

To the Graduate Council:

I am submitting herewith a dissertation written by Ayoub Yousefi Asr entitled "The U.S. Dollar Exchange Value and Merchandise Trade Balances of Less Developed Countries: The Cases of Iran I.R. of, Venezuela, and Saudi Arabia." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Economics.

Paul Davidson
Paul Davidson, Major Professor

We have read this dissertation
and recommend its acceptance:

Don P. Clark
Wing Lung Chan
E. J. C. C. C.

Accepted for the Council:

Leuminkel
Associate Vice Chancellor
and Dean of The Graduate School

The U.S. Dollar Exchange Value and
Merchandise Trade Balances of Less Developed Countries:
The Cases of Iran I.R. of, Venezuela, and Saudi Arabia

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Ayoub Yousefi Asr

May, 1992

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

*In the Name of God
the Merciful
the Compassionate*

ACKNOWLEDGEMENTS

My endless gratitude and prayer to God for blessing me with the precious opportunity for pursuing my education.

This dissertation would have never been completed without the support, guidance, and encouragement of so many wonderful people to whom I would like to express my sincere thanks and appreciation.

I am grateful to professors Paul Davidson, Hui S. Chang, Don P. Clark, and George Philippatos, who have served on my doctoral committee. I am especially thankful to professor Davidson whose guidance and invaluable supervision made this dissertation possible.

I am thankful to Mrs. Elizabeth S. Weatherford for her editorial assistance and also to Mrs. Donna Kemper, the department secretary, for her assistance in preparation of the final copy of this dissertation.

Words can not express my hearty thanks and appreciation to my beloved family, my wife Mehnoush and my children Ali and Sara. My wife was an ultimate source of encouragement and support during my graduate study. It was her patience and inspiration that helped me to complete my doctoral work. Thanks to Ali and Sara, whose love kept me going.

ABSTRACT

There are only a few studies on the exchange rate responsiveness of developing countries' trade balances. These studies, however, focus on changes in the exchange rate of domestic currencies of these countries. Since LDCs' international trade is contracted and settled predominantly in terms of major currencies, the exchange rates among these currencies play a vital role in influencing these countries' balances of trade.

The present study examines the effects of changes in the effective exchange rate of the U.S. dollar on the merchandise trade balances of three oil exporting countries, Iran, Venezuela, and Saudi Arabia. These countries are chosen because their export revenues are almost entirely in dollars; therefore, the impact of changes in the exchange rate of the dollar on these countries' trade balances (in terms of dollars) is expected to be more substantial than on any other developing country's trade balance.

Within an exchange rate Pass-through model, both prices and quantities of traded goods of these nations are estimated by using quarterly data for the period of 1960 through the 1980s. The model allows i) changes in exchange rate of the dollar to affect price of traded goods, and ii) changes in price to influence quantity of traded goods. The model is

estimated over the fixed and floating rate periods. Some of the major conclusions of this study are:

1) Changes in the effective exchange rate of the dollar pass only partially into these countries' import prices. For instance, a 10 percent depreciation of the dollar during the post Bretton Woods period would have caused import prices expressed in dollars to rise by 7-8 percent, leaving 2-3 percent to be borne by exporters of non-dollar denominated commodities.

2) During the fixed rate period, export prices of these countries remained invariant with respect to changes in the exchange rate of the dollar. This result is consistent with the increase in output by international oil companies holding oil concessions in the Middle East during the 1960s and early 1970s. In contrast, under the floating rate system, this study found that a 10 percent depreciation of the dollar, for instance, caused export prices of Iran and Venezuela to rise by 25 and 22 percent, respectively, but Saudi Arabia's export price remained insensitive as during the fixed rate period. The export price elasticity figures, however, are greater than an adequate price adjustment to provide constant purchasing power to Iran and Venezuela. Saudi Arabia, on the other hand, absorbs fluctuations in the exchange rate of the dollar by keeping its export price constant. Consequently industrial countries have shifted their demand away from Iran and Venezuela in favor of Saudi Arabia whenever there has been a

rise in price of oil. This country's price moderation policy is consistent with its market expansion for revenue maximization purposes. This policy of Saudi Arabia's is a reflection of its economic and financial conditions such as oil reserve potentials, financial reserves, as well as long-run surplus in trade balance. However, our results suggest that Saudi Arabia has been neither a "perfect competitor" nor a "dominant producer" within OPEC.

3) With regard to these countries' export price/quantity strategies, the results indicate that Iran and Venezuela are primarily price maximizers, while Saudi Arabia is concerned more with its market share, an outcome consistent with the "absence of a unified OPEC policy" view.

4) While changes in exchange rate of the dollar do influence these countries' trade balances in terms of the U.S. dollar, each country's trade balance follows different adjustment patterns under the fixed and flexible exchange rate regimes. Specifically, responses of trade balances to changes in exchange rate of the dollar are not identical among the group countries.

In fact, the group countries are different not only in their resource endowments, economic positions or political views, but also in the facts that i) their export prices of oil respond differently to the changes in exchange rate of the dollar and ii) the price of oil, to some degree, is reflective of these countries' domestic price levels. Based on the

results of this study we put forward policy implications as follows:

1) A fixed exchange rate system can secure relatively stable import prices for the group countries as well as stable costs of oil-import for industrial countries. Alternatively, indexation of the price of oil to a market basket of major currencies would ensure stable energy costs in oil-importing countries. Such a policy, however, may not be consonant with U.S. and Saudi Arabian economic interests.

2) Despite Saudi Arabia's power to influence market price of oil, other members of OPEC such as Iran and Venezuela could counteract Saudi's unilateral oil production decisions by reducing their market shares.

3) Given the current state of world economy, any coordinated attempt by OPEC members to regulate output in order to raise prices excessively would further worsen the world economy. However, such an attempt is highly unlikely in the near future.

4) Restrictive policies by industrialized nations that directly or indirectly dampen demand for oil from OPEC will put pressure on these countries' demand for manufactured commodities from industrial countries.

TABLE OF CONTENTS

Chapter	Page
I Introduction	1
I.1 An Overview	1
I.2 Invoice Currency and the Role of the U.S. ✓	
Dollar	12
I.3 Selection of the Study Group Countries	
Based on Invoice Currency	23
II Literature Review.....	27
II.1 Single Import Demand Equation.....	28
II.1.1 Single Import Demand Equation	
Without an Exchange Rate	29
II.1.2 Single Import Demand Equation	
With an Exchange Rate	32
II.2 Direct Relationships Between Trade	
Balance, or Balance of Payments and	
Some Explanatory Variables	34
II.2.1 Elasticity Approach	35 ✓
II.2.2 Absorption Approach	38 ✓
II.2.3 Monetary Approach	40 ✓
II.2.4 Empirical Investigations	41
II.3 Import and Export Prices and Exchange	
Rate Pass-through Effect	46
II.4 Currency Invoicing of International	

Contracts	52
II.5 Investigations on LDCs' Trade Flows	56
III The Model and Estimation Methodology	61
III.1 Introduction	61
III.2 The Model	62
III.3 Simultaneity Problem	64
III.4 Exchange Rate Pass-through	69
III.5 Relative Prices	87
III.6 Static vs. Dynamic Models and Lag Structure.....	91
III.7 The Effective Exchange Rate of the U.S. Dollar.....	98
IV Discussion of the Empirical Results	104
IV.1 Iran	104
IV.2 Venezuela	128
IV.3 Saudi Arabia	144
IV.4 Comparison	164
V Summary and Policy Implications	180
REFERENCES	192
APPENDICES	203
Appendix A:	204
Appendix B:	205
Appendix C:	207
VITA	209

LIST OF TABLES

Table	Page
1. Currencies Used in World Trade (percent)	14
2. International Use of Currencies (percent, 1979 weights)	15
3. Currency of Trade Invoicing in Six Major Industrial Countries in 1988 (percent)	16
4. Exports and Imports of Fuels (percent of total)	21
5. Share of National Currencies in Total Identified Official Holdings of Foreign Exchange, End of Selected Year, 1976-1983 (percent)	22
6. Export of Fuels, (percent of total, 1968-1985)	24-5
7. Import and Export Pass-through Sensitivity to Estimation Sample Period (percent)	51
8. Iran, Import (60:I-86:III)	105
9. Iran, Import (60:I-71:III)	107
10. Iran, Import (71:IV-86:III)	108
11. Iran, Import (60:I-80:III)	109
12. Iran, Export (60:I-85:IV)	119
13. Iran, Export (62:I-71:III)	121
14. Iran, Export (71:IV-85:IV)	122
15. Venezuela, Import (60:I-86:III)	129
16. Venezuela, Import (60:I-71:III)	130
17. Venezuela, Import (71:IV-86:III)	131

18. Venezuela, Oil-Export (60:I-86:III)	135
19. Venezuela, Oil-Export (62:I-71:III)	137
20. Venezuela, Oil-Export (71:IV-86:III)	138
21. Saudi Arabia, Import (60:I-86:III)	145
22. Saudi Arabia, Import (60:I-71:III)	146
23. Saudi Arabia, Import (71:IV-86:III)	147
24. Saudi Arabia, Export (63:I-85:IV)	150
25. Saudi Arabia, Export (62:I-71:III)	151
26. Saudi Arabia, Export (71:IV-85:IV)	152
27. Market Share	
(Crude Oil Production Percentage of OPEC)	154
28. Crude Oil Reserves (Percentage of OPEC Reserves) ...	155
29. Total Reserves Minus Gold	
(Millions of U.S. Dollars, end of Period)	158
30. Trade Balance (Millions of U.S. dollars)	160
31. Estimates of the Long-run Exchange Rate	
Elasticities of Import and Export Prices	165
32. Percentage Change in Import and Export	
Prices from a 10 Percent Dollar Depreciation	167
33. Estimates of the Long-run Price Elasticity	
of Demand for Imports and Exports	170
34. Real Income Elasticities of Demand for	
Imports and Exports	174
35. The Long-Run Import Price Elasticity of	
Industrial Countries' Wholesale Prices	176
36. Ratio of Imports to GDP	177

37. The Long-Run Export-Price Elasticity of	
Domestic Wholesale Price	178

LIST OF FIGURES

Figure	Page
1. The G-10 trade-weighted index value of the U.S. dollar	6
2. Units of the Deutsche mark per U.S. dollar	7
3. Units of Japanese yen per U.S. dollar	8
4. Units of the Pound sterling per U.S. dollar	9
5. Units of the Canadian dollar per U.S. dollar	10
6. The G-10 trade-weighted index value of the U.S. dollar and the nominal U.S. trade deficit (billions of U.S. dollars)	71
7. The exchange rate of the U.S. dollar and Iran's import unit value index	75
8. The exchange rate of the U.S. dollar and Venezuela's import unit value index	76
9. The exchange rate of the U.S. dollar and Saudi Arabia's import unit value index	77
10. The exchange rate of the U.S. dollar and Iran's export unit value index	80
11. The exchange rate of the U.S. dollar and Venezuela's export unit value index	81
12. The exchange rate of the U.S. dollar and Saudi Arabia's export unit value index	82

13. The graphic performance of the	
"PROC EXPAND PROCEDURE" (1980=100)	206

CHAPTER I

INTRODUCTION

I.1 An Overview

The adjustment pattern of a nation's trade balance in response to changes in its exchange rate is one of the prominent theoretical issues in the international trade literature. In the past, a substantial number of empirical studies have been devoted to the examination of the impact of changes in exchange rate on industrialized countries' merchandise trade balances. In contrast, there are only a few studies on the exchange-rate responsiveness of developing countries' trade balances. These studies, however, focus on changes in exchange rates of domestic currencies of these countries. A serious drawback with these studies is the fact that they fail to recognize the impact of variations in the exchange rates between the major currencies on developing countries' trade flows. In fact, since Less Developed Countries' (LDCs) international trade is contracted and settled predominantly in terms of major international currencies, the exchange rates between these currencies play a critical role in influencing these countries' trade balances. The significance of the exchange rates between the major currencies is better understood when the invoicing

currency of exports from developing countries is taken into account.

The present study is an effort to examine the effects of changes in the effective exchange rate of the U.S. dollar on the merchandise trade balances of three oil exporting countries, Iran, Venezuela, and Saudi Arabia.¹ These countries have been chosen because their export revenues are almost entirely in dollars.

The preeminent issue of the effect of exchange rate changes on a nation's trade balance has long been discussed in the literature. According to the standard textbook view, a depreciation of the deficit nation's currency vis-a-vis a trade-partner's currency immediately raises the relative price of imports with little or no decline in volume. Therefore, the trade balance initially deteriorates. But, over time, it is expected that the trade balance will improve as import volume declines significantly due to the higher prices of imports at home, and as exports rise because of their lower prices abroad. More specifically, improvement requires price elasticities of demand for imports and exports sum to greater than unity.² Thus, if in the medium and/or long run the

¹ All mentions of Iran refer to the Islamic Republic of Iran.

² A rule of elasticity conditions under which changes in a country's exchange rate improve its trade balance came to be known as the "Marshall-Lerner condition." This criterion will be discussed in more detail later in this chapter.

elasticity condition is met, the volume effect comes to dominate the relative price effect and the trade balance shows an improvement. This pattern of trade balance adjustment is commonly referred to as the "J-curve effect," the letter J being the graphic representation of the time path of movement in the nominal trade balance.

The J-curve phenomenon is, however, subject to some qualifications. Stephen Magee in his 1974 contribution to the literature provides a much broader view of the trade balance adjustment.

(referred to as the "J-curve" in the press is not a theoretical inevitability. For example, if the U.S. import contracts are denominated in dollars and U.S. exports are denominated in foreign currency, the U.S. trade balance would increase rather than decrease immediately following a devaluation of the dollar, and the J-curve would not appear. The reason is that the value of U.S. import contracts would remain constant in dollars; however, since devaluation implies a higher dollar value of foreign currency, outstanding U.S. exports contracted in foreign currency would yield a higher price in dollars. The J-curve result--that is, an immediate decline in the trade balance following a devaluation--will always ensue if the proportion of contracts denominated in foreign currency is higher for imports than for exports (given an initial trade deficit)

As clarified by Magee, the currency denomination of import and export contracts is one crucial determinant of the effect of exchange rate changes on the trade balance. If an exporter or importer uses a foreign currency in his foreign trade contracts, then his income or costs in terms of domestic currency will be immediately affected when the exchange rate changes. On the other hand, if he uses his own currency in

his contracts with foreigners, then a change in the exchange rate will have no effect on his income or costs. By the same token, on the aggregate level, the choice of currency in which trade contracts are agreed upon will determine the effect of changes in exchange rate on a nations' balance of trade.

For international trade, since much of the trade in primary commodities is denominated in U.S. dollar terms, changes in the value of the U.S. dollar against other major currencies will have influential effects on the world economy as well as on the U.S. economy itself. Not only is the impact of dollar fluctuations on the U.S. merchandise trade balance an important and still controversial issue, but it is also similarly important for the world economy in general.

Since LDCs' international trade is mainly settled by payments and receipts in terms of major currencies, with the U.S. dollar playing the most crucial role, much of their trade imbalance could be attributed to the fluctuations of the U.S. dollar against other major currencies. The impact, however, is expected to be more acute in the present flexible exchange rate environment than it was in the Bretton Woods era. The main reason for expecting such an effect is the hypothesis that the flexible exchange rate regime introduced some degree of exchange rate uncertainty into the international transactions environment. Evidently, during the upswing of dollar exchange rates, disbursements for U.S. dollar denominated imports such as crude oil and other primary

commodities lead to a higher payment in terms of a basket of other major currencies, creating a trade balance problem for developed nations and non-oil exporting LDCs alike. Likewise, during the downfall of dollar exchange rates, countries which are exporting dollar denominated commodities will suffer from a decline of their purchasing power in the international markets. Since the exchange rate behavior of the dollar is so vital, it is interesting to note its movements during the flexible rate period. The weighted average value of the dollar in terms of the currencies of other Group-of-Ten nations experienced sizable movements, e.g., uninterrupted appreciation since the beginning of the 80s through 1985:I, then a sharp decline till 1988:II (see Figure 1).³ In addition, Figures 2 through 5 illustrate the bilateral annual average nominal exchange rate of the U.S. dollar, defined as foreign currency units per dollar, against the Deutsche mark, Japanese yen, Pound sterling, and Canadian dollar for the 1960-1989 period.

From these figures some features are evident: First, the U.S. dollar exchange rate experienced more frequent variations and sometimes drastic changes during the floating exchange

³ This Index of the dollar exchange rate (foreign currency units per dollar) is a weighted average of bilateral exchange rates between the United States and the other Group-of-Ten countries (Canada, Belgium, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, and the United Kingdom). The weight for each of the 10 countries is the 1972-76 average world trade of that country divided by the average world trade of all 10 countries combined, with March 1973 equal to 100.

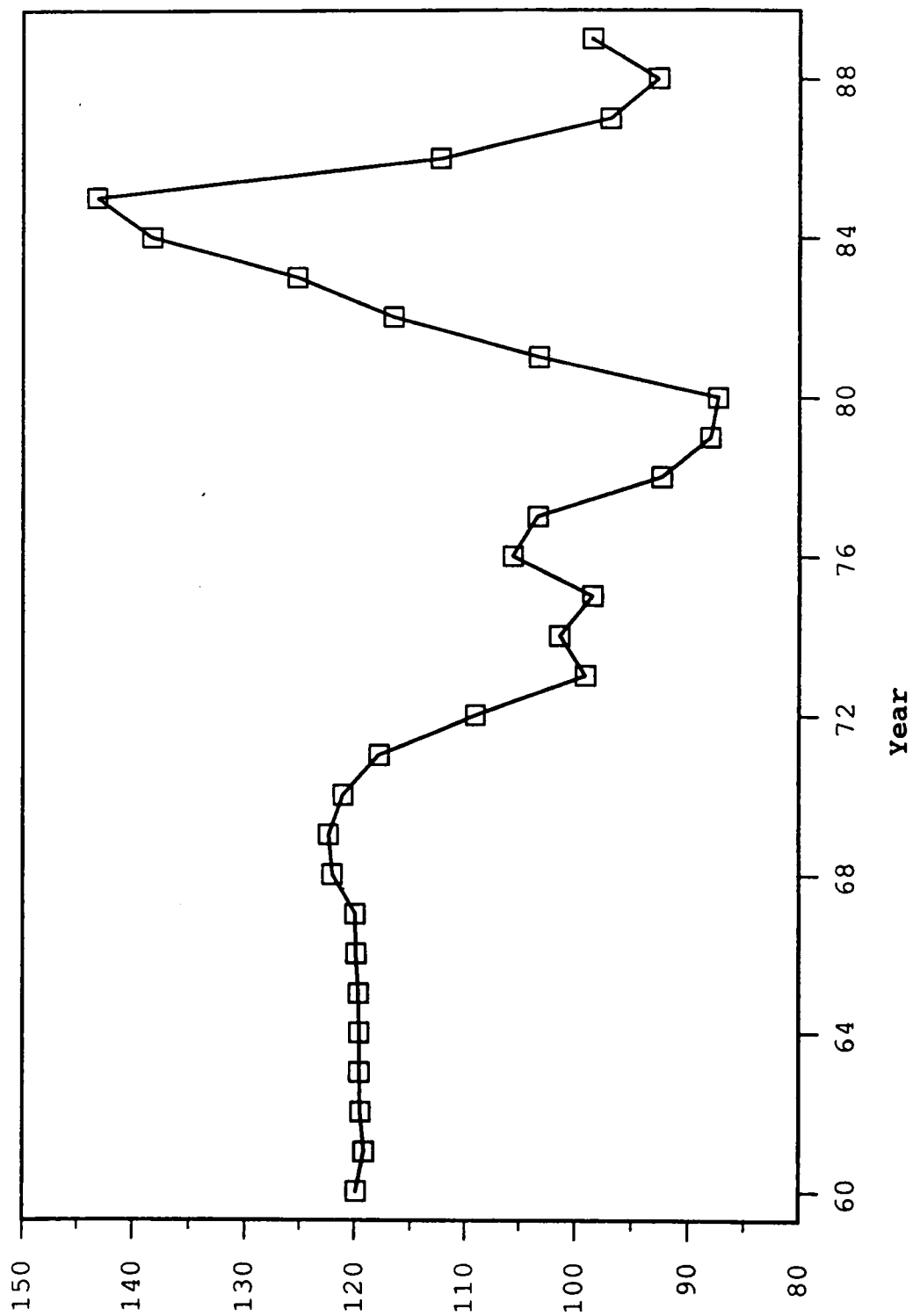


Figure 1. The G-10 trade-weighted index value of the U.S. dollar
(March 1973 = 100)

