be applied to estimate the equations of this system (Kalirajan 1995).

The Use of OLS, 2SLS, and 3SLS in this Study

The behavioural equations of an Iranian macro-model (specified in Chapter Five) are estimated by the OLS method over the period 1970-1993. However, the results for the model obtained by the 2SLS and 3SLS methods are also presented for illustration in Appendix D, Table D.2 and Table D.3.

The equations of the import models, formulated in Chapter Four and then estimated in Chapter Five, indicate that there are no inter-correlations between the explanatory variables and disturbance terms. No endogenous variable can be found on the right hand side of each equation present in the import models. Thus, all disaggregated import equations (the equations for the composition of imports, commodity groups of imports, and imports by country of origin) are estimated by OLS. In this regard, an application of the 2SLS and 3SLS for illustration should generate very similar results to those obtained by the OLS.

Appendix D¹¹¹

Table D.1: List of equations of the macroeconomic model including the black market exchange rate premium in the equations of aggregate import demand and import price.

Classification	Behavioural Equation	Identity
Aggregate Demand:		
$\log Ge_t = \delta_0 + \delta_1 \log Ygno_t + \delta_2 \log Ygo_t + \delta_3 \log Ge_{t-1} + \delta_4 D_2 + u_{1t}$	×	
$Yg \equiv Ygno + Ygo$		×
$\log Ygno_t = l_0 + l_1 \log Yno_t + l_2 \log Ygno_{t-1} + l_3 D_3 + u_{2t}$	×	
$Yno \equiv Pex + Ge + (Xno - IM)$		×
$Y \equiv Yno + Yo$		×
$\log Pex = \phi_0 + \phi_1 \log Yno_t + \phi_2 \log Pex_{t-1} + \phi_3 D_2 + u_{3t}$	×	
External Sector:		
$\log IM_t = \gamma_0 + \gamma_1 \log (P_m / P_d)_t + \gamma_2 \log Y_t + \gamma_3 \log (BM / ER)_t + \gamma_4 \log IM_{t-1} + \gamma_5 D_3 + u_{4t}$	×	
$Xno \equiv \bar{X}no$		
Prices:		
$\log P_{mt} = \varphi_0 + \varphi_1 \log (BM / ER)_t + \varphi_2 \log P_{wt} + u_{5t}$	×	
$\Delta \log P_{dt} = \psi_1 \Delta \log P_{mt} + \psi_2 (\log m_{t-1} - \log m^d_t) + \psi_3 \Delta \log P_{dt-1} + \psi_4 \pi_{t-1} + \psi_5 D_2 + u_{6t}$	×	
Monetary Sector:		
$\log m^d_t = k_0 + k_1 \log Yno_t + k_2 \log m^d_{t-1} + k_3 D_1 + u_{7t}$	×	

¹¹¹ Appendix D refers to Chapter Five.

Table D.2: Estimated model by 2SLS, 1970-1993 (log-log, annual data).

Equation	Variable	Parameter	t-statistic
Aggregate Demand			
Government Expenditures			
	Constant	$\delta_0 = 0.817$	2.717**
	Y_{gno}	$\delta_1 = 0.274$	5.507***
	Y_{go}	$\delta_2 = 0.128$	8.541***
	Ge_{t-1}	$\delta_3 = 0.544$	12.156***
	D_1	$\delta_4 = 0.081$	1.673
	D_2	$\delta_5 = -0.100$	-2.762**
$\bar{R}^2 = 0.981, DW = 1.870^a$			
Government Non-Oil Revenues			
	Constant	$l_0 = 0.440$	0.301
	Y_{no}	$l_1 = 0.426$	1.899*
	$Y_{gno_{t-1}}$	$l_2 = 0.390$	2.245**
	D_3	$l_3 = -0.324$	-2.963***
$\bar{R}^2 = 0.613, DW = 1.939$			
Private Expenditures			
	Constant	$\phi_0 = -0.921$	-1.418
	Y_{no}	$\phi_1 = 0.873$	4.604***
	Pex_{t-1}	$\phi_2 = 0.265$	2.325**
	D_2	$\phi_3 = -0.103$	-2.494**
$\bar{R}^2 = 0.949, DW = 1.565$			
External Sector			
Aggregate Imports			
	Constant	$\gamma_0 = -2.641$	-0.784
	P_m / P_d	$\gamma_1 = -1.462$	-2.315**
	Y	$\gamma_2 = 0.929$	1.948*
	BM/ER	$\gamma_3 = -0.632$	-3.497
	IM_{t-1}	$\gamma_4 = 0.361$	2.350**
	D_2	$\gamma_5 = -0.331$	-3.167***
	D_3	$\gamma_6 = -0.343$	-2.703**
$\bar{R}^2 = 0.947, DW = 2.153$			
Monetary Sector			
Demand for Money			
	Constant	$k_0 = -1.967$	-2.030*
	Y_{no}	$k_1 = 0.348$	2.714**
	m^d_{t-1}	$k_2 = 0.787$	16.315***
	D_1	$k_3 = 0.084$	2.665**
$\bar{R}^2 = 0.986, DW = 2.165$			

(continued)

Table D.2: (continued).

Equation	Variable	Parameter	t-statistic
Prices			
Domestic Price			
	Constant	$\psi_0 = 0.075$	2.857**
	P_m	$\psi_1 = 0.495$	4.923***
	$m_{t-1} - m^d_{t-1}$	$\psi_2 = 0.142$	2.090*
	P_{dt-1}	$\psi_3 = 0.382$	2.982***
	π_{t-1}	$\psi_4 = -0.003$	-2.474**
	D_2	$\psi_5 = 0.034$	1.917*
$\bar{R}^2 = 0.852, DW = 2.359$			
Import Price			
	Constant	$\varphi_0 = 0.294$	0.103
	BM/ER	$\varphi_1 = 0.375$	2.282**
	P_w	$\varphi_2 = 0.889$	1.942*
$\bar{R}^2 = 0.986, DW = 1.077^b$			

* Indicates parameter significance at the 10 percent level.

** Indicates parameter significance at the 5 percent level.

*** Indicates parameter significance at the 1 percent level.

^a Corrected for autocorrelation by the Cochrane-Orcutt iterative technique.

^b Corrected for autocorrelation by the Hildreth-Lu grid technique.

Table D.3: Estimated model by 3SLS, 1970-1993 (log-log, annual data).

Equation	Variable	Parameter	t-statistic
Aggregate Demand			
Government Expenditures			
	Constant	$\delta_0 = 0.1.180$	3.173***
	Y_{gno}	$\delta_1 = 0.309$	4.949***
	Y_{go}	$\delta_2 = 0.108$	5.870***
	Ge_{t-1}	$\delta_3 = 0.481$	8.352***
	D_1	$\delta_4 = 0.087$	2.085*
	D_2	$\delta_5 = -0.036$	-0.770**
$R^2 = 0.948, DW = 2.745$			
Government Non-Oil Revenues			
	Constant	$l_0 = 0.081$	0.630
	Y_{no}	$l_1 = 0.450$	2.635**
	$Y_{gno_{t-1}}$	$l_2 = 0.346$	2.509**
	D_3	$l_3 = -0.341$	-3.921***
$R^2 = 0.666, DW = 1.899$			
Private Expenditures			
	Constant	$\phi_0 = -1.062$	-2.030*
	Y_{no}	$\phi_1 = 0.931$	6.975***
	Pex_{t-1}	$\phi_2 = 0.271$	2.710**
	D_2	$\phi_3 = -0.110$	-3.216***
$R^2 = 0.956, DW = 1.355$			
External Sector			
Aggregate Imports			
	Constant	$\gamma_0 = -5.896$	-2.531**
	P_m / P_d	$\gamma_1 = -1.918$	-4.409*
	Y	$\gamma_2 = 1.422$	4.404***
	BM / ER	$\gamma_3 = -0.814$	-6.731***
	IM_{t-1}	$\gamma_4 = 0.231$	2.274**
	D_2	$\gamma_5 = -0.285$	-3.137***
	D_3	$\gamma_6 = -0.341$	-4.101***
$R^2 = 0.961, DW = 1.960$			
Monetary Sector			
Demand for Money			
	Constant	$k_0 = -1.527$	-1.717
	Y_{no}	$k_1 = 0.250$	2.472**
	m^d_{t-1}	$k_2 = 0.810$	20.234***
	D_1	$k_3 = 0.0589$	2.254**
$R^2 = 0.988, DW = 2.107$			

(continued)

Table D.3: (continued).