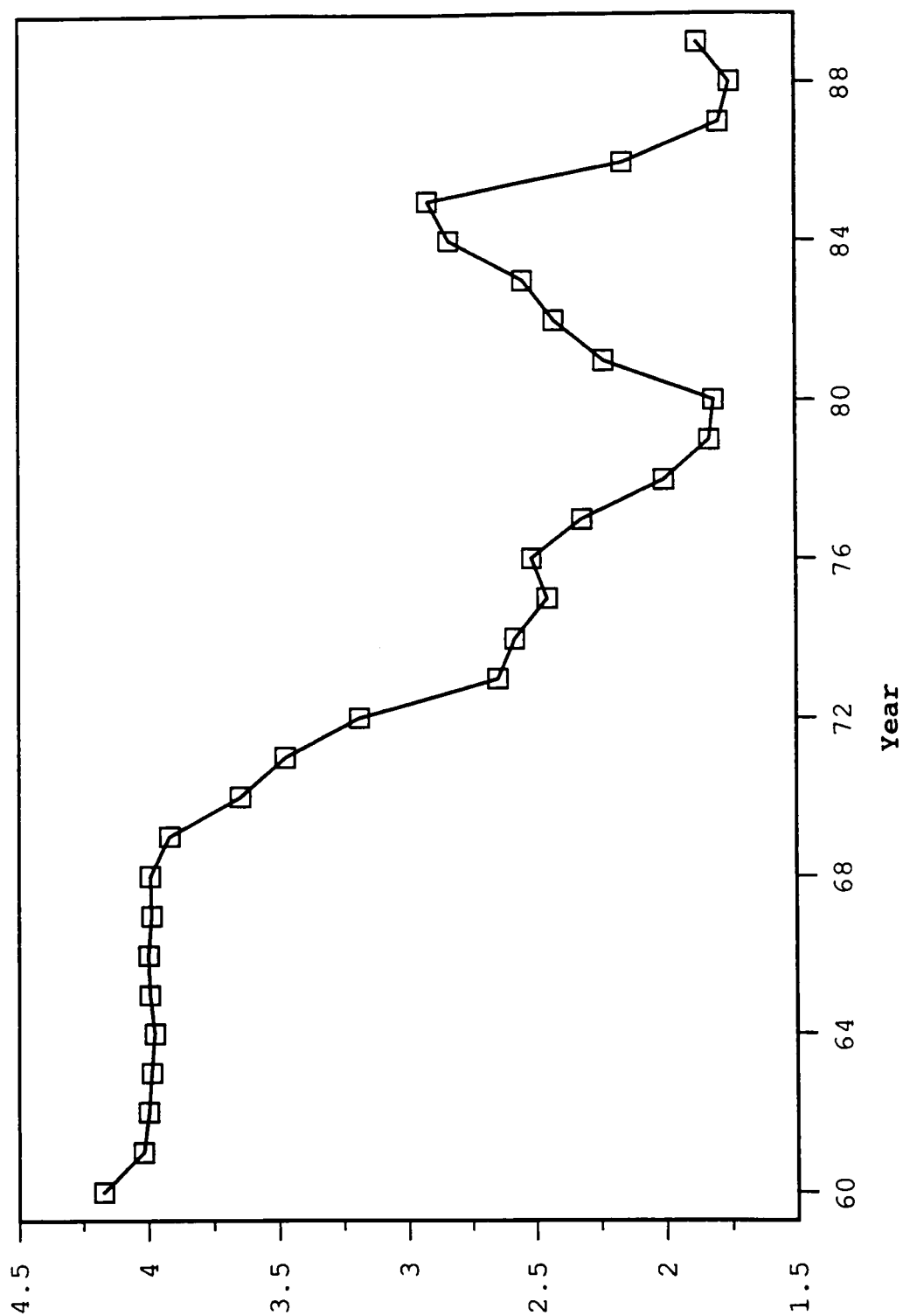


Figure 2. Units of the Deutsche mark per U.S. dollar
(Effective May 10, 1971, DM has been floated)

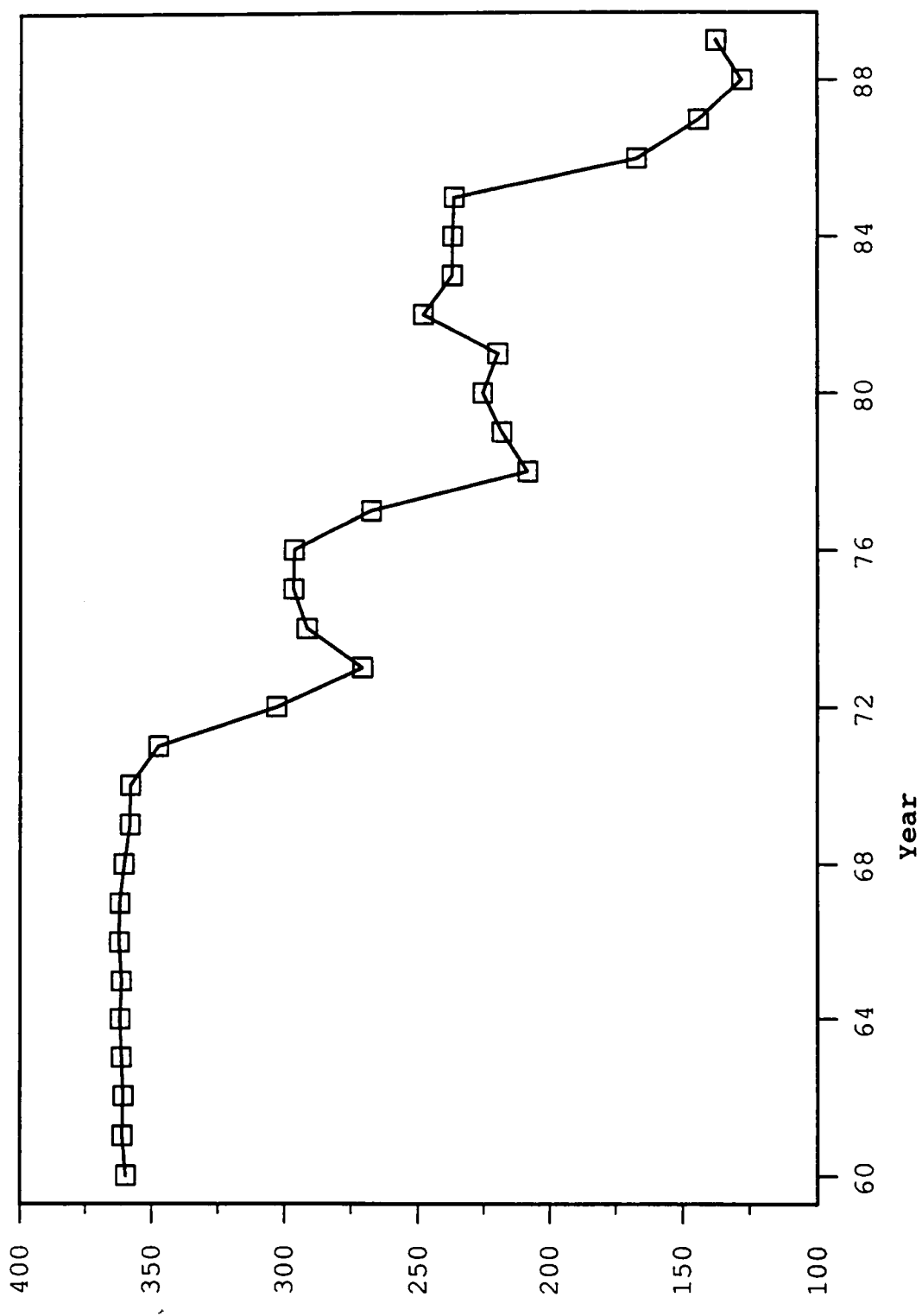


Figure 3. Units of Japanese yen per U.S. dollar

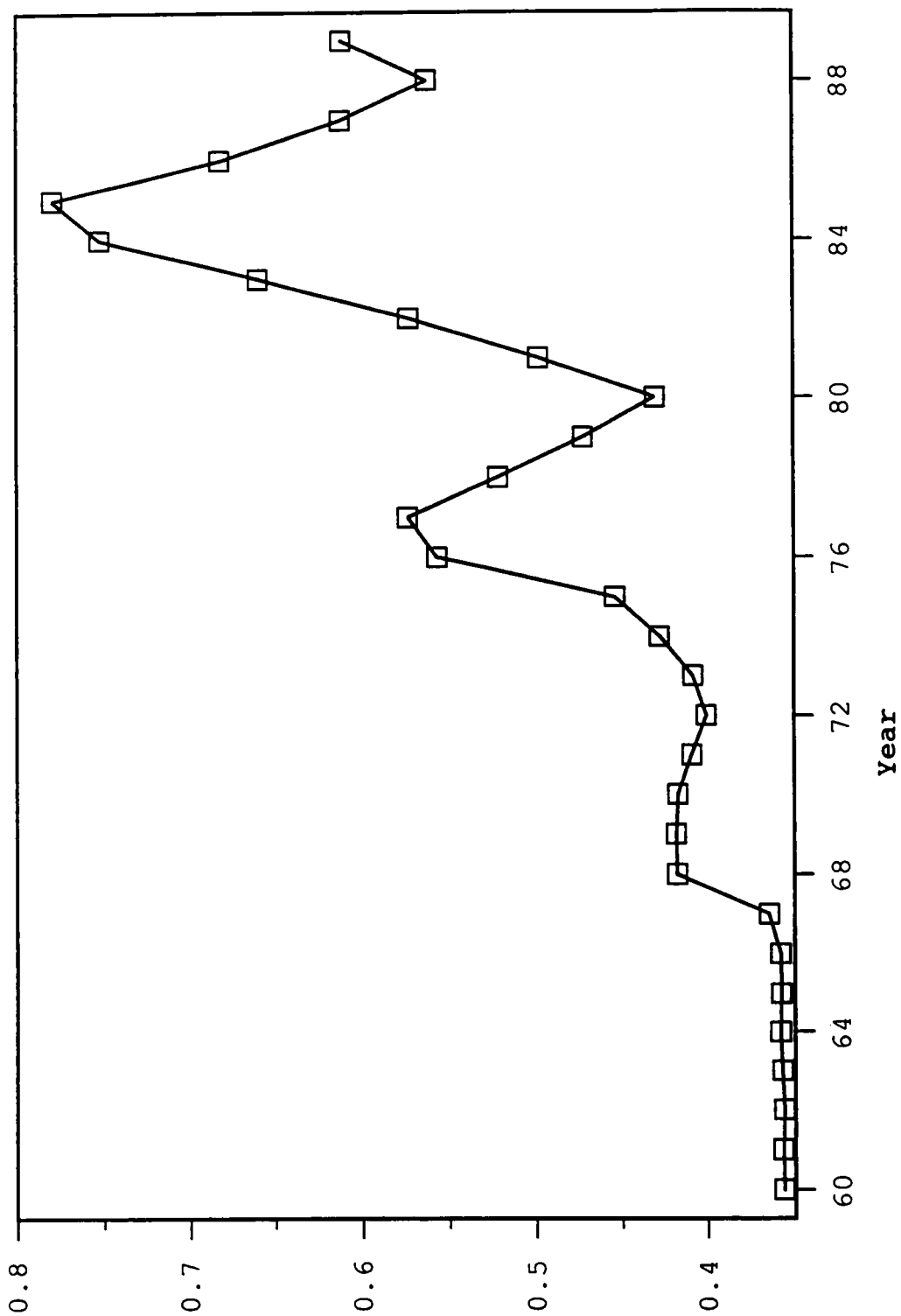


Figure 4. Units of the Pound sterling per U.S. dollar
(Effective June 23, 1972, the Pound sterling has been floated)

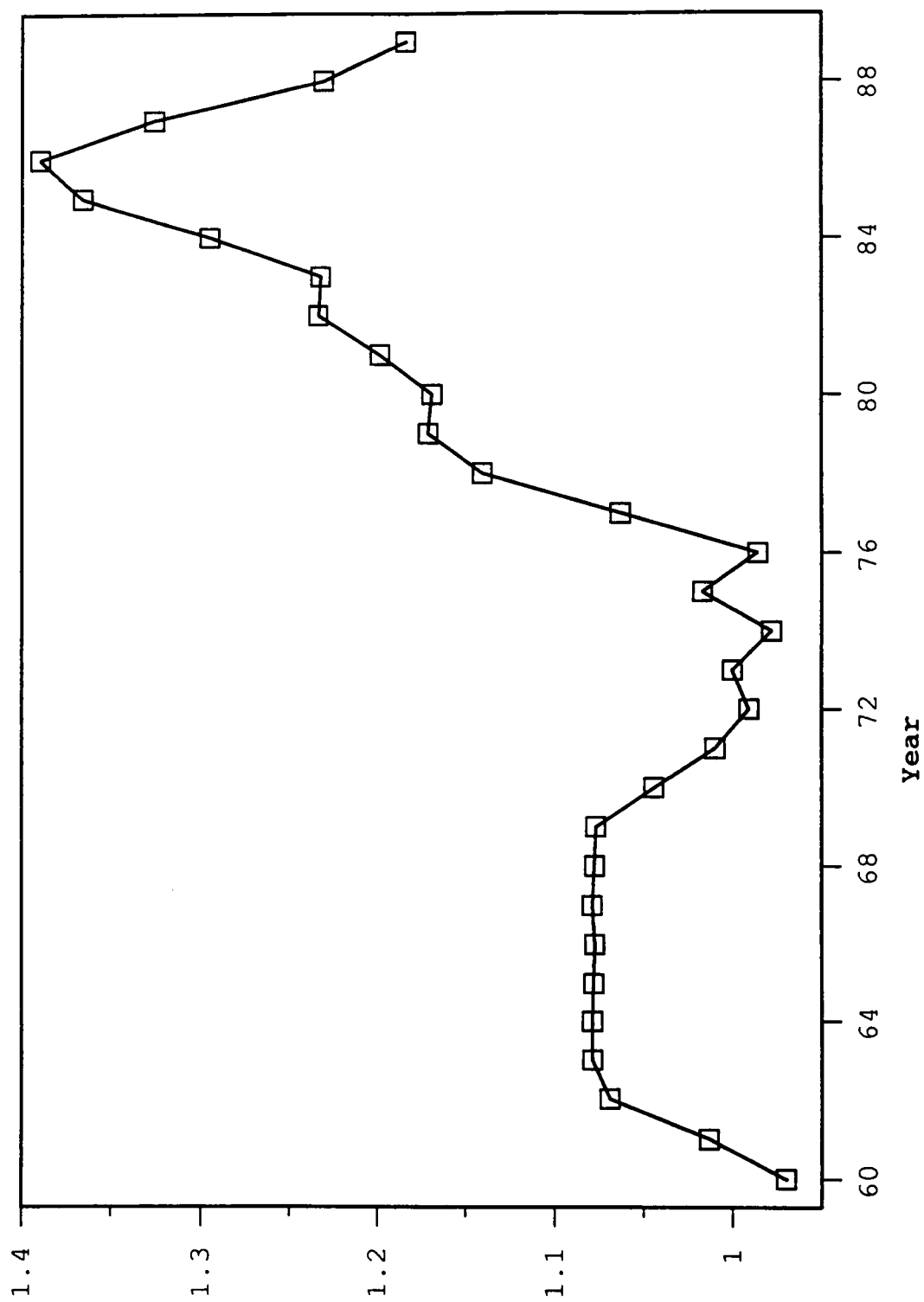


Figure 5. Units of the Canadian dollar per U.S. dollar

rate period than it did during the Bretton Woods era. Second, the U.S. dollar set a record of continuous appreciation against the Canadian dollar during 1976-1986 and against the Pound sterling and Deutsche mark during 1980-85. Moreover, the dollar has lost a significant amount of its value against the Canadian dollar since 1986, and against the Pound sterling, Deutsche mark, and Japanese yen during 1985-1988.

To summarize the arguments so far: C

1) Changes in the exchange rate of the U.S. dollar may partially affect the LDCs' trade balances by affecting import and export prices.

2) These changes may induce exporters in developing countries to alter their export prices in order to avoid, at least partially, declines in their export earnings.

3) Import and export prices of these countries have been less responsive, if any at all, to changes in the exchange rate of the dollar during the period of the fixed exchange rates regime than the period of floating exchange rates.⁴

These issues will be developed in more detail and will be embodied in a model in Chapter 3. The timing and magnitude of the effect of changes in exchange rate of the dollar on prices

⁴ Despite the primary focus of this study on the effect of U.S. dollar fluctuations on the LDCs' trade balances, sources responsible for dollar fluctuations such as exchange rate expectations, capital control, monetary policy, etc., are precluded. In other words, changes in the dollar's value will be considered as exogenous to the economy of LDCs.

and quantities of imports and exports, then, will be estimated in Chapter 4.

1.2 Invoice Currency and the Role of the U.S. Dollar

In the absence of an international money, international contracts must be denominated in terms of the domestic currency of some nation. In the case of many standardized commodities, e.g. oil, agricultural products, minerals, etc., international contracts are almost universally denominated into a single currency (e.g. the U.S. dollar) independent of the nation of residency for buyer and seller. The currency denomination of international contracts, however, has not been given adequate attention in the analysis of international trade flows.⁵ It was not until early in the 1970s that most European countries began to collect data on invoicing. Today, information is available for most European countries and for Japan. There is, however, little reliable information for the rest of the world, including the United States.

The invoicing currency for the European countries and Japan, and estimates for the other countries have been

⁵ Systematic investigation of the currency denomination of international contracts is relatively new. Having been pioneered by Sven Grassman's study for the Swedish economy late in 1960, McKinnon (1979) provided a theoretical explanation for the choice of invoicing currency. McKinnon's theoretical hypotheses were followed up with two empirical investigations: 1) for the United Kingdom, Carse, Williamson, and Wood (1980) and 2) for Italy, Basevi, Cocchi, and Lischi in Hodgeman and Wood (ed.) (1987).

tabulated by Page (1981, Tables 1 and 2). In addition, data on the invoicing currency of trade for six major industrialized countries in 1988 have been compiled by Tavlas and Ozeki (1991, Table 3). There are some features of currency invoicing of trade which are worth noting:

1) For almost all of the countries listed in Table 1, the share of own currency for exports is greater than the corresponding figure for imports (see columns 5 and 10). This phenomenon could also be observed from the 1988 data (Table 3, columns 1 and 3). Although both importers and exporters prefer their own currencies in invoicing traded goods, in reality, it is the seller who takes the initiative and decides in which currency to invoice its products. The sellers calculate their export prices and submit pro forma invoices in terms of their currencies to the buyers. The conveniences as well as benefits of avoiding foreign exchange uncertainty inherited in this practice clarify the exporter's strong tendency in favor of invoicing in their own currencies.⁶

2) The share of each country's currency in world trade

⁶ Contrary to the common belief that places a strong emphasis on tradition as being the dominant factor in selecting a currency of invoicing, Sultan (1986) conducted an investigation to ascertain the true determinants of the choice of a particular currency. Based on a risk minimizing firm model and using data from 14 OECD countries, he concludes that the importer's tendency to accept contracting in the seller's currency could be explained by his market power to raise the domestic price of the imported goods should its home currency depreciate. Such a hedging against changes in exchange rates does not exist for exporters, as their cost of production is fixed in terms of their domestic currency.

Table 1. Currencies Used in World Trade
(percent)

	Year	Share of each country's Exports in					Share of each country's Imports in				
		Dollars (1)	DM (2)	Sterling (3)	French francs (4)	Own (5)	Dollars (6)	DM (7)	Sterling (8)	French francs (9)	Own (10)
Austria	1978	10.4	24.2	2.0	1.2	51.9	17.0	39.4	2.3	1.8	25.1
Belgium	1979	12.5	17.9	2.6	13.0	42.2	23.4	18.3	4.9	10.5	28.4
Denmark	1979	16.0	12.0	8.0	1.3	51.0	27.0	17.0	5.0	1.9	27.0
Finland	1977	27.2	9.4	9.9	2.8	2.4	56.1	9.7	6.2	1.0	2.7
France	1979	11.6	10.2	3.2	62.4	62.4	28.7	14.1	3.8	35.8	35.8
Germany	1980	7.2	82.3	1.5	2.8	82.3	33.1	42.8	3.1	3.3	42.8
Ireland	1981	21.9	1.5	40.0	0.0	23.5	10.5	3.8	53.4	1.4	26.9
Italy	1976	31.1	21.5	2.7	6.4	31.3	50.6	20.2	5.1	6.8	9.1
Netherlands.. ..	1980	16.5	21.7	4.2	5.4	43.5	29.4	22.9	4.7	4.4	27.9
Norway	Estimate	28.0	9.0	22.0	1.0		30.0	12.0	12.0	3.0	
Sweden	1973	14.1	4.8	4.6	0.7	67.4	20.0	19.7	10.3	2.1	25.7
Switzerland . ..	1977	7.1	7.8		1.2	82.8	27.0	24.0	5.0	6.0	38.0
United Kingdom ..	1979	17.0	3.0	76.0	2.0	76.0	29.0	9.0	38.0	5.0	38.0
Other OECD Europe	Estimate	38.0	6.0	6.0	4.0		50.0	11.0	11.0	5.0	
Canada	Estimate	85.0	0.2	1.0	0.1		95.0	1.0	2.0	1.0	
United States ..	Estimate	98.0	1.0	1.0		98.0	85.0	4.1	1.5	1.0	85.0
Japan	1980	61.5	1.9	0.9	0.3	32.7	93.0	2.0	2.0	1.0	2.0
Australia	Estimate	70.0	1.0	1.0	1.0		52.0	14.0	9.0	4.0	
Centrally Planned	Estimate	67.0	13.0	5.0	2.0		58.0	13.0	4.0	6.0	
Oil Exporters ..	Estimate	100.0	0.0	0.0	0.0		50.0	10.0	8.0	7.0	4.0
Other Developing	Estimate	85.0	0.0	15.0	0.0		72.0	7.0	4.0	6.0	
Non-OECD	Estimate	85.0	2.0	7.0	3.0		52.0	14.0	9.0	4.0	
Developed											
World (1979 Weights)		54.8	14.4	7.5	6.1		54.3	13.9	6.9	6.4	

Source: Page (1981, P. 60).

Table 2. International Use of Currencies

(percent, 1979 weights)

	Country's share in world exports (1)	Currency's share in exports (2)	Cumulative Share of currencies (3)
Dollar ..	11.7	54.8	54.8
Deutsche mark ..	11.1	14.4	69.2
Pound sterl. ..	5.9	7.5	76.7
French franc ..	6.3	6.4(a)	83.1
Netherlands gu.	4.1	3.0(a)	86.1
Belgian franc	3.6	2.6(a)	88.7
Yen ..	6.6	2.3(a)	91.0
Swiss franc ..	1.7	2.1(a)	93.1
Lira ..	4.7	1.9(a)	95.0
Swedish krona ..	1.8	1.7(a)	96.7
Schilling ..	1.0	0.8(a)	97.5
Danish krone ..	0.9	0.8(a)	98.3
Irish pound ..	0.5	0.3(a)	98.6
Finnish markka..	0.7	0.0(a)	98.6

Reproduced from: Page, (1981, p. 61).

(a): use in own trade.

Table 3. Currency of Trade Invoicing in Six
Major Industrial Countries in 1988¹
(percent)

	Exports		Imports	
	National Currency (1)	Other (2)	National Currency (3)	Other (4)
France	58.5	41.0	48.9	49.8
Germany	81.5	18.0	52.6	44.9
Italy	38.0	62.0	27.0	73.0
Japan	34.3	65.7	14.1	89.6
United Kingdom	57.0	43.0	40.0	58.0
United States	96.0	3.0	85.0	12.0

Reproduced from: Tavlas and Ozeki (1991).

1) Data for German exports and Italian exports and imports are for 1987.

would equal the country's share in trade If i) each country used its own currency for denominating contracts for all its exports or for all its imports, or ii) domestic currency were used in equal proportions (50 percent) for each country's imports and exports. Table 1, however, shows that the U.S., German, and British shares of exports in their own currencies are greater than their share of imports in foreign currencies. For instance, the estimated figure of the share of U.S. exports invoiced in dollars is 98 percent, while the share of its imports invoiced in other currencies is only 15 percent, (1 - 85%). This implies that the U.S. dollar, Deutsche mark and pound sterling constitute higher shares in world trade. For countries with a high share in world trade, share of own currency in invoicing exports is very high (except for Japan and Italy). Specifically, only 2 percent of exports to Japan is invoiced in Yen, with 98 percent in terms of dollars.