Equation	Variable	Parameter	t-statistic
<i>Prices</i>			
Domestic Price			
	Constant	$\psi_0 = 0.081$	4.034***
	P_m	$\psi_1 = 0.523$	6.048***
	$m_{t-1} - m^d_{t-1}$	$\psi_2 = 0.131$	2.156*
	P_{dt-1}	$\psi_3 = 0.307$	3.135***
	π_{t-1}	$\psi_4 = -0.003$	-3.028**
	D_2	$\psi_5 = 0.032$	2.138*
$R^2 = 0.885, DW = 2.133$			
Import Price			
	Constant	$\varphi_0 = -1.824$	-2.138*
	BM/ER	$\varphi_1 = 0.490$	0.4149***
	P_w	$\varphi_2 = 0.923$	3.846***
$R^2 = 0.931, DW = 0.299$			

* Indicates parameter significance at the 10 percent level.
** Indicates parameter significance at the 5 percent level.
*** Indicates parameter significance at the 1 percent level.

Appendix E¹¹²

Table E.1: Results from using the 3SLS technique for estimating the elasticities of the demand equations by composition of imports, 1970-1993 (log-log, annual data).

Imports	Const.	Activity Variable							Lagged Imports	D_2	D_3	\bar{R}^2	SE*	DW
		P_m / P_d	Ge	Pex	Y	I^M	$I^T - I^M$	BM / ER						
IMC	-2.772 (-1.557)	-2.294 (-5.954)	0.597 (3.608)	0.637 (2.048)				-1.009 (-10.120)				0.966	0.139	2.382
IMR	-2.819 (-1.566)	-1.783 (-4.779)			1.003 (4.188)			-0.726 (-7.211)	0.263 (2.932)	-0.334 (-4.579)	-0.297 (-3.719)	0.958	0.127	1.752
IMK	-2.264 (-2.188)					0.513 (3.821)	0.761 (3.601)	-0.415 (-9.609)		-0.273 (-2.891)		0.932	0.168	1.354

Values in parentheses beneath each estimated coefficient contain the *t*-statistic.

* Refers to standard error of the regression.

¹¹² Appendix E refers to Chapter Six.

Appendix F¹¹³

Sources and Transformation of Data

The data used to conduct the estimation of the various import demand functions are here explained. They were obtained from both domestic and international sources. Various commodity groups of imports and exports are collected by Iran's Customs and generally compiled in Iranian industrial statistics on a four digit Brussels Nomenclature (B.N).¹¹⁴ Selected commodity groups of imports in our analysis include twenty groups which are equivalent to the B.N. classification.

Domestic and import price indices are available from the reports of the Central Bank of Iran (CBI), revised recently in 1993. They have been calculated for the base year of 1990. Both import price and domestic price indices rely directly on the information provided in official statistics of four or five digit SITC (Standard International Trade Classification). The calculated price indices for commodity groups which are imported under the control policy include tariffs in their C.I.F. (Cost Insurance Freight) values.

When calculating a relative price for each commodity group, there is an implicit assumption that goods combined in a group can be treated as one homogenous commodity. There is an obvious problem if, within a SITC group, the nature of the goods imported differs from that of goods produced domestically. Second, a change in the quality of home commodities could show up as a trendwise increase or decrease in imports. We assume that there is no systematic change in the quality of domestic versus imported goods which has taken place during the period, and that domestic importers regard world prices as given. In addition, since imported goods and relevant price indices are respectively classified on the basis of B.N. and SITC, we have arranged them in such a way as to make their classifications equivalent. Table F.1 represents a sample coverage of the entire selected items where Column (2) and Column (3) refer to

¹¹³ Appendix F refers to Section of Chapter Six.

¹¹⁴ Brussels Nomenclature contains 21 sections, 99 chapters, and a number of sub-chapters.

Table F.1: A sample coverage of the selected import items as restricted or free imports.