3) In general, the currencies of large countries are used more than those of small countries in denominating international contracts. For instance, more than half of the world trade, 54.8 percent, is priced in dollars (Table 2, column 3).

4) Table 2 suggests that while total U.S. exports account for 11.7 percent of world exports, the dollar's share in world exports is 54.8 percent. Hence, if the dollar's share in world exports is adjusted for the U.S.' own exports, $[54.8 - (54.8 * 11.7\%)]$, 48.4 percent of the use of the U.S. dollar is

accounted for by its potential use as "third country currency," for this it is sometimes referred to as vehicle currency.⁷

5) A distinction, however, should be made between the use of the dollar as a "third country currency" by developing countries and among industrial countries. Many developing countries' currencies are inconvertible, which clearly limits their choice of currency of invoicing, as well as of international payments. In addition, the major portion of their exports, primary commodities, are invoiced in a particular currency, e.g. the U.S. dollar. These assumptions are used to derive the estimates of currency invoicing for developing and oil exporting countries in Table 1. For instance, exports from oil exporting countries are invoiced 100 percent in dollar terms (even greater than the corresponding figure for the U.S. itself, 98 percent), while only 4 percent of imports to these countries are invoiced in terms of their domestic currency. The function of the U.S. dollar in today's global economic system as a major currency for settlement of international contractual obligations could be viewed both from historical and economic perspectives. The U.S. dollar's importance can be traced to its emergence, after

⁷ Magee and Rao (1980) used a different terminology: "There are two types of currencies in the pricing of internationally traded goods: vehicle and non-vehicle currencies. Non-vehicle currency pricing occurs when the currency of the exporter or the importer is used; vehicle currency pricing occurs when a third currency is used."

World War II, as a primary instrument for international reserves and as a preferred mode of payment. Before World War I, the pound sterling was the dominant international currency. During the interwar period, this role was shared both by the dollar and pound. In the Bretton Woods period 1947-1972, most countries tied their currencies to the U.S. dollar. The United States, in turn, tied the dollar to gold. Until 1971, the United States allowed foreign monetary authorities to convert the holding of U.S. dollars into gold at the rate of \$35 per ounce. Consequently, the dollar became a critical source of international reserves. From an economic standpoint, the role of the U.S. dollar as a "third country currency," or international money, however, could be attributed to the following factors:

a) Reporting conventions influence the choice of invoice currency. The role of the dollar as a numeraire (or unit of account) in exchange rate markets and in trade reporting strengthens, as well as reflects, its role in world trade.

b) A number of LDCs have their currencies pegged to the U.S. dollar. That is, their currencies fluctuate with changes in the value of the U.S. dollar.⁸

c) The bulk of international trade, namely, crude oil,

⁸ As of September 30, 1990, there were 25 countries whose currencies were pegged to the U.S. dollar. Nevertheless, fixing the exchange value of the domestic currency to the U.S. dollar should not be taken as equal to being in a fixed exchange rate environment since the domestic currency varies as the dollar varies against other major currencies such as the DM or the Yen.

LDCs exports of non-oil primary commodities, and part of manufactured exports of the industrialized countries, are denominated in terms of the U.S. dollar. The most reliable data on invoice currency for trade can be found in the oil trade commodity group. Table 4 displays exports of fuels by oil exporting countries and its import by some of the LDCs in 1983.⁹

d) The U.S. dollar is the major currency used as an international reserve asset by most countries in the world (Table 5). Therefore, potential changes in the value of the dollar against other major currencies that are also used as reserves could lead to portfolio adjustments by central banks of nations.

In sum, the role of the dollar as a third country currency can be mainly attributed to economies of scale in foreign exchange markets, financial markets, etc. Because the dollar is the main currency used for international trade and investment and because it is also more liquid than any other currency, the dollar market for each currency is larger and much more well-organized than is the market between any other pair of currencies. This kind of market structure of exchange--using a vehicle currency such as the U.S. dollar--

⁹ Developing countries' use of the dollar as a third country currency accounts for two thirds of the dollar's role as a "third county currency," leaving one third to be explained by its role among other industrial countries Page (1981, p 61).

Table 4. Exports and Imports of Fuels
(percent of total)

Trade by Commodity Sections Exports of Fuels (percentage of total)		Trade by Commodity Sections Imports of Fuels (percentage of total)	
Algeria	98.3	Brazil	55.9
Angola	96.5	Chile	21.5
Congo	86.2	Greece	27.4
Ecuador	73.9	Guinea	29.2
Egypt	62.4	Guyana	39.4
Gabon	79.5	Honduras	22.4
Indonesia	76.4	India	21.3
Iran	97.5	Jamaica	23.5
Iraq	98.9	Korea	26.6
Kuwait	79.1	Mali	27.5
Libya	98.2	Morocco	27.5
Mexico	64.4	Pakistan	28.3
Qatar	92.8	Paraguay	27.2
Saudi Arabia	98.0	Philippines	27.5
Syrian Arab R.	68.8	Portugal	26.9
United Arab Em.	92.1	Sierra Leone	34.7
Venezuela	95.4	Sri Lanka	23.9
Yemen Arab Rep.	68.0	Sudan	21.4
Yemen P.D.Rep.	94.1	Thailand	24.2
		Togo	43.7
		Turkey	43.8
		Uganda	27.7
		Uruguay	36.1
		Zambia	42.7

Source: IMF, International Financial Statistics, Supplement on Trade Statistics, No.15, 1988.

Note: The year 1983 was chosen due to the availability of data for all countries in that year.

Table 5. Share of National Currencies in Total
Identified Official Holdings of Foreign Exchange,
End of Selected Year, 1976-1983
(percent)

	1976	1977	1978	1979	1980	1981	1982	1983
U.S. dollar	76.5	77.9	75.6	72.8	66.7	69.4	68.5	69.1
pound ster.	1.8	1.7	1.7	2.0	3.0	2.2	2.5	2.6
Deutsche mark	9.0	9.2	11.0	12.6	15.1	13.2	12.5	11.9
French franc	1.6	1.3	1.2	1.4	1.7	1.4	1.4	1.2
Swiss franc	2.3	2.4	2.3	2.7	3.2	2.8	2.7	2.4
Netherlands g.	0.9	0.9	0.9	1.1	1.3	1.2	1.0	0.8
Japanese yen	2.0	2.3	3.2	3.5	4.2	4.1	4.2	4.2
Unspecified	5.9	4.3	4.2	4.0	4.8	5.7	7.2	7.8
	---	---	---	---	---	---	---	---
	100	100	100	100	100	100	100	100

Reproduced from: Michael P. Dooley, "The Role of Reserves in the International Monetary System," in Michael Posner (ed.), Problems of International Money, 1972-1985, IMF, 1985, pp. 97-112.

Source: Various fund publications and fund staff estimates.

would certainly enhance efficiency by minimizing worldwide transaction costs.

I.3 Selection of the Study Group Countries

Based on Invoice Currency

As noted earlier, the impact of changes in exchange rates on a nation's trade balance depends crucially on the currency invoicing of international trade contracts. We also observed that information on the invoice currency of trade, specially for LDCs, is scarce. Hence, one way to deal with the problem of currency invoicing would be to study a selected group of countries whose invoicing practices of imports and/or exports are similar in terms of a certain currency. Among major commodity groups crossing national boundaries, petroleum's invoice currency is the most homogenous of all. Indeed, trade involving crude oil is invoiced entirely in terms of the U.S. dollar. Consequently, the share of oil in total exports is a distinct criterion that could pull together a group of LDCs, more specifically, oil exporting countries. The time series data on exports of fuels as percentages of total exports by OPEC and some non-OPEC countries are listed in Table 6.¹⁰ As

¹⁰ OPEC, the Organization of the Petroleum Exporting Countries, was formally organized in 1960 in order to promote cooperation among independent oil producing nations. OPEC's founding members, five of the principal oil-exporting countries, include Saudi Arabia, Iran I.R. of, Kuwait, Iraq, and Venezuela. Since 1960, eight other countries, Qatar, Libya, Indonesia, United A.E., Algeria, Nigeria, Ecuador,

Table 6. Export of Fuels
(percent of total, 1968-1985)

Y E A R	A l g e r i a	A n g o l a	C o n g o	E c u a d o r	G a b o n	I n d o n e s i a	I r a n	I r a q
68	-	-	2	1	35	41	89	-
69	-	-	1	0	35	47	89	-
70	-	-	1	0	42	33	89	-
71	75	20	1	1	45	40	87	-
72	82	27	5	18	32	51	88	6
73	83	31	33	3	43	50	90	6
74	93	52	69	62	69	70	97	20
75	92	52	73	60	83	75	97	34
76	94	-	75	59	79	70	98	34
77	96	-	55	50	82	68	98	99
78	86	66	63	46	73	69	-	99
79	98	72	85	76	78	65	94	99
80	98	78	90	63	88	72	93	99
81	98	82	80	62	83	80	93	98
82	98	94	84	64	85	82	97	99
83	98	97	86	74	80	76	98	99
84	98	-	-	70	-	72	-	-
85	98	-	-	-	-	-	-	-

Source: IMF, International Financial Statistics, Supplement on Trade Statistics, No. 4, 1982, and No. 15, 1988.

and Gabon, have been admitted as full members, bringing the total membership to thirteen. Nigeria (a member of OPEC), Norway, and Britain are not included in the list because the ratio of exports of fuels as a percentage of total exports is not available for Nigeria, and the ratios are relatively small for the other two countries.

Table 6. Continued...

Export of Fuels

(percent of total, 1968-1985)

Y E A R	K u w a i t	L i b y a	M e x i c o	Q a t a r	S a u d i A r a	S y r i a n A R	U n i t e d A E	V e n e z u e l a
-	-	100	3	-	100	-	-	-
69	-	100	3	-	100	-	-	-
70	94	100	3	-	100	-	-	-
71	95	100	2	100	99	24	96	92
72	94	100	1	97	98	18	96	90
73	92	100	1	97	99	22	97	93
74	95	100	4	98	100	55	99	95
75	92	100	16	97	99	70	98	95
76	90	100	16	99	100	65	97	94
77	88	100	24	-	100	61	95	95
78	89	100	29	97	99	63	95	95
79	89	100	44	95	99	72	-	94
80	89	100	67	-	99	79	-	94
81	84	100	72	-	99	79	-	93
82	77	-	77	-	99	77	-	-
83	79	98	64	93	98	69	92	95
84	83	-	62	-	-	63	-	-
85	-	-	-	-	-	-	-	-

Source: IMF, International Financial Statistics, Supplement on Trade Statistics, No. 4, 1982, and No. 15, 1988.

it is evident from this table, there have been, and there still are, countries such as Algeria, Iran, Libya, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela whose share of oil exports accounts for up to more than 90 percent of the their total exports during the last two decades. These countries therefore seem quite appropriate candidates for the purposes of this study. The selection of study group countries is limited further by lack of data series on variables of interest for some of these countries. Considering the data limitation, a subgroup of oil exporting countries is chosen by process of elimination. These countries, hereafter called "study group countries," are Iran, Saudi Arabia, and Venezuela. Although the group is limited to a small number of countries, it consists of three major oil exporting countries out of the five founding members of OPEC, two from the Middle East and one from the western hemisphere. The study of these countries' imports and exports responsiveness to changes in the exchange value of the U.S. dollar is expected not only to reflect their pricing/production strategies, but also to shed light on our understanding of OPEC pricing/production behavior as a whole.

CHAPTER II

LITERATURE REVIEW

This chapter identifies and evaluates briefly the major theoretical and empirical studies of nations' trade flows. The voluminous literature is classified primarily on the main points of interest of the present study.¹ In particular, we focus explicitly on the roles played by changes in the exchange rate of the U.S. dollar and invoicing currency practices in determination of countries' trade balances. In doing so, five different types of studies are identified and discussed below. Section II.1 describes a single import demand equation. Section II.2 represents direct relationships between trade balance, or balance of payments and some

¹ This effort is by no means an exhaustive review of the literature. The subject matter has been addressed through several survey articles in the past years. Goldstein and Khan (1985) provide a concise list of such empirical studies:

Trade surveys have appeared at least once every five years since 1959. Early (1936-57) estimates of income propensities and price elasticities have been surveyed and evaluated by Cheng (1959) and by Prais (1962). Early world trade models are discussed in Taplin (1973), and more recent multi-country models are compared and analyzed by Deardorff and Stern (1977) and by Fair (1979). Special mention should be made of the comprehensive trade surveys of Leamer and Stern (1970), Magee (1975), and Stern et al. (1976). The Leamer and Stern (1970) book has, among other things, a lucid discussion of the time-series estimation of import and export demand relationships.

explanatory variables. Section II.3 summarizes a category of studies which account for foreign suppliers' pricing behavior in response to changes in exchange rate (exchange rate pass-through effect). Section II.4 is a brief review of theoretical studies and empirical investigations on currency invoicing practice and its impact on a nation's balance of trade. Finally, section II.5 is a review of investigations on LDC's trade flows.

II.1 Single Import Demand Equation

There is a substantial number of studies which are devoted to the analysis of import demand behavior. Traditionally, an aggregate import demand function is estimated based on two key explanatory variables, i.e, real GNP and the ratio of import prices to domestic prices.² Since 1971:I introduction of the floating exchange rates, demand equations without an exchange rate variable were no longer considered as a complete model for analyzing trade flows. In the following, we address studies of single import demand equations with and without an exchange rate variable:

² For instance, Kreinin (1967, 1973), Price and Thronblade (1972), and Khan and Ross (1975) are only a few examples of such traditional studies which are conducted within the fixed rate environment. In addition, Magee and Houthakker (1969) and Khan (1974) adopted a different approach toward analyzing nations' trade flows by modeling and examining the import demand as well as demand for export equations.

II.1.1 Single Import Demand Equation Without an Exchange Rate

Thursby and Thursby (1984) conducted extensive investigations to determine which of the frequently used single-equation models of import demand generate unbiased (or at least consistent) and efficient elasticity estimates. They started with an aggregate import demand equation of the following form:

$$Q = f(P, Y) \tag{1}$$

where

Q = quantity of import demanded,
P = price of imports relative to all other goods, and
Y = income or activity variable.

Nine different variants of <1> were estimated for each of the five industrial countries (Canada, Germany, Japan, the United Kingdom, and the United States). The study covers some years of the fixed rate system plus the first few years of the floating rate regime, i.e., Canada (1957:I-1977:IV), Germany (1960:I-1978:II), Japan (1957:IV-1977:IV), United Kingdom (1957:I-1977:III), and the United States (1955:I-1978:I). The empirical examination of <1> is accomplished through estimation of 324 equations which are generated by permutations by functional form, lag structure as well as specification of relative price and scale variables. All of the models except one are estimated in two different forms: i) as models with constant coefficient parameters and ii) as

models which allow for the presence of possible structural shifts arising from changes in exchange rate regimes or from oil price shock. In addition, both the linear and double-log specifications of each model are estimated and each functional form is estimated by using two different measures of the dependent variable and three different measures of the price of all other goods (import substitute goods).³ Based on the estimation results, the majority of models which satisfy the unbiased and efficient elasticity criteria are dynamic models. That is, except for Canada, the majority of accepted models involved a log specification. These models include lagged values of the dependent variable as independent variable, implying a geometric lag adjustment of the quantity of imports to changes in income and prices, as in

$$Q_t = f(P_t, Y_t, Q_{t-1}, D_{72} \text{ or } D_{74}) \quad <2>$$

where D is a dummy variable beginning in the indicated year. However, models such as <1> (with no lag adjustment) and Almon lag models yield unsatisfactory results. Among the conclusions of the Thursby and Thursby study, the most important one suggests that results concerning functional

³ The measures of dependent variable are the import quantity index (1970=100) and the real value of imports computed as the ratio of the nominal value of imports relative to the price of imports. The measures of domestic prices are the implicit price deflator, the wholesale price index and the consumer price index. The results obtained from the alternative measures of dependent variables do not appear to be significantly different from each other; also, 60 percent of the models which produce expected coefficient estimates use the wholesale price index (WPI) as a deflator of import price index.

form, structural shifts, and measures of variables vary from one country to the other. That is, import demand functions differ among countries in way more fundamental than in simple parameter differences.

With regard to the specification of the relative price variable, Thursby and Thursby's findings are consistent with those of Murray and Ginman (1976). Both sets of investigations reject the homogeneity assumption--the assumption that constrains the import demand elasticity with respect to import prices to be equal in magnitude but opposite in sign to the elasticity with respect to domestic prices. That is, the import demand equation found to yield better results according to the criteria indicated earlier when in the following functional form:

$$Q_t = f(P_{1t}, P_{2t}, Y_t, Q_{t-1}, D_{72} \text{ or } D_{74}) \quad <3>$$

where P_1 is the price of imports and P_2 is the price of other goods in the home country.

The studies mentioned, including Thursby and Thursby, however, have one thing in common: They do not incorporate an exchange rate variable in the demand equations to be estimated. The absence of an exchange rate from the models is a major shortcoming on both theoretical and empirical grounds. Although it is widely accepted that the floating rate mechanism introduced a new element of uncertainty into international transactions, such uncertainty was not completely absent at the time of the Bretton Woods system.

Indeed, during the Bretton Woods period, sizable (but not frequent) changes in exchange rates were not unusual phenomena.

II.1.2 Single Import Demand Equation With an Exchange Rate

Since the 1971:I introduction of the floating exchange rates, the exchange rate became an essential determinant of nations' trade flows. Warner and Kreinin (1982) examined the conventional income and price variables, and, especially, the effects of variations in the exchange rate on real trade flows.⁴ They modeled and estimated demand for import and export equations for 19 industrial countries as well as 18 other (mainly developing) countries for the 1957:I-1970:IV and 1972:I-1980:IV periods. The structure of their study is much more enhanced than were previous studies, as it allows for a lag structure on the exchange rate as well as on domestic and import price variables. Among different import demand equations estimated by Warner and Kreinin we explain the more general ones:

$$\text{LnM} = \alpha_0 + \alpha_1 \text{LnY} + \alpha_2 \text{LnPD} + \alpha_3 \text{LnPM} \quad <4>$$

Period I: 1957:I-1970:IV

$$\text{LnM} = \beta_0 + \beta_1 \text{LnY} + \beta_2 \text{LnPD} + \beta_3 \text{LnPM}^{\text{FC}} + \beta_4 \text{LnE}, \quad <5>$$

⁴ Studies such as Junz and Rhomberg (1973), Hooper and Kohlhagen (1978), Wilson and Takacs (1979), and Bahmani-Oskooee (1984, 1986) also incorporated an exchange rate variable in import and export demand equations.

Period II: 1972:I-1980:IV

and also demand for exports function:

$$\ln X_i = \gamma_0 + \gamma_1 \ln Y_{wi} + \gamma_2 \ln P_{xi}^{L.C.} + \gamma_3 \ln E_i + \gamma_4 \ln E_i^P + \gamma_5 \ln P_{copm.}^{F.C.} \quad <6>$$

where

- M = volume of Imports,
- Y = real GNP (M and Y are computed on a per capita basis),
- PM = import prices,
- PD = domestic wholesale prices,
- E = nominal exchange rate,
- X_i = the volume of the country i's exports,
- Y_{wi} = the weighted average GDP of 23 major importing countries from country i,
- $P_{xi}^{L.C.}$ = the export unit value index of country i,
- E_i = the effective exchange rate index of country i's currency,
- E_i^P = the expected rate of change in the exchange rate, and
- $P_{copm.}^{F.C.}$ = the average export price of 64 competing countries expressed in foreign currency.

In addition to other conclusions which will be referred to later in this study, results derived from the estimates of exchange rate variables suggest:

1) The introduction of floating exchange rates affects the volume of imports in several major countries, but the direction of change varies among them.

2) The exchange rate and the export prices of competing countries are powerful determinants of a country's exports.

With regard to the models explained so far, some objections are in order: a) These models emphasize the estimation of import demand relationships but do not deal with the reactions of foreign suppliers to changes in exchange rate

and to the impact of their behavior on import and export prices. During the 1950s and 1960s this practice was not considered a serious problem on the grounds that prices and exchange rates were, to a considerable extent, stable, but it has become a major drawback under the current floating exchange rate regime. b) In these models, it is an implicit assumption that trade contracts are agreed upon and also settled in terms of a single currency. Since such an assertion is not necessarily correct, misspecification of demand equations would be quite possible.

II.2 Direct Relationships Between Trade Balance, or Balance of Payments and Some Explanatory Variables

As opposed to the first category of studies which is mainly concerned with the estimation of import and export demand equations, other investigations have examined directly the relationships between trade balance, or balance of payments (as dependent variables) and some underlying explanatory variables. Balance of payments adjustment has been viewed from different perspectives--the elasticity approach, the absorption approach, the monetary approach, and their variants.⁵ The theoretical setting of these approaches as well as empirical investigations which are based on some

⁵ Anne O. Kruger (1983) presents a chapter surveying models of exchange rate and current account determination in conjunction with a payment mechanism.

combinations of these approaches are discussed below.

II.2.1 Elasticity Approach

The elasticity approach to balance of payments is one of the popular explanations of adjustments in trade balance following changes in exchange rate. Based on the elasticity approach, the necessary and sufficient conditions for an improvement in the trade balance following a devaluation are sufficiently large demand elasticities and sufficiently small supply elasticities. To elaborate this proposition briefly, let us start with a two-country model with two goods in which all cross price effects are ignored, and in which relative price is defined as

$$\% \Delta P^m = \% \Delta E + \% \Delta P^f \quad <7>$$

where

P^m = price of imported goods in terms of the home country's currency,
 E = home currency price of unit of foreign currency,
 P^f = price of foreign goods expressed in terms of foreign currency.