(1)	(2)	(3)	(4)	(5)	(6)
B. N. Tariff No.	SITC Code No.	Description	IM^R_i	IM^F_{ji}	Tariff (%) Average
Restricted Imports					
04/01-04/07, 15/01-16/05, 18/01-23/07	020000, 080000- 120000	Food Products*	IM^R_1		23.1
09/01-09/10	070000	Coffee, Tea, Mate, and Spices	IM^R_2		24.8
17/01-17/05	050000	Sugar and Sugar Confectionery	IM^R_3		23.6
44/01-46/06	630000	Wood and Articles made of Wood and Cork	IM^R_4		21.7
41/01-43/04	610000	Leather and Skins	IM^R_5		36.3
50/01-63/02	650000	Textile Materials and Textile Goods			
47/01-49/11	640000	Paper and its Applications	IM^R_6		10
68/01-70/21	660000	Construction Materials	IM^R_7		26.4
74/01-83/15	680000- 690000	Base Metals and Articles except Iron and Steel	IM^R_8		19.3
84/01-84/65	710000- 720000	Machinery, Apparatus and Mechanical Applications	IM^R_9		10
85/01-85/28	740000	Electrical Machinery and others	IM^R_{10}		17.3
86/01-89/05	780000	Transport Materials	IM^R_{11}		14.4
92/01-92/13	760000	Household Appliance	IM^R_{12}		15.7
93/01-99/06		Miscellaneous Products	IM^R_{13}		36.7
Free Imports					
02/01	010000	Meat		IM^F_1	-
10/01-10/07	040000	Cereals		IM^F_2	-
25/01-25/32	270000	Mineral Products**		IM^F_3	8
29/01-30/05	510000- 540000	Chemical and Pharmaceutical Products		IM^F_4	-
31/01-31/05	560000	Fertilisers		IM^F_5	-
39/01-40/16	620000	Rubber and Article made of Rubber**		IM^F_6	8.2
73/01-73/16	670000	Iron, Cast Iron, and Steel		IM^F_7	-

Sources: Iran's Customs, and the Central Bank of Iran.

* Includes milk and dairy products, animal and vegetable oils, and some products of the food industry.

** Commodity groups with an average tariff of less than 10 % are assumed to be freely imported.

codes of both classifications. Column (4) and Column (5) also categorise the commodity groups in the form of restricted imports (IM^R_j) and freely imported goods (IM^F_i) depending on the inclusion, or otherwise, of tariffs [Column (6)]. Imports can be calculated in terms of either volume or value. In this study, imports are calculated in value terms. For each commodity group, import values are deflated by the calculated import price indices in the base year 1982.

As previously indicated, the data for price indices drawn from the report of the CBI (1993) were scaled to 100 in 1990. To transfer them to a base year of 1982¹¹⁵, we use the following formula:

$$P_{t,1982} = P_{t,1990} \cdot \frac{L}{L'}$$

where $P_{t,1982}$ and $P_{t,1990}$ are price index based on 1982 for year t and price index based on 1990 for year t , respectively. L is the price index of the new base year (1982) with respect to the new base year (1982) and L' is the index price of the old base year (1990) with respect to the new base year (1982).

The data for activity variables such as expenditures on each commodity group, private and government expenditures, gross domestic product (GDP), total investment, investment in manufacturing, and oil revenues are obtained from the Central Bank of Iran, *National Accounts* (1980-1994) and from the Budget and Planning Organisation of Iran (B.P.O.I.), *Time Series of National, Financial and Monetary Accounts* (1994).

¹¹⁵ Since most variables in real terms are available using a base year of 1982.

Appendix G¹¹⁶

Table G.1: Percentage deviation from the control solution for the endogenous variables of the macroeconomic model.