A devaluation of home currency raises the import price by the percentage change in the foreign exchange rate. But quantity of import demanded depends, among other things, on relative prices of foreign goods and goods produced at home, rather than on import prices alone. The relative price is simply defined as

$$p = E P^f / P^d \quad <8>$$

where P^d is the domestic currency price of goods produced at home. The relative price, p , plays a crucial role in the determination of output and the trade balance. A rise in the relative price implies that either domestic goods have become relatively cheaper, or import goods more expensive--the phenomenon referred to as a *terms of trade* deterioration. A rise in the relative prices is therefore expected to reduce imports and raise exports. That is,

$$M^f = M^f(p), (\sigma M^f / \sigma p > 0); M = M(p), (\sigma M / \sigma p < 0) \quad <9>$$

where

$$\begin{aligned} M^f &= \text{foreign demand for domestic goods,} \\ M &= \text{home demand for imports.} \end{aligned}$$

The foreign demand for domestic goods and home demand for imports are both defined as functions of the relative price. Therefore, the trade balance in terms of domestic goods, in its simplest form would be

$$TB = M^f(p) - pM(p). \quad <10>$$

In order to show the comparative static relationship between the trade balance and relative price, we take the derivative of <10> with respect to p :

$$dTb/dp = dM^f/dp - p dM/dp - M. \quad <11>$$

Since $\alpha^f = dM^f/dp \cdot p/M^f > 0$, $\alpha = -dM/dp \cdot p/M > 0$, assuming that trade is initially balanced, $M^f = PM$, it could be shown that

$$dTb/dp = M (\alpha^f + \alpha - 1). \quad <12>$$

Equation <12>, which is known as the Marshall-Lerner condition, implies that an increase in the relative price of

imports need not necessarily improve the trade balance unless $(\alpha^f + \alpha) > 1$. That is, an increase in the relative price of imports, caused by a devaluation, would cause exports to rise and imports in real terms to decline if the sum of the import demand elasticities exceeds unity. The conditions thus ensure sufficient a quantity response to offset the increased cost of imports brought about by higher prices of imports in terms of home currency. In fact, although devaluation could increase export earnings, it might not reduce total foreign exchange expenditures on imports if demand for imports is price-inelastic.

In general, with regard to the elasticity approach, two major criticisms are identified: 1) The assumption that supply schedules of both exports and imports are perfectly elastic is not warranted on theoretical grounds. The perfectly elastic supply schedule is assumed based either on underemployment in both home and foreign countries, or on an excess supply of nontradeable goods in the background that could provide a perfectly elastic supply of factors. These assertions, however, are subject to verification through empirical investigations. 2) The validity of the elasticity approach is doubtful when it is applied to the situation of a small country, a country defined as a price-taker in world markets for both its exports and imports. Clearly, for most small countries, one would expect the elasticity of demand for imports, α , not to exceed zero. Consequently, unless α^f

exceeds unity, devaluation would be subject to failure.

II.2.2 Absorption approach

It was after the Keynesian revolution that aggregate-demand analysis found its way into exchange-rate and balance of payments determination. Under the fixed exchange rate environment, for instance, the exchange rate seemed to be an instrument that could free the domestic economy from balance of payments constraints. At less than full employment, a country could properly maintain its external balance with expenditure-switching policies through exchange rate adjustment. Devaluation was then expected to change the terms of trade, switch expenditures from foreign to domestic goods, and improve the trade balance.

The absorption approach could be simply explained by a trade balance identity

$$TB = Y - A \quad <13>$$

where

Y = total production of goods and services,
A = total absorption.

As in the elasticity approach, the impact of exchange rate changes on the trade balance is indirect. Since absorption is a function of income, the impact of exchange rate changes on trade balance works through both income and expenditures. Also, changes in exchange rates could change the relationship between expenditures and income. In functional forms:

$$TB = f(Y, A, E) \quad <14>$$

while $Y = g(E)$, $A = h(E)$, and $A = l(Y)$

where

E = exchange rate of domestic currency.

Taking total derivatives of <14> yields

$$\begin{aligned} dTB/dE = \sigma_{TB/\sigma Y} \cdot dY/dE + \sigma_{TB/\sigma A} \cdot dA/dE \\ + \sigma_{TB/\sigma A} \cdot dA/dY \cdot dY/dE \end{aligned} \quad <15>$$

Consequently, the absorption approach to balance of payments adjustment leads to several fundamental questions: 1) How does the devaluation affect income? 2) How does a change in the level of income affect absorption? and 3) How does the devaluation directly affect absorption at any given level of income?

The questions surrounding the absorption approach have been subject to enormous empirical investigations in the past years. We discuss some of these investigations later in this chapter. Finally, it should be noted that the absorption approach is not by itself an exhaustive model of exchange rate and balance of payments determination. Given that the exchange rate is the price of foreign currency in terms of domestic currency, an entirely income-expenditure model of the effect of exchange rate changes, leaving out the supply of and demand for money, seems short of a complete model.

II.2.3 Monetary Approach

The third important approach to balance of payments adjustment incorporates real money balances into the model. The argument is that devaluation reduces the real value of cash balances, and thus improves both the trade balance and the balance of payments. In effect, it is the impact of changes in the real balances on the real output, employment, and real rate of interest that makes the real balance effect as important as in the two other approaches explained before. Despite the fact that the impact of changes in real balances on real variables of the economy and transmission mechanisms of such changes are controversial issues, neoclassical monetary models, one way or the other, assert that expenditures increase or decrease at any given level of income as desired cash balances fall short of or exceed actual money holdings. That is, excess demand for commodities is a decreasing function of the gap between desired and actual money holdings:

$$dE/d(M^* - M) < 0 \quad <16>$$

where

E_* = excess demand,
 M^* = desired nominal cash balances, and
 M = stock of money.

Since demand for nominal cash balances increases with the price level, which increases with the exchange rate, the gap between desired and actual money holdings would be an

increasing function of exchange rate:

$$d(M^* - M)/d(R) > 0 \quad <17>$$

where

R = exchange rate defined as price of foreign currency in terms of domestic currency.

Hence, excess demand declines (trade balance improves) following an increase in exchange rate. This relationship is expressed as:

$$dE/dR = dE/d(M^* - M) \cdot d(M^* - M)/d(R) < 0 \quad <18>$$

II.2.4 Empirical Investigations

In order to explore empirically the statistical relationship between trade balance and exchange rate, researchers have conducted investigations based on different combinations of the aforementioned approaches. The following is a selection of such investigations:

1) Miles's (1979) investigations of the relationship between trade balance and factors that affect domestic expenditure relative to domestic output is carried out in an absorption framework. His balance of payments model, on the other hand, is a monetary approach, concentrating on money supply relative to money demand. The relationships are shown as:

$$\begin{aligned} \Delta(TB/Y)_i = & \alpha_0 + \alpha_1 \Delta(g_i - g_r) + \alpha_2 \Delta(M_i - M_r) \\ & + \alpha_3 \Delta(G_i - G_r) + \alpha_4 \Delta ER_i \end{aligned} \quad <19>$$

and

$$\Delta(BP/Y)_i = \beta_0 + \beta_1\Delta(g_i - g_r) + \beta_2\Delta(M_i - M_r) + \beta_3\Delta ER_i \quad <20>$$

where

TB = level of trade balance, i = country i , and r = rest of the world,
 BP = level balance of payments,
 Y = level of output,
 g = growth rate of income,
 M = ratio of the average level of high-powered money to output,
 G = ratio of government consumption to output, and
 ER = exchange rate.

This model, indeed, in addition to providing a mechanism for assessing the J-curve phenomenon, reconciles the so-called elasticity, income-expenditure, and monetary approaches into a single equation. The statistical relationship between exchange rate and both the trade balance and the balance of payments is examined for 16 devaluations in 14 countries during the 1960s. The effect of devaluation alone is encountered by standardizing for the effects of other exogenous variables. By using seemingly unrelated and pooled cross-section time series regression techniques, Miles concluded that, i) devaluation does not improve the trade balance but improves the balance of payments, ii) adjustment following devaluation is of monetary nature. That is, while many have suggested that devaluation will be accompanied by changes in real variables such as the trade balance, Miles's study provides little evidence of such changes.

2) Bahmani-Oskooee's study (1984) is based on a simple trade balance relationship of the following form

$$TB = f (Y , E/P) \quad <21>$$

where

TB = trade balance,
Y = level of domestic real activities,
E = exchange rate, and
P = domestic price level.

He extends this relationship by incorporating world income (YW), the levels of high-powered money for the home country and for the rest of the world (M, WM), and exchange rate with a lag structure

$$TB = \alpha_0 + \alpha_1 Y_t + \alpha_2 YW_t + \alpha_3 M_t + \alpha_4 MW_t + \sum_{i=0}^n \beta_i (E/P)_{t-i} + \mu_t \quad <22>$$

where μ is a stochastic disturbance term.

Equation <22> then is applied to four developing countries, with quarterly data used on the relevant variables for the 1973-1980 period. The results obtained from this study indicate that the trade balances of all four countries first improve and then deteriorate, supporting a pattern of adjustment that resembles the "Inverse of the J-Curve." The long-run effect of devaluation, however, was found to be improving the trade balance of only one country.

3) Koch and Rosensweig's study (1990) is an effort to find out the reasons for the delay in expected improvement in the U.S. nominal trade deficit after the dollar's drastic decline from its February 1985 peak. This study tries to identify the channels through which changes in dollar value affect the U.S. trade balance. The study therefore specifies an underlying structure that decomposes the trade balance into four components

$$TB = P_x \cdot X - P_m \cdot M \quad <23>$$

where

TB = nominal trade balance,
 P_x = price of exports,
 X = quantity of exports,
 P_m = price of imports, and
 M = quantity of imports.

The change in the nominal trade balance at time t following a change in dollar exchange rate at $t-k$, (E_{t-k}), includes changes in the following components:

$$\begin{aligned} dB_t/dE_{t-k} = & dP_{x_t}/dE_{t-k} \cdot X_t + dX_t/dE_{t-k} \cdot P_{x_t} \\ & - dP_{m_t}/dE_{t-k} \cdot M_t + dM_t/dE_{t-k} \cdot P_{m_t}. \end{aligned} \quad <24>$$

Time series independence tests and regression tests of causal priority are applied to identify the nature and extent of any empirical dynamic relationships between an index of the dollar's exchange rate and U.S. import-export prices and volume aggregates in the following forms

$$\begin{aligned} P_{m_t} = & \text{intercept} + \sum_{k=0}^{\infty} a_k E_{t-k} + \mu_t \\ = & A(L)E_t + \mu_t \end{aligned} \quad <25>$$

$$P_{x_t} = B(L)E_t + v_t \quad <26>$$

$$M_t = C(L)E_t + \tau_t \quad <27>$$

$$X_t = D(L)E_t + \sigma_t \quad <28>$$

where the distributed lag coefficients-- a_k , b_k , c_k , and d_k --($k = 0, 1, 2, \dots$) reflect the lagged responses implied in <24> and μ_t , v_t , τ_t , and σ_t are random disturbance terms.

The results obtained from this study for the 1973-1987 period suggest that two of the four channels of influence, import price and import quantity, display a weaker and more

delayed response than what the standard J-curve theory would suggest. In sum, the results suggest that the belated response of the nominal trade balance could be attributed to the partial Pass-through of changes in the dollar's value on import prices, as well as the slow and weak response of import volume to import prices.

Although it appears plausible to argue that changes in exchange rates affect the trade balance through four channels as shown in <25-28>, the following determinants should not be ignored:

- 1) the responses of import and export quantities to changes in relative prices, or in general the simultaneity between prices and quantities, and

- 2) the impact of domestic and rest-of-the-world's real income variables on the quantity of traded commodities.⁶ Neglecting a key explanatory variable such as real income accounts for a misspecified trade balance equation on theoretical grounds, and consequently, leads to biased and inconsistent estimates of the effects of changes in the dollar's value on the variables of interest.

In general, estimations of the trade balance and balance of payments are subject to the following criticisms: First, the impact of exchange rate changes on trade balance is

⁶ It should be remembered that neither Miles's (1979) study nor Bahmani-Oskooee's (1984) study includes import-export prices or import-export quantities in the estimation of the trade balance equations.

indirect; therefore, estimation results of a single-equation trade balance or balance of payments should not be taken as equal to the responses of import-export volumes and prices to exchange rate fluctuations. In other words, estimation of trade balance identity does not reflect the fact that, for any country, the volume of imports depends on domestic income, relative prices and the exchange rate. Second, as in the case of estimation of a single-demand equation, these studies pay no attention to the behavior of foreign suppliers in terms of their treatment of invoice currency, markup pricing, and market share strategies following exchange rate fluctuations.

The next section discusses the estimation of import and export demand as well as price equations, while suppliers' reactions to changes in exchange rate are accounted for.

II.3 Import and Export Prices and Exchange Rate

Pass-through Effect

The investigation of the effect of exchange rate changes on trade flows through import and export prices was pioneered by Magee's (1973) seminal paper. The study identified three periods reflecting exchange rate impacts and distinguishes them from each other based on their characteristics. The first period, the "currency contract period," involves changes in import and export expenditures resulting from contractual obligations agreed upon prior to the exchange rate changes.

This period refers to a brief period immediately following a depreciation or appreciation of exchange rate but before any change in prices or quantities can take place. The second period, the "Pass-through period," represents a period in which the import and export prices respond to the exchange rate changes, but it precedes price-induced changes in quantities. Finally, the third period, the "quantity adjustment period," involves a period in which quantities of traded goods adjust in response to the new relative prices of domestic and foreign tradeables. A brief review of some of the empirical investigations on the exchange rate Pass-through effect follows:

1) Ahluwalia and Hernandez-Cata (1975) introduced an econometric model of U.S. merchandise imports by accounting for the impact of foreign suppliers' pricing behavior on import prices. Unlike previous econometric models, their model deals with estimation of the price as well as the volume of U.S. imports. Therefore, new elements such as the invoicing currency of import contracts and the possibility of absorption of exchange rate effects by foreign exporters are taken into account. The model is estimated in two phases: First, U.S. import prices are estimated from the current and lagged values of foreign prices, domestic prices, and exchange rates. Unit value indices of several categories of U.S. imports are used in estimating most of the equations. Second, import prices, domestic expenditure and domestic prices are

used to estimate the volume of U.S. imports. The main contribution of this study is its methodological innovations towards more accurate trade flow analysis by examining suppliers' responses to changes in exchange rates. This end is accomplished by including properly defined price equations in the model. Among the statistical results of the study, we refer to the following: a) The elasticity estimates contrast substantially with those obtained from models that do not include price or supply equations--the models that ignore the impact of foreign suppliers' pricing behavior. b) The results suggest that imperfections in the use of unit value indices (to which we refer in Chapter III) need not be a cause of concern.

2) Hooper (1976), following Ahluwalia and Hernandez-Cata, constructed a partial equilibrium model in order to forecast U.S. import and export prices and volumes. He incorporated, among other things, prices or supply equations as well as a price setting behavior (described by markup factor) into the traditional model. The equations of the model were estimated from quarterly data for the period 1956:III-1975:IV. The following is one of the major results of his study.

The price equation estimates suggest that both U.S. exporters and foreign exporters to the U.S. market eventually Pass-through about 70 per cent of an exchange rate change into their export prices in terms of the importing currency. This Pass-through estimate is consistent with the estimates of other recent studies, but the estimated time period during which it takes place (two quarters) is somewhat shorter than previously estimated.

The inertia in the U.S. nominal trade deficit following a substantial decline in the dollar's value between early 1985 and the middle of 1988 cast serious doubts about the validity of the standard J-curve theory. This development led to the revival of Pass-through analysis, which is a series of empirical studies investigating the supply side, or foreign suppliers' pricing behavior.⁷

3) Hooper and Mann (1989:I) conducted an empirical analysis of the effect of exchange rate changes on U.S. import prices from the top nine suppliers of U.S. imports of manufactured goods during the 1980s. The results of their study are essentially similar to those of previous ones. Part of their results is as follows:

...some 50 percent to 60 percent of the change in nominal exchange rate is reflected in prices of manufactured imports. That estimate is indeed lower than those of many previous studies. It is also remarkably robust across alternative functional forms of the import price or profit margin equation and across different estimation techniques. ...Japanese firms appear to absorb a higher proportion of exchange rate fluctuations into their profit margins on sales to the United States than they do into margins on their sales to other countries on average. However, the Pass-through coefficient for U.S. imports from Japan is about in line with the average for total U.S. imports. This suggests that if Japanese firms price discriminate in the U.S. market they are not alone. ...we find little evidence that the Pass-through relationship has changed over the past decade.

⁷ An extensive review of these studies requires a survey of its own which is beyond the scope of this study. Nonetheless, a brief list of such studies includes: Koch and Rosensweig (1988), Deyak et al. (1990), Anderson et al. (1987), Froot and Klemperer (1989), Baldwin and Krugman (1987), Helkie and Hooper (1987), Baldwin (1986), Mann (1986), Fisher (1987), and Mead (1988).

4) Finally, Moffett's study (1989) contains estimated figures of exchange rate Pass-through on import as well as export prices.⁸ To estimate the degree of Pass-through, Moffett utilized the following functional relationship:

$$P_t^m = f(R_{t-i} / P_{t-i}^*) \quad <29>$$

where

P_t^m = index of import unit value,
 R_{t-i} = trade weighted exchange rate, and
 P_{t-i}^* = foreign price deflator.

Table 7, which is reproduced from his study, summarizes the degree of import and export price Pass-through--the cumulative percentage changes in import and export prices from changes in exchange rate. The degree of exchange rate Pass-through into import price has been subject to change, continually declining over the three sub-periods. The export price Pass-through, on the other hand, does not follow the same path, experiencing only little Pass-through prior to

⁸ Mead (1988) and Helike and Hooper (1987) provide different theoretical bases and empirical findings on this issue. Mead concludes that import prices have responded less in the recent period to declines in the dollar's exchange value than was expected, thereby suppressing the J-curve effect. She also concludes that the gap between the growth rate of U.S. income and domestic demand, on the one hand, and that for the trade partners, on the other hand, is the main source of the problem.

Helike and Hooper focus on U.S. price competitiveness and changes in U.S. and foreign growth as determinants of the widening external deficit between 1980 and 1986. They conclude that while both factors were significant, the decline in U.S. competitiveness associated with the appreciation of the dollar was the dominant factor. Finally, with respect to the belated trade balance response after dollar's decline since 1985, they suggest that the delay could be attributed largely to normal lags in response to exchange rate changes.

Table 7. Import and Export Pass-through
Sensitivity to Estimation Sample Period
(percent)

Sample Period	Cumulative Import Pass-through	Cumulative Export Pass-through
1967:I-1980:I	82	3
1967:I-1985:I	74	36
1967:I-1987:IV	53	13

notes:

a) Percent Pass-through is the summation of the coefficient¹ of eight-quarter, second-order polynomial distributed lags, with no tail constraints.

b) Pass-through coefficients for exports are statistically insignificant for all sample periods except that of the 1967:I-1985:I period.

1980. One of the major outcomes of this study is that dollar depreciation appears to cause import and export prices to rise with import and export quantities subsequently decreasing. The net result of such a series of occurrences is, however, deterioration of the non-oil, non-agricultural merchandise trade balance.

II.4 Currency Invoicing of International Contracts

The currency in which international trade is contracted is an essential catalyst through which changes in the exchange value of domestic currency translate into the prices of traded goods. Many of the early disagreements about the mechanisms which transmit changes in the exchange value of domestic currency to the merchandise trade balance could be attributed to lack of information, particularly, lack of data series pertaining to the currency denomination of contracts.⁹ Indeed, unless the currency denomination of international contracts is taken into account, any model of trade balance designed to reflect the impact of exchange rate could result in unreliable outcomes.

The first systematic investigation of the invoice currency was carried out by Sven Grassman (1973). According

⁹ With respect to the currency denomination of U.S. trade, the U.S. Bureau of Customs converts all import invoices into U.S. dollars and does not keep any record of currency denomination of contracts, Magee (1973).

to the actual currency distribution of total Swedish foreign trade in 1968, 66 percent of exports were invoiced in Swedish kronor and 34 percent in other currencies. In contrast, only 26 percent of imports were paid for in Swedish kronor, against 74 percent in foreign currencies. By examining additional European countries' trade data, and by generalization, he concluded that invoicing in the currency of the selling country dominates total foreign trade both for imports and exports. As exceptions to this symmetry rule, Grassman found that 64.5 percent of Swedish exports to the U.S. and Canada were in the importing country's currency, while 94.3 percent of Swedish imports from these two countries were in the exporting country's currency. Other cases of exceptions were trade with LDCs, the Eastern block, and trade in primary commodities such as crude oil. Trade between developed and developing countries as well as eastern block countries was invoiced predominantly in developed countries' currencies. In addition, trade in raw materials was mediated through either the pound sterling or the U.S. dollar. Grassman's study is within the "international monetary framework," analyzing the international monetary properties of different national currencies in order to assess their share in international payments--in part, to quantify the significance of the U.S. dollar in the international payments scheme.

Since Magee's (1974) article, the role of invoicing currency in explaining the movements of trade balances in

response to changes in exchange rate has become an integral part of the international trade literature. Although his examination of the invoicing currency from a sample of customs data of U.S. imports from West Germany and Japan for 1972 and 1973 is in Grassman's tradition, Magee's contributions differ substantially from that of Grassman's. In fact, Magee's study showed that the J-curve is only one possible shape that a trade balance adjustment could take. In other words, the J-curve phenomenon is only a special case of response of trade balance to changes in exchange rate. Magee's own study, for instance, suggested that, considering the invoicing currency of contracts, the movement of the U.S. trade balance with Germany and Japan in response to devaluation could be described by a γ curve (gamma curve) rather than a J-curve.

Although a few theoretical works on this issue exist, quantitative examination of the effect of currency denomination of contracts are even fewer.¹⁰ Hooper and Kohlhagen (1978) constructed a model in which invoice currency is explicitly accounted for. Two additional factors are encountered as instrumental in determining the impact of exchange rate uncertainty on the prices and volume of traded goods: 1) the proportion of forward hedging and 2) the

¹⁰ Unlike other fields of international economics, the amount of effort devoted to the examination of currency denomination of international contracts has been very limited. Studies by Magee and Rao (1980), Page (1981), and Krugman (1984) are likely the latest efforts directly dealing with this issue.

relative risk preferences of importers and exporters.¹¹ Thus, a weighted average of the cost of foreign exchange to the importer, H , is defined in the following form:

$$H = \beta(\alpha F + (1-\alpha)R_1) + (1-\beta)F \quad <30>$$

where β is the imports denominated in the exporter's currency, while some proportion $(1-\beta)$ is denominated in the importer's currency. Out of the proportion denominated in foreign currency, α is a constant proportion that importers are assumed to hedge in the forward exchange market at the forward exchange rate of F . Finally, R_1 is the spot exchange rate prevailing on the future date of payment. Examinations of the U.S.-Germany and U.S.-Japan trade flows for 1965-1975 suggest that

¹¹ This model is, however, subject to the following criticisms:

a) Unless importers and exporters have the same exchange rate expectations and their uncertain expectations are realized (as is assumed by authors, P. 507), it is possible that some of the importers' or exporters' expectations fail to be realized in the forward exchange market by hedging on a currency whose forward spot rate is lower than expected. In fact, on the aggregate level, the outcome of forward hedging by individual profit-maximizer importing firms might be that they cancel each other out rather than reduce exchange rate uncertainty.

b) Even if the uncertain exchange rate expectations of some of the importing firms on the forward exchange contracts are realized, this would be more of a gain on exchange rate speculation than on trade per se. After all, there is no reason to believe that the possible gain from forward hedging would be passed on to import prices or import volume.

c) Since any risk-averse trader prefers contracts in his own currency, relative risk averseness of importers and exporters could be best approximated by the currency denominations of contracts.

... if traders are risk averse, an increase in exchange risk will unambiguously reduce the volume of trade whether the risk is borne by importers or exporters. However, we also found that the effect of an increase in exchange risk on the price of traded goods could be in either direction, depending upon who bears the risk. If importers bear the risk, the price will fall as import demand falls, whereas if exporters bear the risk, the price will rise as exporters charge an increasingly higher risk premium.

The results on the price effects are consistent with those of previous surveys on the currency denomination of export contracts, namely, that with the exception of some U.S. imports, most trade is largely denominated in the exporter's currency.

II.5 Investigations on LDCs' Trade Flows

As an integral part of the international trading scheme, developing economies play their own mutual role in affecting as well as being influenced by the trade activities of developed economies. In the past, enormous effort has been devoted to the empirical examination of the trade flows between industrial countries in general, and between the U.S. and other developed countries in particular. In contrast, the amount of investigations on developing economies' trade relationships with the rest of the world seems inadequate. During the 1950s and 1960s, price elasticities of imports and exports were considered to be the primary factors in explaining trade flows. In particular, the relationships between developed and developing economies were looked at from

the viewpoint of movements in their terms of trade. Since the inception of developing countries' balance of payments difficulties, investigations of their trade flows have become more specific and have been carried on within a framework similar to that of developing countries. What follows is a brief review of such studies:

1) Khan's study (1974) is the first empirical analysis conducted for the estimation of import and export demand equations of 15 developing countries. Because the study covers the 1951-1969 period of the fixed rate regime, the absence of an exchange rate variable from the equations is considered a safe assumption. The major concern of this study is whether changes in prices of traded and nontraded goods exert any significant influence over trade flows, and the answer is affirmative. In other words, prices do have an important impact on imports and exports of developing countries.

2) Warner and Kreinin's study (1982) is explained in Section II.1.2 for its results on industrial countries' aggregate import and export demand estimations. The results obtained from the estimation of developing countries' aggregate import demand equations indicate that income coefficients are positive, sizable, and significant. Also, the exchange rate coefficients are significant for many of the countries.

3) Augustine and Afifi (1987) modeled and estimated

import demand functions for thirty developing economies (most African countries) over the 1960-1982 period. The primary objectives of the study were: 1) to determine the price responsiveness of import demand, and 2) to address the question of the stability of the import demand function over the period of estimation. The estimation results suggest that, for the majority of cases, import volume shows a fairly large response to changes in relative prices. Nonetheless, the absence of an exchange rate variable from the model remains a serious drawback of this study. The authors fail to incorporate an exchange rate variable into their models for two reasons: First, the models are estimated over a period which is largely dominated by fixed exchange rates. Second, the model was built by relying on results derived from another empirical study, Bahmani-Oskooee (1986).

4) Bahmani-Oskooee's study (1986) is an empirical examination of international trade flows of seven developing economies, Brazil, Greece, India, Israel, Korea, South Africa, and Thailand for the 1973-1980 period. With respect to the effect of effective exchange rates, this study suggests that exchange rate does not appear to have a statistically significant effect on the imports of developing countries. Among seven developing economies which were examined, the estimated coefficients of the effective exchange rate were significant only for two countries, Brazil and Greece. For the export side, the estimated coefficients of the effective

exchange rate were significantly different from zero at the 10 percent level and had the expected signs for the cases of Greece, Israel, and South Africa. The main conclusions of the study could be summarized as follows: First, changes in exchange rate appear to have adverse effects on trade flows in the short-run and favorable effects in the long-run. Second, in the long run, trade flows are more responsive to changes in relative prices than to changes in the effective exchange rates. Moreover, lags on prices are found longer than those for exchange rates. Third, for most cases, the estimated long-run elasticities of relative price and exchange rate are found to be less than one, implying that developing countries may have a price-inelastic demand for import goods. Finally, all of the estimated income elasticities have the expected positive signs, and for most cases they are statistically significant.

There are two important remarks to be made about these studies: First, currency denominations of LDCs trade contracts were entirely neglected in their trade flow analysis. Second, despite the fact that the domestic currencies of most of the LDCs are impotent in settling international contractual obligations, the exchange rates of these currencies have been used. The imports and exports of developing countries are predominantly priced and settled in terms of major currencies, therefore, the impact of changes in exchange rates between these currencies on LDCs' merchandise

trade balances should not be neglected. In reality, exchange control, import-export licensing and other similar trade and commercial policies, which have been practiced by most of the LDCs for a long time, are measures in response to foreign currency shortages. Lack of foreign exchange resources constitutes one of the critical constraints on their development strategies. Thus, inclusion of a relevant exchange rate variable in developing economies' trade models is indispensable.

CHAPTER III

THE MODEL AND ESTIMATION METHODOLOGY

III.1 Introduction

This chapter develops a model in which the effects of exchange rate changes on trade flows of LDCs are evaluated. Three oil-exporting countries, Iran, Venezuela and Saudi Arabia, the "study group countries," are chosen for the purposes of this empirical investigation. The choice of these countries is based on the criterion that their export receipts are almost entirely in terms of U.S. dollars. For more than two decades, their export of fuel as a percentage of total exports has been above 90 percent, and in the case of Saudi Arabia, close to 100 percent.

Three features of the model are emphasized: First, invoicing currencies of trade contracts are encountered in the model by focusing on the trade flows of the "study group countries." This criterion is important, as the degree to which changes in exchange rate affect the import and export flows depends on the currency used to denominate trade contracts. Second, the study examines the responsiveness of the group countries' merchandise trade balances in terms of U.S. dollars to changes in the exchange value of the U.S.

dollar. This is accomplished by studying the impact of changes of the effective exchange rate of the U.S. dollar on import and export prices and quantities. The rationale for utilizing the effective exchange rate of the dollar, as opposed to the exchange rate of these countries' home currency, will be explained later in this chapter. Third, price or supply equations are examined along with the single-equation demand models, which have traditionally been used by themselves to predict trade flows.

Quarterly observations for the 1960 through the 1980s are analyzed in this study. This time period covers both the second half of the Bretton Woods period, 1960:I-1971:III, as well as the period of floating exchange rates, henceforth referred to as the Bretton Woods and post- Bretton Woods periods, thus making possible a comparison between the two eras. Since data are less available for the 1980s, the study covers as much of this period as the data series permit (for the sources of data as well as information on quarterly data series see Appendices A and B).

III.2 The Model

The volume of a country's imports depends on two independent variables, namely, real income and relative prices (import prices divided by the domestic wholesale prices), where a degree of substitutability between imports and

domestically produced goods is assumed. Similarly, demand for a country's exports is defined as a function of the trading partners' real income and the ratio of export prices to the price level pertaining to the importing countries. In addition, because exchange rate variations change the actual price paid or received for traded goods, causing adjustments in quantities traded, it is necessary to incorporate an exchange rate variable in the demand equations. Since the breakdown of the Bretton Woods fixed exchange rate regime, the importance of exchange rate changes on trade flows has been a source of concern both on theoretical and empirical grounds.

These import and export relationships can be written as:

$$M_{it}^d = f \{ Y_{it} , (PM_{it} / PDM_{it}) , E_t \} \quad <1>$$

$$X_{it}^d = h \{ W_t , (PX_{it} / PFM_{it}) , E_t \} \quad <2>$$

where

- M_{it}^d = quantity of import demanded by country i at time t,
- Y_i = real income of country i,
- PM_i = import prices by country i,
- PDM_i = domestic wholesale price index of country i,
- E = exchange rate (foreign currency units per unit of domestic currency),
- X_i^d = quantity of exports demanded by the trading partners,
- W = trading partners' real incomes (computed as weighted averages across trading partner countries),
- PX_i = export prices by country i, and
- PFM = foreign wholesale price index (computed as weighted averages of the wholesale prices in trade partner countries).

The model is estimated for the stability of relationships over both the Bretton Woods fixed exchange rate period and also over the current floating rate period. The

distinction between the two exchange rate regimes is basically made to account for the infrequent, but potentially important devaluations during the former system and more frequent fluctuations in the current exchange rate regime.

Our immediate concerns are the theoretical foundations of these relationships and the validity of the functional forms employed for <1> and <2> as well as problems involved with their estimation.

III.3 Simultaneity Problem

The estimates of price elasticities of demand for imports and exports derived from relationships such as those in <1> and <2> can be biased and inconsistent because of simultaneity between prices and quantities. Such estimates are weighted averages of the true elasticities of demand and supply, rather than estimates of the price elasticity of demand. More specifically, simultaneity implies correlation between the determinant variables in an equation and the error term, and such a correlation would violate one of the basic conditions for the use of the Ordinary Least Squares (OLS) technique for the estimation of the single import and export demand equations, see Kmenta (1986).

In dealing with trade flow analysis, it has been traditional to ignore the supply side of imports by making an assumption that the price elasticity of supply is infinite.

In other words, import and export prices have been considered to be exogenous to any given country, rather than that the import volume-import prices and export volume-export prices are simultaneously determined. This assumption has been adopted not because a nation's export supply elasticity is infinite, but because of the fact that it is one of many suppliers.

Several different arguments have been made to support the exogeneity assumption. Murry and Ginman (1975) refer to firms operating at less than full employment capacity, implying that the industry supply curve will be horizontal before the full-capacity production level is reached. Also Warner and Kreinin (1983) employ import prices in terms of foreign currency in order to legitimately apply the OLS estimation technique. McKinnon's (1979) classification of traded goods clarifies the exogeneity of import and export prices by commodity groups.

McKinnon divided tradeables into two categories. Tradeables I are those in which producing firms can control the market prices for their own particular products. Usually tradeables I are manufactured products with distinctive characteristics. The heterogeneity allows different market prices to exist for similar, though not identical, products in the relevant market. The Volvo automobile is an example of the tradeable I. For tradeable I goods, for example, the Volvo company avoids exchange rate risk by having its sale prices fixed in Kronor, to both domestic and foreign buyers.

The foreign importer, therefore, must bear the foreign exchange risk of using his home currency to buy the exporter's currency. Prices for this category of commodities do not fluctuate in response to daily or weekly demand or supply conditions. This is similar to John Hicks's "fix price" goods, where prices remain unchanged over a fairly long contractual period.

Tradeables II, on the other hand, are more homogeneous commodities where one firm's output may be graded and precisely compared to that of others. Wheat and petroleum are prototype tradeables II. Tradeables II are what John Hicks called "flex price" goods. They are neither firm specific nor country specific and there are other sources of supply which are very good if not perfect substitutes. Unless prevented from fluctuating by specific quota or tariff barriers, daily and weekly fluctuations in the prices of this category of commodities are quickly arbitrated across the international boundaries of convertible-currency countries. A high volume of trade in tradeables II is carried out in centralized commodity exchange markets, normally in a country with a commonly-used international currency.

Homogeneous commodities traded in centralized international exchange markets are usually quoted and invoiced either in U.S. dollars or pounds sterling rather than in the domestic currency of the exporters. In this case, exporters from LDCs are bearing the currency risk by accepting dollar

payments and converting back to their own currency ,or by engaging in foreign contracts in terms of other currencies. Nonetheless, there is a substantial administrative convenience in developing world markets for tradeable II commodities for LDCs to quote export prices in dollars to their overseas customers. Since petroleum is priced in terms of U.S. dollars on centralized markets, its price for non-U.S. markets is directly sensitive to changes in the dollar exchange rate. Consequently, for countries other than the U.S., the home currency prices of petroleum vary directly with the exchange value of the U.S. dollar against their domestic currencies. There is also an equivalent fluctuation in the oil-exporting countries' potential international purchasing power.

In addition to McKinnon's argument which implicitly supports the proposition of the exogeneity of import and export prices, the exogeneity of import prices for LDCs can be justified on the basis of the "small country" criterion, in the sense that a country's import prices are given in the world markets and are independent of the country's level of imports. The assumption that small countries face an infinitely (or very highly) elastic export supply schedule from their trading partners, and therefore take the prices of imports as given, is quite appropriate. This proposition, then, implies that for the small countries, simultaneity is not a problem, and that application of OLS to the single-equation demand for imports and exports will yield unbiased estimators of

elasticities.

The study group countries' imports seem consistent with McKinnon's tradeables I. Prices for manufactured or semi-manufactured imports are given to these countries because each of them is simply one of many buyers where none possesses any monopsony power. On the contrary, export prices of the group countries, if not fully country specific, could be, to some degree, reflective of individual exporting countries' reserve position and price/output strategy. In particular, the import and export prices are subject to variations following changes in the exchange rate of the dollar. Thus, the treatment of import and export prices in this study is not based on infinite price elasticity of supply. Simultaneity is not a problem that can be dealt with by assumption. In other words, the price variable in demand equations for imports and exports can not be treated as exogenous just by assumption. Rather the correct procedure is to formulate a complete model including export-supply functions.

Following Moffett (1989), explicit price equations are included in addition to the demand equations for imports and exports. These equations are expected to reflect the dynamic impacts of changes in exchange rates and supply conditions on the price of traded goods. The specification of separate price equations also serves to reduce the problem of simultaneous equation bias in single-equation estimation, Orcutt (1950).

III.4 Exchange Rate Pass-through ¹

There is another source of problems with the estimation of a single-equation demand for imports. The impacts of changes in exchange rate on import and export prices can invalidate the application of OLS for estimation of the import and export demand equations. That is, because price and exchange rate variables are not independent of each other, using these variables as determinant variables in a single-equation demand for imports violates one of the basic conditions of the OLS technique. For example, U.S. suppliers of exports and their major trade partners such as Japan and Germany may be adjusting their supply prices, in terms of domestic currency, to the exchange rate changes. Many firms in these major trading countries may practice pricing policies designed to keep their export prices competitive despite changes in exchange rates. In response to U.S. dollar

¹ In Branson's terminology (Magee 1973 p. 315), "successful" pass-through means that in devaluing countries the domestic currency price index of imports should be rising substantially, while in revaluing countries it should be falling. That is to say, successful pass-through means that the burden of adjustment will be borne by importers and therefore less capital loss will be absorbed by the exporters. Other researchers have taken a slightly different approach on this issue.

Hooper and Mann (1:1989) focus on a narrower definition of pass-through as the partial derivative of the import price with respect to the nominal exchange rate in a model that relates import price to the exchange rate and other variables.

depreciation (or appreciation of their domestic currency) German and Japanese firms, for example, have reduced the domestic-currency prices of their exports in order to limit increases in the foreign currency prices of these products. The price discrimination in international trade that is triggered by exchange rate movements, has been referred to as "pricing to market," Krugman (1987).

The inertia in the improvement of the nominal U.S. trade deficit following the drastic decline of the dollar from its 1985:I peak shifted researchers' attention more toward the mark-up pricing behavior of trade partners. During 1985:I-1988:II, the trade-weighted average value of the dollar measured against the currencies of G-10 countries declined by over 42 percent, in about 3 years. Despite such a continuing precipitous decline in the dollar's value, the U.S. nominal trade deficit continued to rise from \$ 23.38 billions in 1985:I to \$ 42.47 billions in 1987:III, see Figure 6. Although the nominal trade deficit had started to shrink since the 1987:III peak, it did not return to its 1985:I level in the 1980s. In recent years, a series of studies has been conducted to examine the exchange rate Pass-through effect. For instance, the effects of exchange rate changes on U.S. import prices have been investigated by Hooper and Mann (1989:I). Their study suggests that for U.S. imports of manufactured goods, on the average, 40 to 50 percent of the change in the nominal exchange rate is absorbed by foreign

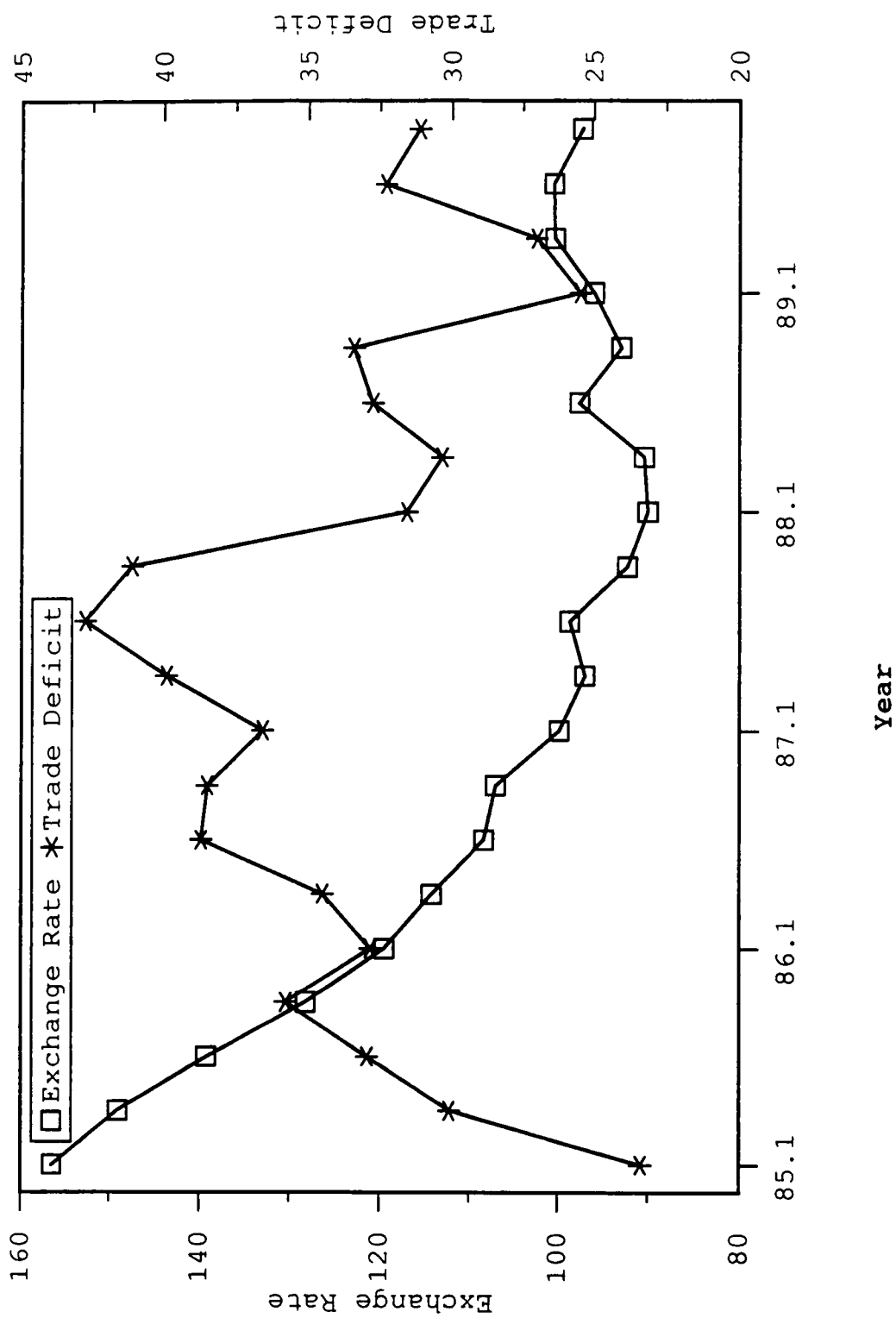


Figure 6. The G-10 trade-weighted index value of the U.S. dollar and the nominal U.S. trade deficit (billions of dollars)

firms (cutting profit margins) in order to minimize the losses of market share in the United States. This study also concluded that Japanese firms apparently absorb a higher proportion of exchange rate fluctuations into their profit margins on sales to the United States than they do into margins on their sales to other countries. Also, Moffett (1989) examined the degree of exchange rate Pass-through and its sensitivity to estimation sample periods during 1967:I-1987:IV for U.S. import prices. As shown in Table 7, the degree of exchange rate Pass-through has been continually declining over the three sub-periods, 1967:I-1980:I, 1967:I-1985:I, 1967:I-1987:IV. But, in general, the degree of exchange rate Pass-through, 53 percent over the entire period, is not substantially different from that found in similar studies.²

In sum, there is enough evidence that exporters react to changes in exchange rate by adjusting their export prices in terms of their domestic currencies. Under these circumstances, if exporters in major exporting countries such

² Other researchers focused more on the timing of exchange rate Pass-through. Koch and Rosenswieg (1990) concluded that, unlike the assertion by the standard J-curve theory which calls for a rapid response of import prices, it takes a lag exceeding one year before U.S. import prices react significantly to changes in the dollar's value. These results support the growing evidence of unusually long delays (from the viewpoint of J curve theory) in U.S. import price pass-through. In addition, a study by Deyak et al. (1990) suggests that:

"The lag from a change in exchange rates to changes in import prices is approximately two years."

as Japan and Germany charge the same export prices across all national markets (or their cross national market discrimination is minimal), then all nations who buy, for example, Japanese exports would enjoy the benefits of profit margin cuts following dollar depreciation. Studies of pricing to market behavior of exporting countries across destination countries are scarce. The recent study on pricing to market in international trade by Gagnon and Knetter (1990), however, does not provide much support for the view that foreign exporters tend to exercise pricing to market towards the U.S. more than to other destinations, and Japan and Germany do more pricing to market than other source countries.³ The study also acknowledges the sharp differences in pricing to market behavior across source countries toward each specific destination.

The study group countries' payments for and receipts from international transactions are not different from those of industrial countries. Their export receipts, for instance,

³ For long-run movements in export unit value, this study investigates two alternative agendas: pricing-to-market behavior and the law of one price. It is believed that, even if the law of one price does not hold in the short run, there may be limits to the extent of price discrimination due to the possibility of profitable arbitrage. In the long run, arbitrage pressure might grow in response to large deviations in sales prices across markets, thus enforcing the law of one price. The study leads to a very interesting result, i.e., pricing to market can persist in the long run within certain bounds. Beyond these bounds arbitrage pressures may operate to keep foreign prices from deviating too far from domestic costs. Nonetheless, pricing to market can certainly persist over the longer term and the bounds may be quite wide.

and therefore their potential foreign expenditures are entirely in U.S. dollars. It would seem plausible that the effect of changes in the exchange value of the dollar will, although only partially, pass through to their import prices. This phenomenon simply implies that the import prices of these countries will be subject to changes following changes in the value of the U.S. dollar. Therefore, the U.S. dollar exchange rate and import prices, in terms of U.S. dollars, may not be statistically independent of each other when utilized as explanatory variables in the import quantity equation, see <1>.