Year	Government Expenditure (Ge)				Private Expenditure (Pex)				Import Price (P _m)			
	Scen. 1	Scen. 2	Scen. 3	Scen. 4	Scen. 1	Scen. 2	Scen. 3	Scen. 4	Scen. 1	Scen. 2	Scen. 3	Scen. 4
1972	-0.239			5.638	-1.738			-11.047	-4.512			33.004
1973	-0.303			12.576	-1.443			-11.731	-3.738			14.034
1974	-1.571			0.159	-4.735			19.496	-17.860			-7.136
1975	-0.577			4.931	-2.908			35.873	-5.176			-0.389
1976	-1.077			-9.988	-3.136			38.081	-7.258			-3.947
1977	0.102			-2.305	-1.258			23.874	-1.748			-8.943
1978	-2.239			-16.473	-3.240			19.916	-13.760			-15.298
1979	-0.423			1.022	-1.956			1.698	-6.015			4.022
1980	-0.248	0.011	0.105	-1.389	-1.732	-0.955	0.244	-13.672	-5.524	-2.828	1.222	-7.885
1981	-0.489	-2.599	1.010	3.274	-5.270	-6.046	-0.091	1.495	-12.504	-19.241	3.418	-13.227
1982	0.349	0.015	-0.056	16.332	-3.279	-0.411	0.025	20.455	-12.765	-1.359	0.412	1.269
1983	-0.380	-0.243	0.665	12.165	-1.207	-0.188	0.905	8.153	-3.517	-1.269	4.472	16.895
1984	-2.707	-2.373	-0.681	14.117	-4.003	-1.667	3.144	15.621	-37.276	-33.156	-12.448	-0.169
1985	-0.594	-0.309	0.226	18.478	-4.105	-0.814	0.790	29.556	-13.167	-2.762	2.260	47.409
1986	-1.289	-0.117	0.208	14.369	-7.048	-0.441	1.216	44.949	-28.984	-2.349	5.518	45.602
1987	-0.493	-0.060	0.454	15.340	-2.827	0.000	-1.023	35.790	-13.274	-2.054	15.851	37.766
1988	-1.596	-5.939	-0.550	7.006	-6.624	-6.765	0.258	39.434	-37.526	-28.132	7.450	9.569
1989	-0.828	-0.011	0.001	17.547	-5.959	-0.368	-0.274	16.720	-17.852	-0.625	0.750	8.956
1990	-0.458	-0.085	-0.033	4.417	-2.151	-0.253	-0.094	-7.562	-7.622	-0.625	0.294	-9.376
1991	-0.849	-0.064	-0.018	-12.388	-3.406	-0.228	-0.029	-34.028	-10.924	-0.592	0.189	-23.896
1992	-0.573	0.915	0.111	-7.677	-7.114	-4.132	0.085	-37.345	-32.454	-23.623	0.628	-41.022
1993	-0.442	0.099	-0.004	-6.168	-2.271	0.232	-0.062	-11.235	-29.869	-4.234	0.832	-46.875
Average	-0.769	-0.768	0.103	4.136	-3.519	-1.574	0.364	10.204	-14.697	-8.775	2.203	1.839

continued

¹¹⁶ Appendix G refers to Chapter Seven.

Table G.1: (continued)