Figures 7-9 illustrate the long-run movements of the dollar's effective exchange rate against G-10 currencies and the import unit value indices (proxies for import prices) of Iran, Venezuela, and Saudi Arabia respectively.⁴ At first

⁴ A unit value is not a price but an estimated average value per physical unit of a commodity category at the time of delivery. Unit value should be interpreted with care since a change in the unit value index generally involves an unknown combination of price change, variation in the commodity mix as well as changes in exchange rate. Also, because of order-delivery lags and the fact that some contracts are invoiced in foreign currencies, the import or export unit values represent a combination of present and past contract prices (determined by unit labor cost, unit material cost, and the markup factor at the exporting country), and the exchange rate.

Unit value indices used in this study are obtained from IFS, Supplement on Trade Statistics, IMF. The methods used in their construction are explained as follows:

"The data for the *Export and Import Unit Value Indexes* table are obtained from national sources. For some countries, indexes are compiled according to the Laspeyres formula with trade values for a particular year as weights. For others, they are derived from the ratio of a value index and a Laspeyres volume index resulting in a Paasche index."

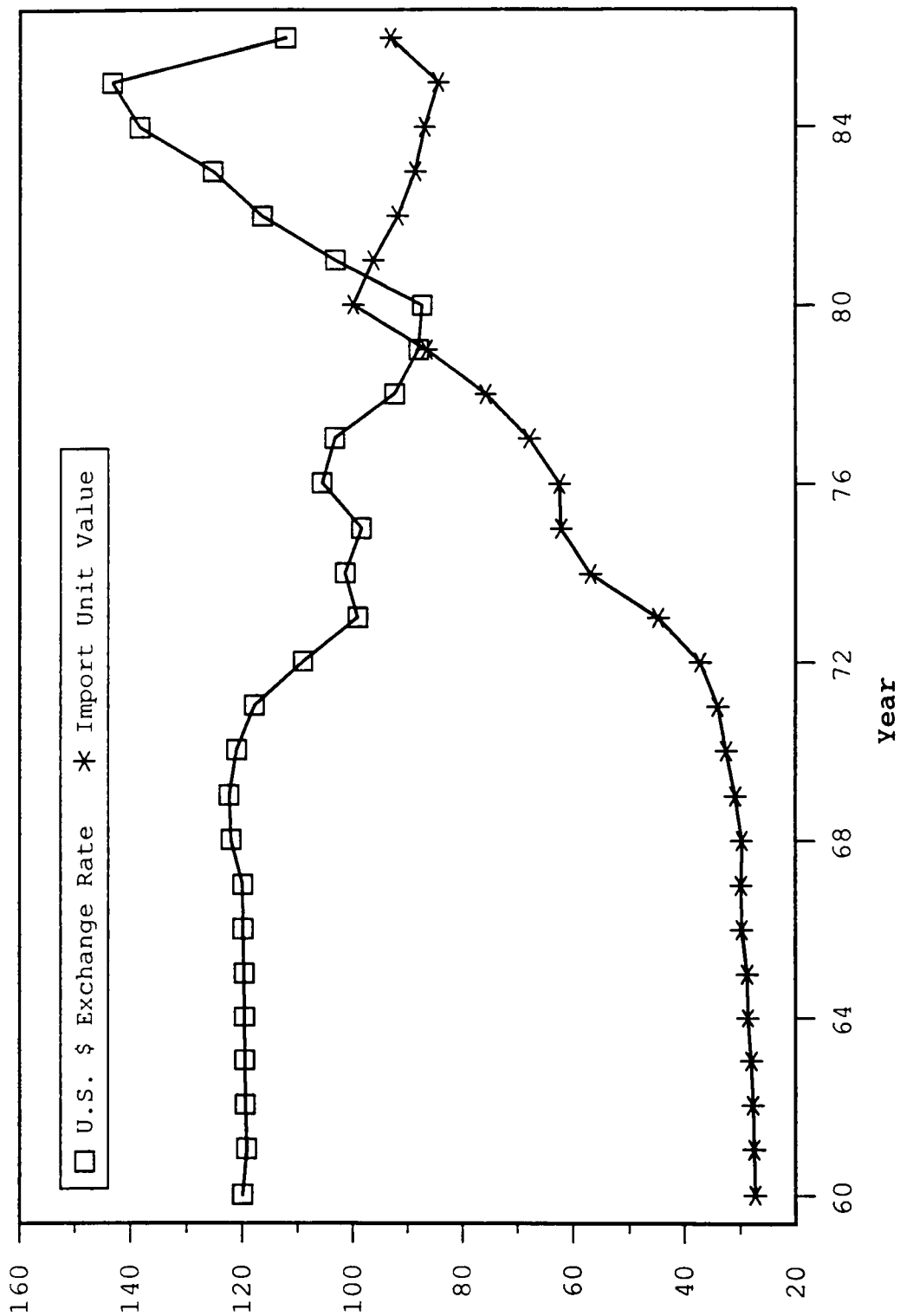


Figure 7. The exchange rate of the U.S. dollar and Iran's import unit value index (1980 =100)

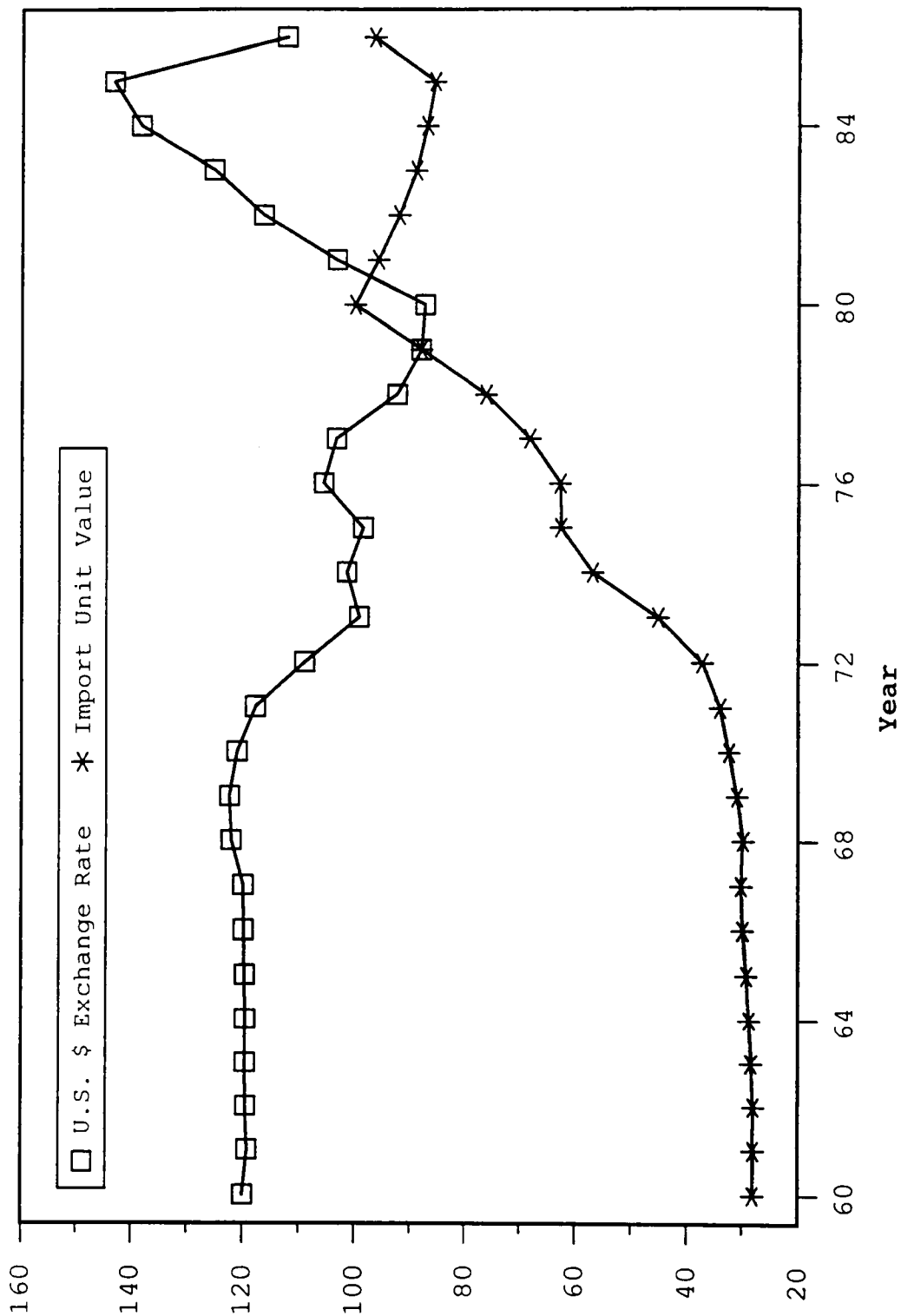


Figure 8. The exchange rate of the U.S. dollar and Venezuela's import unit value index (1980 =100)

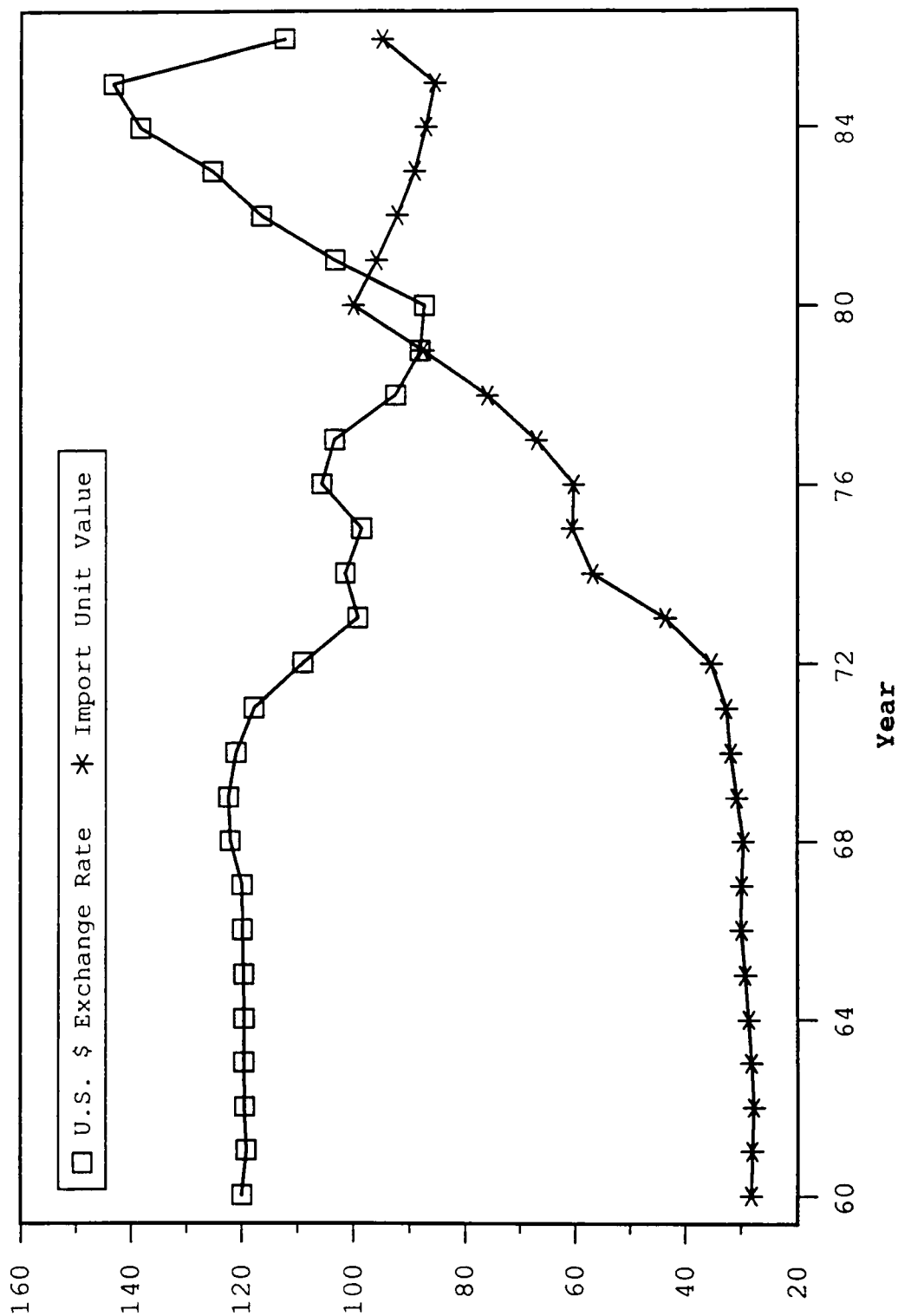


Figure 9. The exchange rate of the U.S. dollar and Saudi Arabia's import unit value index (1980 =100)

glance, the import unit value indices of these countries appear to follow an extremely similar pattern. In addition, these figures suggest how closely the effective exchange rate of the dollar and the import-unit value indices are related. One could easily observe that during the fixed exchange rate system, until 1971, import-unit value indices showed a record of fairly small but continuous rise. During the post-Bretton Woods period, on the other hand, it is not difficult to see how the movements of the import-unit value indices mirror those of the exchange rate of the dollar. That is, there appears to be an inverse relationship between import unit value indices and the dollar exchange rate against the G-10 countries. Such a negative relationship, however, is expected to be stronger in the post-Bretton Woods period than in the former period. More importantly, the movement pattern of these two variables during 1979-81 suggest that the import-unit value indices are lagging behind the exchange rate variable. Verification of such relationships, however, is subject to statistical investigation which will be pursued over in Chapter 4.

As for the relationship between export prices and the exchange rate of the U.S. dollar, the impact of changes in the exchange rate of the dollar on export-price of oil is a well-understood phenomenon.⁵ With regard to export unit value, it

⁵ The most fundamental commitment of the OPEC conference is to maintain or increase "real oil prices," a concept which approximates the cost of alternative energy

is plausible that substantial dollar fluctuations, either directly or indirectly, influence the market price of oil. Therefore, export prices, in terms of U.S. dollars, and exchange rates may not be statistically independent of each other when utilized as explanatory variables in the export demand equation; therefore, the OLS estimation technique can not be legitimately applied because of interdependency between explanatory variables, see <2>.

The long term movements of the export-unit value indices of the group countries are depicted in figures 10-12. For the Bretton Woods era, export unit values seem extremely stable. After 1973, the export-unit value movements reflect the oil-price shocks of 1973-74 and 1979-80. Although possibly

resources. The concept of "real oil prices" is a complicated matter as different OPEC members may have different economic and political objectives or different trade linkages with the rest of the world. There are, however, three variables that determine the real price of oil: (1) the nominal price of oil, (2) the nominal prices of goods purchased by OPEC member countries, and (3) the exchange rate of currency in which the oil price is quoted and paid for. Although the OPEC conference can strongly influence if not fully determine nominal oil prices, they have little or no control over nominal prices of imported commodities or over the exchange rate of the U.S. dollar. Hence, the nominal oil price appears to be the only one to be influenced by the conference's policy actions.

The specific issues called upon by these factors are indexation of oil prices to prices of a bundle of goods imported by OPEC member countries and/or indexation of oil prices to a composite currency, such as SDRs, rather than the U.S. dollar. In particular, the OPEC conference has, in several occasions, discussed the possibility of indexing oil to other commodities or to a basket of major currencies. Such a view, however, has never come close to realization because of fundamental practical difficulties involved and severe economic interest conflicts among oil-exporting countries and oil-importing countries alike.

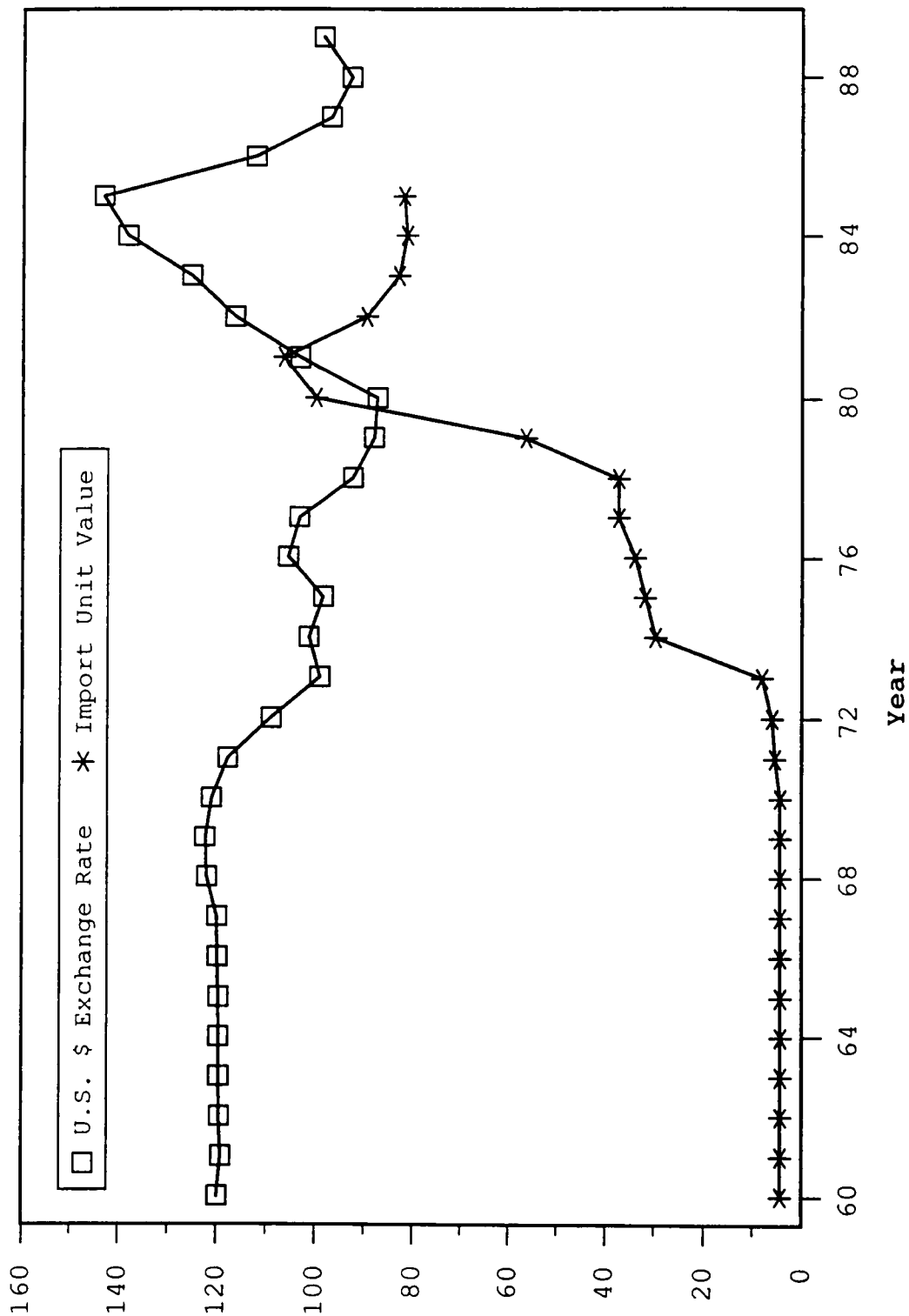


Figure 10. The exchange rate of the U.S. dollar and Iran's export unit value index (1980 =100)

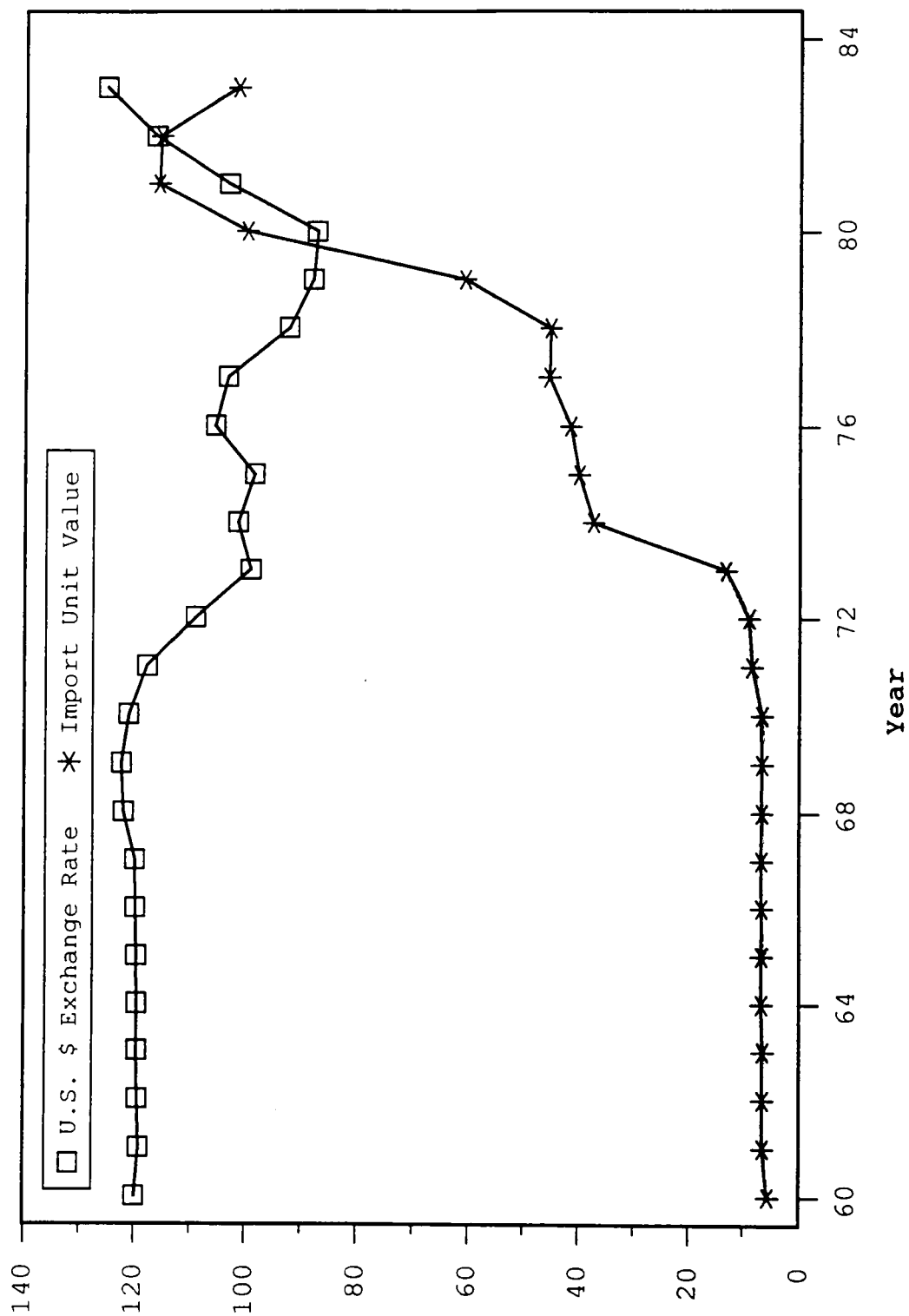


Figure 11. The exchange rate of the U.S. dollar and Venezuela's export unit value index (1980 =100)