Year	Government non-oil revenues (Ygno)				Government revenues (Yg)				Imports (IM)			
	Scen. 1	Scen. 2	Scen. 3	Scen. 4	Scen. 1	Scen. 2	Scen. 3	Scen. 4	Scen. 1	Scen. 2	Scen. 3	Scen. 4
1972	-0.857			6.603	-0.375			2.894	40.920			0.252
1973	-0.796			3.901	-0.285			1.395	19.969			-0.724
1974	-2.063			16.147	-0.312			2.444	16.548			6.116
1975	-1.863			-5.434	-0.424			-1.237	7.034			-5.887
1976	-2.386			-5.959	-0.613			-1.531	4.073			18.666
1977	-0.027			-5.981	-0.007			-1.637	3.247			27.130
1978	-5.696			-26.920	-2.540			-12.004	8.548			20.502
1979	-1.174			-1.344	-0.412			-0.471	15.625			5.478
1980	-0.594	0.200	0.417	30.824	-0.233	-0.078	0.163	12.070	15.854	8.511	-4.096	-15.666
1981	-2.290	-5.235	1.351	4.516	-1.057	2.476	0.623	2.085	8.240	3.858	-4.780	4.280
1982	-1.284	-0.197	-0.012	18.726	-0.487	0.075	-0.004	7.096	13.385	3.571	-13.913	46.439
1983	-1.084	-0.584	1.671	26.773	-0.447	0.241	0.688	11.024	13.812	5.741	-1.379	-2.527
1984	-2.240	-1.009	1.756	16.927	-1.221	0.553	0.957	9.223	20.196	7.160	-5.273	5.999
1985	-2.188	-0.414	0.427	18.661	-1.321	0.251	0.258	11.266	32.830	19.944	-1.914	37.928
1986	-5.218	-0.300	-0.020	13.376	-4.176	0.241	-0.016	10.704	72.519	27.502	-24.735	49.122
1987	-1.549	-0.009	-0.499	18.041	-1.083	0.006	-0.349	12.617	124.586	70.712	-27.583	41.834
1988	-2.946	4.252	1.009	32.921	-2.171	-3.038	0.743	24.263	135.161	79.565	-28.480	36.677
1989	-1.865	-0.055	0.110	36.905	-1.469	0.043	0.086	29.073	100.883	26.940	-29.185	35.706
1990	-1.640	-0.225	-0.134	-14.446	-1.346	0.185	-0.110	-11.861	120.715	68.388	-28.619	7.287
1991	-2.192	-0.158	-0.033	-30.938	-1.904	0.137	-0.029	-26.873	80.817	74.674	-27.533	-31.057
1992	-0.934	5.156	0.498	-5.687	-0.507	-2.723	0.270	-3.087	77.906	26.870	-27.261	-38.585
1993	-1.388	0.167	-0.014	-5.424	-0.764	-0.092	-0.008	-2.984	83.234	23.479	-26.927	-22.138
Average	-1.922	0.114	0.466	6.463	-1.052	-0.123	0.234	3.385	47.463	31.923	-17.977	10.311

continued

Table G.1: (continued)

Year	Real money (m)				Income (Y)				Non-oil income (Yno)			
	Scen. 1	Scen. 2	Scen. 3	Scen.4	Scen. 1	Scen. 2	Scen. 3	Scen.4	Scen. 1	Scen. 2	Scen. 3	Scen.4
1972	-0.620			-4.861	-1.091			-2.674	-1.999			-4.900
1973	-0.580			-0.930	-0.895			-2.607	-1.711			-4.984
1974	-2.170			4.119	-3.871			8.500	-6.991			15.351
1975	-1.208			13.367	-2.099			20.744	-3.358			33.192
1976	-1.430			16.562	-2.613			12.396	-4.091			19.409
1977	-0.442			18.801	-0.789			8.383	-1.195			12.700
1978	-1.941			12.642	-3.725			1.972	-5.162			2.733
1979	-0.700			2.415	-1.734			1.476	-2.261			1.924
1980	-0.535	-0.163	0.148	2.986	-1.753	-0.874	0.319	-8.526	-1.930	-0.962	0.351	-9.387
1981	-2.016	-1.829	-0.284	6.250	-5.306	-7.151	0.490	1.601	-5.870	-7.912	0.542	1.771
1982	-1.126	-0.156	-0.005	13.938	-3.377	-0.398	0.052	13.550	-4.141	-0.488	0.063	16.611
1983	-0.394	-0.007	0.168	11.067	-1.325	-0.360	1.321	9.607	-1.593	-0.432	1.588	11.550
1984	-5.626	-4.869	-1.605	14.846	-5.311	-3.011	2.254	13.933	-6.120	-3.470	2.597	16.054
1985	-1.642	-0.423	0.182	23.034	-4.100	-0.752	0.732	23.654	-4.736	-0.869	0.845	27.322
1986	-1.915	-0.116	0.511	35.294	-7.346	-0.457	1.054	34.846	-8.406	-0.523	1.206	39.872
1987	-0.718	-0.092	0.890	47.422	-2.674	-0.059	-0.416	29.090	-3.127	-0.069	-0.487	34.019
1988	-1.947	-7.189	-0.587	41.510	-6.352	-7.211	0.227	28.947	-7.620	-8.651	0.272	34.729
1989	-2.378	-0.237	-0.214	29.481	-5.179	-0.298	-0.180	14.727	-6.246	-0.359	-0.217	17.761
1990	-0.711	-0.089	-0.049	17.570	-1.862	-0.214	-0.064	-4.537	-2.281	-0.262	-0.078	-5.556
1991	-0.990	-0.065	-0.011	10.147	-2.988	-0.193	-0.016	-26.169	-3.655	-0.237	-0.019	-32.013
1992	-1.182	1.094	0.149	13.959	-6.460	-3.295	0.126	-27.390	-7.838	-3.998	0.153	-33.232
1993	-0.531	0.112	-0.013	8.627	-2.542	0.100	-0.028	-6.596	-3.081	0.122	-0.034	-7.995
Average	-1.400	-1.002	-0.051	15.375	-3.336	-1.727	0.419	6.588	-4.246	-2.008	0.484	8.497

continued

Table G.1: (continued).

Year	Domestic price (P_d)			
	Scen. 1	Scen. 2	Scen. 3	Scen. 4
1972	-4.282			21.162
1973	-4.282			20.830
1974	-9.064			4.885
1975	-4.674			4.992
1976	-5.196			-2.155
1977	-4.123			-7.723
1978	-6.139			-10.023
1979	-5.940			-2.790
1980	-5.550	-1.434	0.593	-7.294
1981	-5.695	-10.268	1.723	-11.794
1982	-6.587	-0.815	0.224	-8.031
1983	-5.046	-0.675	2.302	2.140
1984	-22.434	-18.011	-5.944	-1.759
1985	-7.925	-1.920	1.043	29.330
1986	-9.874	-1.211	2.807	34.134
1987	-10.351	-1.055	8.100	32.521
1988	-15.925	-14.710	4.476	18.369
1989	-9.652	-0.410	0.365	9.399
1990	-9.619	-0.305	0.151	-2.058
1991	-8.197	-0.295	0.094	-14.039
1992	-10.294	-12.464	0.312	-27.747
1993	-10.437	-2.358	0.410	-35.453
Average	-8.240	-4.709	1.190	2.132

Table G.2: Percentage deviation from the control solution for the composition of imports.

Year	Consumer Imports (IMC)			Intermediate Imports (IMR)			Capital Imports (IMK)		
	Scen. 1	Scen. 2	Scen. 3	Scen. 1	Scen. 2	Scen. 3	Scen. 1	Scen. 2	Scen. 3
1971	110.387			73.966			63.955		
1972	60.909			39.018			36.619		
1973	32.896			25.841			-0.497		
1974	23.504			17.305			9.203		
1975	10.250			7.692			4.278		
1976	6.692			4.378			2.168		
1977	5.697			3.422			1.294		
1978	11.848			9.002			5.325		
1979	23.218			14.231			9.414		
1980	16.594	7.477	-9.216	22.637	14.540	2.155	-4.885	-7.350	-14.390
1981	10.888	4.909	-6.532	8.629	4.271	-4.369	2.900	0.764	-3.767
1982	18.694	5.053	-34.736	13.360	3.522	-7.046	7.340	2.012	-10.633
1983	20.493	11.410	-2.111	14.450	5.959	-1.473	7.701	1.362	-0.647
1984	29.591	9.900	-7.624	20.294	6.723	-5.624	14.301	6.474	-3.071
1985	47.648	35.276	-4.479	34.341	19.642	-1.675	17.930	10.629	-0.972
1986	117.795	41.325	-33.595	74.025	28.871	-25.839	35.520	13.956	-15.491
1987	196.381	101.920	-33.528	134.605	77.481	-31.037	51.263	33.371	-15.561
1988	212.019	101.273	-33.557	148.809	92.368	-32.423	44.941	33.345	-15.471
1989	188.994	48.101	-33.575	96.223	25.560	-32.795	52.492	16.086	-15.484
1990	194.749	101.243	-33.617	134.747	75.683	-32.942	47.550	33.329	-15.491
1991	111.788	101.232	-33.575	92.851	91.825	-32.935	46.603	33.318	-15.485
1992	122.199	31.187	-33.544	90.739	34.643	-32.919	39.821	12.303	-15.471
1993	171.184	45.155	-33.574	95.518	28.437	-32.927	35.177	8.661	-15.483
Average	75.844	46.104	-23.805	51.134	36.395	-19.418	23.061	14.161	-11.244

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