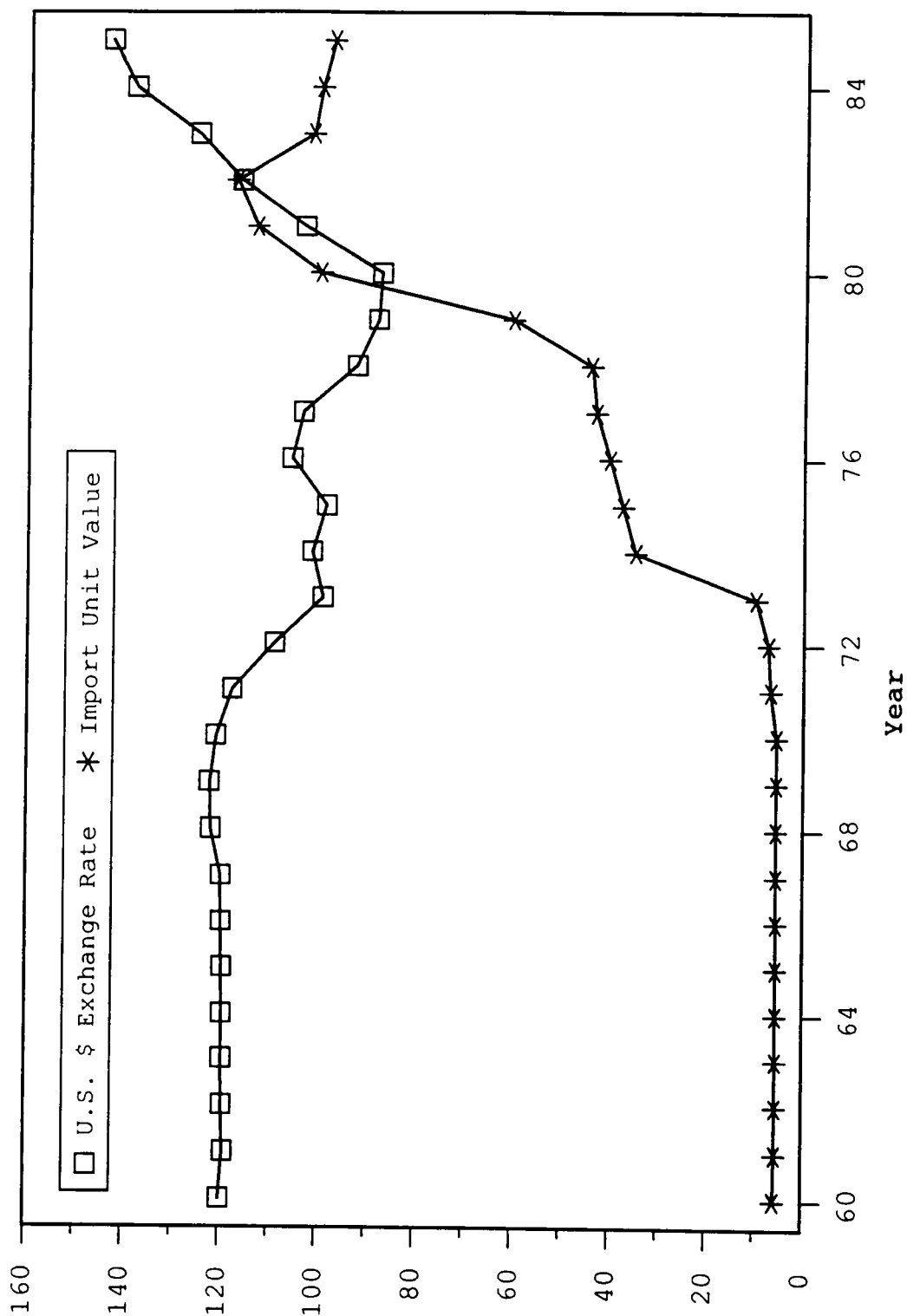


Figure 12. The exchange rate of the U.S. dollar and Saudi Arabia's export unit value index (1980 =100)

affected by the shocks, opposite movements of the exchange rate of the U.S. dollar and export-unit value indices could be observed for the period between the two major oil price shocks and the period after the second shock.

Our model is tailored for an environment in which prices are not determined solely by competitive forces of world demand and supply. Rather, merchandise trade takes place in a world market which is characterized by imperfect competition. Heterogeneity of manufactured commodities allows different market prices to exist for similar, but not identical, products in the market. Producers of this category of commodities, McKinnon's tradeables I, can control the market prices for their own product. Despite some belief that standardized commodities are exchanged in competitive markets, in reality, however, supply of these commodities is not unaffected by a cartel of suppliers. For instance, the influence of the U.S. and OPEC in world markets for grain and oil are beyond doubt. International agreements, long-term contracts, technological linkages, and some other factors play crucial roles in the conduct of all international business. Exporters are concerned with increasing, or at least maintaining, existing market shares and profit margins. Exporters are able to exercise a certain amount of control in setting prices. Given their concern with profit margins, cost of production appears as one of the determinants of the prices they list. On the other hand, facing some degree of

competition from foreign producers or and fearing losses in market share, exporters are compelled to take the price of competing foreign goods, including exchange rate, into account. Such a circumstance is one in which our model is organized.

The model is a four-equation representation of prices and quantities of merchandise imports and exports. Prices or supply equations are included in addition to demand equations, which have traditionally been used by themselves to study trade flows.⁶ The model works in two stages. First, prices of imports and exports, in terms of U.S. dollars, are estimated from some explanatory variables, including the exchange rate of the U.S. dollar, variables representing supply conditions and competitive factors. Second, the prices of imports and exports that are derived in the first stage together with other variables, such as an activity variable, constitute factors which determine quantities of imports and exports. Thus, the effect of exchange rate changes on the merchandise trade balance is allowed to appear in two

⁶ For a more explicit rationale for this modeling see Ahluwalia and Hernandez-Cata (1975), Winters (1976) and especially Hooper (1976). Hooper treats the price equations in the following manner:

The price equations are specified in two parts. First, contract prices (prices at which goods are ordered) are determined in supply equations. Second, unit values (average dollar prices at the time of delivery) are determined by distributed lags of contract prices and exchange rates. Since contract prices are not observed, the price equations must be estimated as reduced-form unit value equations (p. 6).

consecutive phases. First, the long-run impact of exchange rate fluctuations on the price of the traded goods, the Pass-through effect, is estimated. Second, the exchange rate transmission is followed through the impact of the changes in the price of traded goods on the trade volume.

Following Krugman and Baldwin (1987:I), Hooper and Mann (1989:I), and Deyak et al. (1990), merchandise import and export prices could be shown simply in the following functional relationships:⁷

$$PM_{it} = f (PFM_t, E_t) \quad <3>$$

$$PX_{it} = h (PDM_t, E_t). \quad <4>$$

Import and export prices are assumed to be negatively related to the exchange rate (foreign currency units per dollar) and positively related to wholesale price indices in foreign countries and at home, respectively.⁸

⁷ A partial list of studies that have addressed the transmission of changes in nominal exchange rate to trade balance through import prices includes: Stern, Baum, and Greene (1979); Haynes, Hutchinson, and Mikesell (1986); Gerald, Nicholas, and Peter (1987).

⁸ This assertion is consistent with the empirical examination of the trade flows of the U.S. by Moffett (1989). He notes that:

that export prices respond with the same sign as did import prices (negatively) to a domestic currency depreciation. Thus, a fall of the dollar on world markets possibly results in rising dollar prices of U.S. exports. Whether this response is a result of rising imported input prices on final export product prices, or the pricing strategies of U.S. exporters to maintain foreign currency prices of their product and thus not expand market shares during periods of dollar depreciation, is unknown and obviously an area of significant future research for industry level analysis.

Since individual countries of this study are definitely small countries, neither scale variables nor import-export quantities need be incorporated in the price equations. The Deyak et al. (1990) study of the U.S. trade flows for 1958-1985 suggests that the impact of quantity variables over import and export prices are not significantly different from zero. Krugman and Baldwin's (1987:I), by using quarterly data from 1977:II through 1986:IV suggested that there does not appear to be any significant effect of U.S. aggregate demand on import prices.⁹ Moreover, studies by Haynes et al. (1986) and Haynes and Stone (1983) support this conclusion as well, implying that even for the U.S. economy the supply schedules are infinitely (or very) elastic.

For estimation purposes, the equations will be used in their log-linear form.¹⁰ Moreover, since the timing and magnitude of impacts of changes in the exchange rate as well as domestic and foreign wholesale prices on import and export prices are two key issues in this study, a lag structure will

⁹ Also, they found no evidence of lags in the effect of real expenditure (GDP+IM-EX) on imports reaching beyond one quarter. That is, the income effect works much more quickly than the price effect.

¹⁰ Despite its economic properties, such that estimated coefficients are interpreted as elasticities with respect to corresponding variables, log-linear form brings some restriction into the model. For example, log-linear demand for imports implies that i) importers will respond in proportion to a rise or a fall in the explanatory variables, and ii) elasticities will remain unchanged during the given range for each explanatory variable.

be imposed on the explanatory variables. The idea is to capture the long-run impact of changes in exchange rate and domestic price levels on the prices of traded commodities.

$$\text{LnPM}_t = \alpha_0 + \sum_{i=0}^{n1} \alpha_{1i} \text{LnPFM}_{t-i} + \sum_{i=0}^{m1} \alpha_{2i} \text{LnE}_{t-i} + \mu_t \quad <5>$$

$$\text{LnPX}_t = \delta_0 + \sum_{i=0}^{n2} \delta_{1i} \text{LnPDM}_{t-i} + \sum_{i=0}^{m2} \delta_{2i} \text{LnE}_{t-i} + v_t \quad <6>$$

The predicted prices of imports and exports along with other independent variables would constitute explanatory variables of the quantity equations. In the meantime, should the impact of exchange rate changes on the import and export prices turn out to be insignificant, the proxies of import and export prices (import and export unit-value indices) will be utilized in the quantity equations. This situation is perceived to be the more likely case for the Bretton Woods system as exchange rate and the group countries' export unit values remained almost constant, see figures 10-12. Finally, the quantity equations could be written as follows:

$$\text{LnM}_{it}^d = \beta_0 + \beta_1 \text{LnY}_{it} + \beta_2 \text{Ln} (\text{PM}_i / \text{PDM}_i)_t + \epsilon_t \quad <7>$$

$$\text{LnX}_{it}^d = \gamma_0 + \gamma_1 \text{LnW}_{it} + \gamma_2 \text{Ln} (\text{PX}_i / \text{PFM})_t + \zeta_t \quad <8>$$

where μ_t , v_t , ϵ_t and ζ_t are the stochastic disturbance terms assumed to be normally distributed with zero mean and constant variance.

III.5 Relative Prices

The estimation of the relative prices is another source of problems. When the relative prices are used in a log-form

demand equation for imports, the import price elasticity is constrained to be equal in magnitude but opposite in sign to the price elasticity of domestic substitutes. Analogously, in the case of the export demand equation, export price elasticity would be equal in magnitude but opposite in sign to the world price elasticity. This constraint, however, is debatable on several counts: First, even a model that assumes that the true values of the elasticities with respect to the prices of import goods and domestic substitutes are equal in absolute value should allow the estimated elasticities with respect to the price indices, the import unit value index, and domestic wholesale price index to differ because of the methodological differences in the way these indices are constructed. Second, since the full impacts of changes in exchange rate on import price and wholesale price are expected to occur over time, it is quite conceivable that the pattern of dynamic influence--lag distribution, will be different. Some studies have investigated the validity of application of the relative price in international trade analysis. Murray and Ginman (1975), by using unadjusted quarterly data for Canada covering 1950 through 1964, concluded that the relative price specification of the traditional import demand model is inappropriate for estimating aggregate import demand parameters.¹¹ Also there are other studies rejecting

¹¹ In addition to the conclusion derived from their empirical investigation, the following rationale made in their paper (p. 76) is summarized here:

composite relative price variables. Augustine and Afifi (1987), in an effort to specify and estimate appropriate import demand functions for thirty developing countries over the 1960-1982 period, concluded that consumers tend to respond more to changes in the price of domestic goods than to equal changes in import prices. Warner and Kreinin (1983) estimated import and export demand functions for most industrial countries and for 15 LDCs. In these studies, the relative price variable is separated into three components: domestic price, import price in foreign currency, and exchange rate.

i) In recent studies the authors generally limit their investigation to manufactured goods and sometimes to more narrowly defined but still heterogeneous commodity groups. In such cases any individual commodity price is likely to be weighted in the import price index differently than it is in the domestic price index. For example, assume the price of imported automobiles and domestically produced substitutes (U.S. sub-compacts) increased by 20%. We might see the import price index of manufactured goods increase by 5% while the domestic price index increases by 2%; thus, the relative price index increases even though imported automobiles have lost no competitive advantage to U.S. sub-compacts due to the price increases.

ii) Even if it were possible to correctly include the price of import substitutes, it is possible that a significant number of domestic consumers hold a preference for domestic over foreign goods. It is not obvious that anti-foreign campaigns such as "Buy American" are without consequence. Also, such factors as local reputation, available servicing, retail outlets, etc., are likely to influence the consumer's operational preferences. Certainly, those factors are not completely effective in separating the markets for domestic and foreign goods; however, if they are only partially effective consumers may react differently to a change in import prices than to an equal but opposite change in domestic prices. Of course, it is also possible that for certain goods a reverse preference holds, i.e., a preference for a prestigious foreign good over an American made substitute.

Their results suggest that in most countries, it does not appear justified to employ a composite relative price variable, since separation into its components yields more accurate results. Moreover, since an import price index based on unit values and a domestic price index may refer to very different points in time, it is inappropriate to impose homogeneity through the use of relative price variables. Inasmuch as validity of these arguments, separated prices will be utilized in this study.

$$\text{LnM}_{it}^d = \beta_0 + \beta_1 \text{LnY}_{it} + \beta_2 \text{LnPM}_{it} + \beta_3 \text{LnPDM}_{it} + \epsilon_t \quad <9>$$

$$\text{LnX}_{it}^d = \gamma_0 + \gamma_1 \text{LnW}_{it} + \gamma_2 \text{LnPX}_{it} + \gamma_3 \text{LnPFM}_{it} + \zeta_t \quad <10>$$

Equations 5 and 9 together describe aggregate imports and <6> and <10> describe aggregate exports. The volume and associated price of traded goods are endogenous variables, and the remaining variables are assumed exogenous. The assertion of an exogenous exchange rate seems justified based on the small country proposition. In particular, each of the group countries captures only a limited share of the global international market so that their trade flows may not have a meaningful impact on exchange rate changes. Furthermore, the model established here abstracts from issues associated with the capital account and exchange control mechanisms.

III.6 Static vs. Dynamic Models and Lag Structure

A choice should be made between equilibrium and partial adjustment, i.e., static vs. dynamic, models. Although most traditional studies are based on equilibrium assumptions, they are prone to serious specification problems. Indeed, if imports and exports fail to adjust instantaneously to their long-run equilibrium levels following a change in any of the factors that influence their behavior, then the estimates of price and real income elasticities would be biased and inconsistent.

The adequacy of equilibrium models has been examined by Augustine and Afifi (1987) and Khan (1974). Augustine and Afifi conclude that, on an annual basis, a static equilibrium model may be justified. Similarly, Khan's study of 15 developing countries for 1951-1969 on an annual basis shows that for both import and export equations, a simple equilibrium formulation is adequate, where for both imports and exports the estimated adjustment period in response to changes in demand is one year (the intervals between observations).

In reality, however, importers and exporters are not always on their long-run import and export demand schedules. In the presence of imperfect information, product differentiation, price discrimination, adjustment costs and

other market imperfections, adjustment of the dependent variables to explanatory variables may not be instantaneous, i.e., the quantities of import and export demanded at each given relative price and real income may not be identical with the actual quantities traded.

A simple approach for modeling a dynamic trade relationship would be a framework of a distributed-lag model with geometrically declining weights. Two different rationalizations could be provided for the geometric-lag distributed model:

1) the "adaptive expectations model," which assumes that the actual quantity of imports, M , is a function of, let us say, the expected value of X at time $t+1$, X_{t+1}^* . This relationship and its auxiliary hypothesis about expectation formation could be written as:

$$M_t = \alpha + \beta X_{t+1}^* + \epsilon_t \quad <11>$$

$$(X_{t+1}^* - X_t^*) = (1-\lambda)(X_t - X_t^*) \quad <12>$$

where ϵ_t is a stochastic disturbance term with zero mean and constant variance and $0 \leq \lambda < 1$.

2) the "partial adjustments model," which assumes that imports adjust to the difference between the demand for imports and actual imports in the previous period:

$$M_t^d = \alpha + \beta X_t + \epsilon_t \quad <13>$$

$$(M_t - M_{t-1}) = (1-\gamma)(M_t^d - M_{t-1}) + \mu_t \quad <14>$$

where μ_t is a disturbance term, $(1-\gamma)$ is the speed of adjustment and $0 \leq \gamma < 1$.

By successive substitution of X_t for X_t^* in the adaptive expectations model and M_t for M_t^d in the partial adjustments model both yield a geometric-lag distributed model, with an infinite number of lags.

In principle, the effects of an explanatory variable on the dependent variable could be distributed across time. The lag effects are necessary in circumstances where forward contract, production, and delivery lags, and some other institutional and structural rigidities prevail. A plausible microeconomic justification for the lag, in a simple view, would be the fact that lags represent short-run supply inelasticity due to the limits on the rate at which physical trade flows could be changed, or they might represent order-delivery lags, or bottlenecks in distribution. The lag effects and their timing and magnitudes depend on a variety of factors, including trading countries' behavior over trade-offs between profit margins and market shares. A primary concern with the lag distributions is the choice of a proper distributed-lag model. Unfortunately, there is no theoretical basis for application of any specific lag model. In particular, the timing, the lag lengths, and the pattern of changes in the lag effects are not pinned down by any theoretical analysis. The choice, therefore, remains to be determined by empirical investigation on dynamic quantity equations in the following forms

$$\text{LnM}_t^d = \beta_0 + \beta_1 \text{LnY}_t + \sum_{i=0}^{n1} \beta_{2i} \text{LnPM}_{t-i} + \sum_{i=0}^{m1} \beta_{3i} \text{LnPDM}_{t-i} + \epsilon_t \quad <15>$$

$$\text{LnX}_t^d = \gamma_0 + \gamma_1 \text{LnW}_t + \sum_{i=0}^{n2} \gamma_{2i} \text{LnPX}_{t-i} + \sum_{i=0}^{m2} \gamma_{3i} \text{LnPFM}_{t-i} + \zeta_t \quad <16>$$

Among the different distributed-lag models, some of them, particularly geometric-lag models, are not appropriate for the purpose of trade flow analysis for the following reasons:

1) The infinite number of lags implies that the effects of explanatory variables on dependent variables extends indefinitely into the past and that the coefficients decline at a constant rate such that the effect of the far-end lag eventually becomes negligible. Although application of the Koyck transformation procedure resolves the problems involved with estimation of the infinite-lag variables, an infinite number of lags is not reflective of reality; therefore, the assumption of an infinite-lag is unappealing from the viewpoint of economic theory. Moreover, the Koyck transformation restricts adjustments of dependent variables to be identical for the changes in the past values of independent variables. As Magee (1975) argues, there is, however, no reason to believe that a dependent variable responds in an identical way to changes in independent variables.

2) By definition, the geometric-lag models assume that the largest effect of any changes in the explanatory variables occurs in the initial periods, and declines geometrically over time.

A number of studies have concluded that the lag responses of imports and exports are likely to be quite different depending on the explanatory variable which causes the response. A model that allows different time periods in which a dependent variable responds to changes in independents is the polynomial distributed lag, or Almon lag (1965). Further, this model assumes that the weights of lagged-terms follow a polynomial of given degree. The polynomial distributed-lag model allows not only for the choice of an appropriate number of lags, also for degree of polynomial and beginning-end point restrictions. But the problem with the whole analysis is that there is no *a priori* information about the appropriate number of lags or degree of polynomial. The selection of these features, therefore, remains to be determined simply by application of some statistical criteria.¹² The polynomial distributed-lag model of the imports as a function of exchange rate, E , could be written as follows:

$$M_t = \alpha + \beta \sum_{i=0}^m W_i E_{t-i} + \epsilon_t \quad (i = 0, 1, 2, \dots, m). \quad <17>$$

Also, distribution of the lag coefficients could be well approximated by

$$W_i = (\lambda_0 + \lambda_1 i^1 + \lambda_2 i^2 + \lambda_3 i^3 + \dots + \lambda_p i^p) \quad (i = 0, 1, 2, \dots, m) \quad <18>$$

where p is the degree of polynomial and m is the number of lags. To make each of the weights $W_0, W_2, \dots, W_m$ lie along a

¹² The joint estimation of the lag length and degree of polynomial is a problematic matter and it is not fully resolved in the literature.

fourth degree polynomial curve, then

$$W_i = \lambda_0 + \lambda_1 i^1 + \lambda_2 i^2 + \lambda_3 i^3 + \lambda_4 i^4$$

$$(i = 0, 1, 2, \dots, m). \quad <19>$$

By substituting <19> into <17>, the polynomial lag becomes

$$M_t = \alpha + \beta [\lambda_0 E_t + (\lambda_0 + \lambda_1 + \lambda_2 + \lambda_3 + \lambda_4) E_{t-1}$$

$$+ (\lambda_0 + 2\lambda_1 + 4\lambda_2 + 9\lambda_3 + 16\lambda_4) E_{t-2}$$

$$+ \dots + (\lambda_0 + m\lambda_1 + m^2\lambda_2 + m^3\lambda_3 + m^4\lambda_4) E_{t-m} + \epsilon_t, \quad <20>$$

which could be simplified as

$$M_t = \alpha + \beta (\lambda_0 Z_{t0} + \lambda_1 Z_{t1} + \dots + \lambda_4 Z_{t4}) + \epsilon_t \quad <21>$$

where $Z_{t0} = E_t + E_{t-1} + \dots + E_{t-m}$,

$$Z_{t1} = E_{t-1} + 2E_{t-2} + \dots + mE_{t-m},$$

.

.

$$Z_{t4} = E_{t-1} + 2^4 E_{t-2} + \dots + m^4 E_{t-m}.$$

To deal with the estimation of lag length and degree of polynomial, most studies assume a second degree polynomial with head and tail point restrictions.¹³ In this study, unlike other studies, the number of lags and the degree of polynomial are not restricted to an *a priori* assumed number. A two-step procedure is adopted in order to deal with determination of the lag length and degree of polynomial.

¹³ In a study by Deyak et al. (1990), a second degree polynomial with an end point restriction was adopted. The far-end zero constraint was imposed on the assumption that the economic impact of lags would at some point reach zero.

Kmenta (1971) and Johnston (1984), however, do not recommend the use of end-point restriction on the grounds that the regression model gives no information about the behavior of the lag variables outside the model.

First, to test for the length of lag, the estimation of each equation is started with the maximum possible number of lags of each independent variable without any constraint imposed on the lag distributions. For instance, for the import price equation, contemporaneous values of the exchange rate and industrial countries' wholesale price variables plus eight (m^*) and four (n^*) lagged-terms of each independent variable, respectively, are incorporated into the equation. When the estimated coefficients of the far-end lags are found insignificant, these terms are dropped from the equation and the estimation is continued with m^*-1 and n^*-1 lagged-terms on the right hand side. The process of estimation is continued until no more insignificant far-end coefficients emerge. In addition, to choose among similar results, the sign and significance level of the coefficients of the independent variables, as well as the goodness-of-fit, are taken into consideration.

Second, to determine an appropriate degree of polynomial, with the lag length determined in the previous step, estimation of <21> is begun with a fairly high degree of polynomial, say, p^* which could be equal to $(m-1)$. The degree of polynomial is reduced by one whenever an insignificant coefficient is encountered for the highest degree polynomial, the far-end Z_t . The process is continued until the first significant coefficient is found.

Positive serial correlation is a potential problem when

using economic time-series data. This problem causes ordinary least square estimates of coefficients to be inefficient and their standard errors to be downward biased. Consequently, ignoring serial autocorrelation leads to apparent statistical significance of estimated regression parameters when in fact the null hypothesis (no relationship) may not be rejected. In order to test for autocorrelation, the Durbin-Watson test is utilized. Whenever serial correlations are detected, the Yule-Walker estimation technique is used in order to eliminate the problem of autocorrelation.

III.7 The Effective Exchange Rate of the U.S. Dollar

This section addresses two issues: 1) the rationale for utilizing the exchange rate of the U.S. dollar rather than the group countries' own currency exchange rates, 2) the choice of an effective exchange rate of the dollar.

To illustrate the relevance of the dollar exchange rate, we generalize a static trade-balance identity in order to account for the currency invoicing of trade contracts:

$$TB^d = [P_x^d Q_x^d + P_x^{\$} Q_x^{\$} e^{\$} + P_x^o Q_x^o e^o] - [P_m^d Q_m^d + P_m^{\$} Q_m^{\$} e^{\$} + P_m^o Q_m^o e^o] \quad <22>$$

where

TB^d = merchandise trade balance in terms of domestic currency,
 $P_x^d, P_x^{\$}, P_x^o$ = export unit price denominated in terms of domestic currency, the U.S. dollar, and a weighted average of other currencies except the U.S. dollar, respectively,

$P_m^d, P_m^{\$}, P_m^o$ = import unit price with denominations as in the exports,
 $Q_x = Q_{xd} + Q_{xs} + Q_{xo}$ = corresponding volume of exports,
 $Q_m = Q_{md} + Q_{ms} + Q_{mo}$ = corresponding volume of imports,
 e = domestic currency units per U.S. dollar, and
 e^o = domestic currency units per weighted-average of major currencies, excluding the U.S. dollar.

As pointed out earlier, the group countries' currencies play almost no role at all in settling international contractual obligations, and the countries therefore are strictly constrained for foreign payments by their receipts from exports.¹⁴ Moreover, the group countries' exports are almost entirely invoiced in dollars, no matter where the export commodities are destined, while their imports could, conceivably, be settled in terms of almost any convertible currency. Therefore, it is reasonable to set Q_x^d, Q_m^d , and Q_x^o equal to zero. Hence, <22> simplifies to

$$TB^d = P_x^{\$} Q_x^{\$} e^{\$} - [P_m^{\$} Q_m^{\$} e^{\$} + P_m^o Q_m^o e^o]. \quad <23>$$

From <23>, changes in the exchange rate of the U.S. dollar affect TB^d directly through $e^{\$}$ and indirectly through

¹⁴ This argument is consistent with what is known as the "foreign-exchange gap" in economic development literature. The two-gap model distinguishes between low domestic savings, the "saving gap," and insufficient foreign exchange resources, the "foreign-exchange gap." The foreign-exchange gap arises not only out of domestic currency inconvertibility, but also out of commodity inconvertibility. In McKinnon's words, foreign exchange inconvertibility for nonresidents implies that the national monetary authority is not obligated to repurchase domestic-currency balance from foreigners at a known parity; and commodity inconvertibility implies that domestic currency owned by nonresidents can not be freely used to purchase domestic goods and services for exports (1979, p. 48).

e^0 . That is, variations in the TB^d depend, among other things, on the extent to which the value of the U.S. dollar changes against other major currencies. For instance, when the dollar depreciates against domestic currencies of the group countries, other major currencies may depreciate, gain value, or remain unchanged against these currencies. That is, $\Delta e^s < 0$, may be associated with $\Delta e^0 < 0$, $\Delta e^0 > 0$, or $\Delta e^0 = 0$. Therefore, theoretically, the merchandise trade balance in terms of domestic currency can change in any direction following dollar fluctuations. This implies that the direction of change in TB^d in response to changes in the dollar's value is indeterminate. In other words, a model of trade balance in terms of domestic currency such as <23>, which includes different exchange rates of domestic currency, is inappropriate for analyzing the impact of changes in the exchange rate of the dollar on these countries' trade balances. The problem with TB^d , however, could be resolved when TB is written in terms of dollars

$$TB^s = P_x^s Q_x^s - [P_m^s Q_m^s + P_m^0 Q_m^0 E] \quad <24>$$

where

TB^s = merchandise trade balance in terms of U.S. dollars,
 E = units of the U.S. dollar per weighted average of other major currencies.

When the trade balance and exchange rate are defined in terms of dollars, depreciation of the dollar, $\Delta E > 0$, clearly leads to deterioration of the trade balance, while appreciation does the opposite. Therefore, unlike other

studies of LDCs' trade flows, this study utilizes the dollar exchange rate and excludes the domestic currency exchange rate of the group countries from the model.

A key issue in assessing the impact of changes in the dollar's value on the group countries' trade flows, and consequently on their merchandise trade balance, is to determine which measure of dollar exchange rate to employ. A study by Anderson et al. (1987) suggests that the method of index construction has a significant impact on estimates of the effect of changes in the dollar's value on the balance of trade. While different measures of the dollar's foreign currency price do exist, clearly, each measure could properly fit into a specific setting of trade flow analysis. The choice of a specific measure of the dollar's foreign currency price should be motivated by the nature of the trade flows being investigated. In examining the effect of changes in the dollar's exchange value on a bilateral trade between the U.S. and Germany, for instance, the most appropriate measure of the dollar would be its price relative to the Deutsche mark. However, when analyzing the impact of changes in the dollar's value in a multilateral trade framework, no single bilateral exchange rate could adequately reflect changes in the dollar's value; therefore, a broad measure (weighted-average) of dollar value would be more appropriate. In effect, the dollar may change in varying degrees against any number of individual floating currencies; a weighted average of all the bilateral

changes is required to determine the true change in the exchange value of the dollar. Such an average is called the effective exchange rate of the dollar. Several possible weights can be used in calculating the average, and correspondingly, each currency can have several effective exchange rates.¹⁵ For instance, to mention only a few, the Federal Reserve Board (FRB), the Morgan Guaranty Trust Company (MG), and the International Monetary Fund (IMF) have constructed some of the well-known dollar effective exchange rate indices. The path in which any dollar index moves could be significantly affected by the choice of currencies included, weights applied to each currency, and by accounting for inflation. For instance, between 1980:III and 1985:I, the FRB's measure of the dollar appreciated by more than 83 percent. At the same time, the Federal Reserve Bank of Cleveland's (FRBC) measure rose as just over 78 percent. However, from 1985:I to 1986:III, while the FRB index depreciated by about 31 percent, the FRBC index showed that dollar depreciated by only 9 percent, and that depreciation offset considerably much less of the dollar's previous

¹⁵ Both the bilateral and effective exchange rates are known as the nominal exchange rates because they do not account for inflation differentials at home and in foreign countries. For that reason they do not adequately reflect the change in the country's relative competitive position in the world market.

To measure the changes in a country's competitive position, the nominal rates should be adjusted for inflation differentials between the trading countries. This measure is called the real exchange rate.

appreciation.

Studies dealing with the dollar exchange rate indices, such as Pauls (1987) and Anderson et al. (1987), suggest that no single measure of weighted-average exchange rate index is appropriate for the trade flow analysis under different circumstances of commodity groups or trading partner countries.

In principle, the weights assigned to each foreign currency in an index should reflect the importance of that currency with respect to the economic problem being analyzed. The two most common weighing schemes, however, are bilateral trade and multilateral trade shares. The most broad-based effective exchange rate index of the dollar is constructed in such a way as to reflect U.S. exports and imports of merchandise to and from the rest of the world. Such an index is the Federal Reserve Board's trade-weighted average index of dollar value which incorporates ten major currencies. This index will be utilized as a major exchange rate index in this study, see Appendix C for details.

CHAPTER IV

Discussion of the Empirical Results

IV.1 Iran

The results of the estimation of the aggregate import prices and quantities for Iran are illustrated in Tables 8-11. Each equation is estimated based on quarterly data using a Yule-Walker estimation procedure with a correction for the first-order autocorrelation whenever it is detected. Equations are estimated separately over the entire period of study, 1960:I through the 1980s, 1960:I-1971:III, and 1971:IV through the 1980s. Definitions of the variables are given in the tables. All variables are used in natural logarithm form. Unusual events such as the breakdown of the Bretton Woods system and the first and second sharp increases of oil price, which are expected to influence trade flows, are accounted for by applying dummy variables.¹

Since one can not expect theory to indicate the length of lag and degree of polynomial, determining these--(m) and (p)

¹ The so-called "first-oil-shock" is a reference to an almost fourfold price increase associated with the October 73-March 74 Arab oil embargo. The second oil shock, on the other hand, refers to the disruption in oil supply triggered by the Iranian revolution in 1979 that caused prices to more than double.

Table 8. Iran, Import (60:I-86:III)

Import Price¹**Long-Run Coefficient Estimates (60:I-86:III)²**

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg	Rsqr ³
3.698* (22.632)	-0.818* (-29.63)	0.99* (107.76)	0.0058/94	2763		0.99
Lag Quarter	0	1	2	3	4	5
Log E	-0.205* (-9.32)	-0.196* (-20.07)	-0.173* (-13.05)	-0.136* (-9.88)	-0.086* (-7.60)	-0.022 (-0.99)
Log INWP	0.581* (5.99)	0.331* (2.97)	0.08 (0.85)			

Aggregate Import Volume⁴**Long-Run Coefficient Estimates (61:II-86:I)**

Constant	Log GDP ⁵	DUMMY1	Log IMUV ⁶	Log IRWP	F-stat.	Reg	Rsqr
-2.85* (-2.89)	1.16* (8.869)	0.34 (1.81)	0.582 (1.69)	-0.29 (-1.768)	96.68		0.86
Lag Quarter	0	1	2				
Log IMUV	0.884 (0.353)	-4.806 (-1.06)	4.504 (1.773)				
Log IRWP	-0.392 (-0.535)	0.098 (0.135)					

SSE/df=3.80/89

t-statistics are in parentheses.

1- A fixed(0)/flexible(1) dummy variable--fixed versus flexible exchange rate regime--is adopted to test for the stability of the intercept parameter. The dummy coefficient is found insignificant at the 10 percent level. That is, the intercept parameter might not have shifted when the Bretton Woods system broke down.

2- The sum of the estimates of the contemporaneous and lagged coefficients of each variable is interpreted as long-run

elasticity.

3- The REG RSQ is a measure of the fit of the structural part of the model after transforming for the autocorrelation and is the R^2 for the transformed regression.

4- The dependent variable is defined as the logarithm of a country's merchandise import minus the logarithm of the aggregate import unit value index.

5- Examination of lag structure on the GDP variable did not improve the present results.

6- Some researchers drop a model-designated variable from the estimation equation when its estimated coefficient turns out to be insignificant. There are two problems with this practice. First, there is a question of whether we are allowing the sample data to determine a model, or to examine the way in which sample data explain an already proposed model. Second, from a statistical viewpoint, dropping a relevant variable causes a more serious problem than does adding an irrelevant one. Exclusion of a relevant explanatory variable, unless it is independent of the remaining explanatory variables, leads to biased estimates of coefficients of other explanatory variables. Also, estimated variance of the coefficients would be downward biased, which invalidates the application of the t-test. Inclusion of an irrelevant variable, however, yields unbiased but inefficient estimates, while t-test remains valid.

Definition of symbols and variables:

*	= significance at the 5 percent level.
SSE	= Sum of Squared Errors.
df	= degrees of freedom.
D-W	= Durbin-Watson statistics.
INWP	= Industrial Countries Wholesale Price index, (1980=100).
GDP	= Gross Domestic Product of Iran at 1985 prices.
DUMMY1	= 73-74 oil-shock dummy variable.
IMUV	= Import Unit Value index of Iran, (1980=100).
IRWP	= Iran's Wholesale Price index, (1980=100).
E	= Index of trade weighted-average exchange value of the U.S. dollar against currencies of other G-10 countries plus Switzerland (March 1973=100).

Table 9. Iran, Import (60:I-71:III)

Import Price**Long-Run Coefficient Estimates (60:I-71:III)**

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg Rsq
2.25* (3.38)	-0.532* (-3.86)	1.013* (35.19)	0.00033/38	367.36	0.97
Lag Quarter	0	1	2		
Log E	-0.283* (-2.587)	-0.249 (-1.862)			
Log INWP	0.34* (3.315)	0.366* (3.155)	0.307* (2.89)		

Aggregate Import Volume**Long-Run Coefficient Estimates (60:III-71:III)**

Constant	Log GDP ¹	Log IMUV	Log IRWP	SSE/df	F-stat.	Reg Rsq
-5.60 (-1.27)	1.045* (2.80)	-1.23 (-0.48)	2.65 (1.55)	0.63/35	31.55	0.81
Lag Quarter	0	1	2			
Log IMUV	7.35 (1.04)	-21.60 (-1.83)	13.02 (1.92)			
Log IRWP	-1.372 (-0.245)	4.02 (0.726)				

1- Examination of lag structure on the GDP variable did not improve the present results.

Table 10. Iran, Import (71:IV-86:III)

Import Price

Long-Run Coefficient Estimates (71:IV-86:III)

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg	Rsqr
3.73* (19.69)	-0.775* (-18.87)	0.942* (45.29)	0.0048/47	470.6	0.98	
Lag Quarter	0	1	2	3	4	5
Log E	-0.199* (-6.50)	-0.189* (-14.43)	-0.166* (-9.33)	-0.129* (-6.95)	-0.078* (-5.47)	-0.014 (-0.486)
Log INWP	0.526* (3.468)	0.342* (2.109)	0.074 (0.55)			

Aggregate Import Volume¹

Long-Run Coefficient Estimates (73:I-86:I)

Constant	Log GDP ²	Log IMUV	Log IRWP	SSE/df	F-stat. ³	Reg	Rsqr
-8.91 (-1.61)	1.67* (3.22)	1.29* (2.25)	-0.47* (-2.127)	3.06/43	3.86	0.30	
Lag Quarter	0	1	2				
Log IMUV	-0.009 (-0.002)	-1.51 (-0.226)	2.81 (0.758)				
Log IRWP	-0.733 (-0.731)	0.263 (0.263)					

1- The estimated coefficient of the 73-74 oil-shock dummy variable is found insignificant at the 10 percent level, therefore it is dropped from the regression equation.

2- Examination of lag structure on the GDP variable did not improve the present results.

3- significant at the 5 percent level.

Table 11. Iran, Import (60:I-80:III)

Import Price**Long-Run Coefficient Estimates (60:I-80:III)**

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg	Rsqr
2.902*	-0.705*	1.05*	0.0028/70	3678		0.996
(6.707)	(-9.54)	(44.72)				
Lag Quarter	0	1	2	3	4	5
Log E	-0.169*	-0.179*	-0.166*	-0.13*	-0.07*	0.009
	(-5.48)	(-11.48)	(-8.59)	(-6.31)	(-3.69)	(0.254)
Log INWP	0.581*	0.383*	0.093			
	(6.62)	(4.087)	(1.59)			

Aggregate Import Volume**Long-Run Coefficient Estimates (61:II-80:III)**

Constant	Log GDP ¹	DUMMY1	Log IMUV	Log IRWP	F-stat.	Reg	Rsqr
-3.39*	1.235*	0.389	-0.17	0.50	93		0.89
(-3.42)	(8.691)	(1.84)	(-0.19)	(0.703)			
Lag Quarter	0	1	2				
Log IMUV	-1.29	-2.87	3.99				
	(-0.388)	(-0.478)	(1.195)				
Log IRWP	-0.051	0.548					
	(-0.045)	(0.481)					

SSE/df = 2.977/67

1- Examination of lag structure on the GDP variable did not improve the present results.

respectively--becomes an important empirical problem. Most studies estimate regression parameters for time series data by using distributed lag models in which distribution of the lag is modeled by imposing the number of lags and/or the degree of polynomial.² To impose a less *a priori* structure, of course, means that more information has to be extracted from the data. The best approach would be a procedure that lets the data determine the number of lags and degree of polynomial.

In this study, therefore, unlike most other studies, the number of lags and degree of polynomial are not restricted to an *a priori* assumed number. A two-step procedure is adopted in order to deal with the determination of the lag length and degree of polynomial.

First, to test for the length of lag, the estimation of each equation is started with a possible maximum number of lags of each independent variable without any constraint imposed on the lag distribution. For instance, for the import price equation, contemporaneous terms of the exchange rate and

² A partial list of studies which use second-degree polynomial distributed lag models includes: Ahluwalia and Hernandez (1975), Stern et al. (1979), Anderson et al. (1987), Hooper and Mann (1989), Moffett (1989), and Deyak et al. (1990). The application of a second-degree polynomial distributed lag model is primarily based on the belief that a single turning point best describes the lag influences. In other words, the influences of changes in explanatory variables first build up, peak, and then decline. Ahluwalia and Hernandez apply a second-degree polynomial distributed lag model based on the results shown by Amemiya and Morimune (1974), where the optimal degree of polynomial is negatively related to the degree of multicollinearity and to the smoothness of the lag distribution.

industrial countries' wholesale price variables plus eight (m^*) and four (n^*) lagged-terms of each independent variable, respectively, are incorporated into the equation. When the estimated coefficient of a far-end lagged term is found insignificant, this term is dropped from the equation and the estimation is continued with m^*-1 and n^*-1 lagged-terms on the right hand side. The process of estimation is continued each time by dropping a far-end lagged term until no insignificant coefficient estimate is found. In addition, for choosing among similar results, the sign and significance level of the coefficient of the independent variables, as well as the goodness-of-fit, are taken into consideration.

Second, to determine the appropriate degree of polynomial, with the lag length determined in the previous step, estimation is started with a fairly high degree of polynomial (p^*), which could be equal to $(m-1)$. The degree of polynomial is reduced by one whenever an insignificant coefficient is encountered for the highest degree polynomial. As in the first step, the process is continued until the last significant coefficient is found.³

Since for most cases the estimation results lead to the selection of lags in the range of two to five quarters, a fourth degree polynomial appears to be the first one to be

³ As Kmenta (1986) points out, the difficulty with selecting the length of the lag and the degree of the polynomial in this way is that the true level of significance is unknown.

tested for selection. With the sequential testing procedure described above, fourth, third, and second degree polynomials are rejected at the 5 percent significance level for all cases of estimations (with a few exceptions for the second degree). However, the estimation results obtained from the second-degree polynomial with at least three lags of each variable turn out to be quite similar to those obtained in step one. That is to say, equations estimated both with unconstrained distributed lags and with second-degree polynomial distributed lags yield similar values for both short-run and long-run coefficient estimates. In order to facilitate comparison between the results of this study and similar ones, the results reported below are those obtained from the second-degree polynomial distributed lag structure. Throughout the study, the estimation results of the aggregate import price and aggregate import quantity (or aggregate export price and aggregate export quantity) equations are shown in tables for the different periods in the following sequence: 1960:I-1980s, 1960:I-1971:III, and 1971:IV-1980s, referred to as the entire period, the Bretton Woods, and the post-Bretton Woods periods respectively. Also, this sequence is followed in explaining the results.

Estimates of the long-run effect of foreign wholesale prices (the industrial countries' wholesale price index) and of exchange rates on import prices--the import unit value index is used as a proxy--have the expected signs and they are

statistically significant (Tables 8-11).⁴ A negative sign on the coefficient estimate of the effective exchange rate of the dollar implies that the import price in terms of dollars rises or declines as the dollar depreciates or appreciates against other major currencies.⁵ The magnitude of the exchange rate elasticity has been subject to change from the Bretton Woods era to the floating exchange rate regime. Estimates of the long-run exchange rate elasticities, -0.532 and -0.775, for the fixed and floating exchange rate regimes (Tables 9-10) suggest that the introduction of a generalized floating exchange rate system contributed to the higher sensitivity of import prices. In addition, comparison of the long-run exchange rate elasticities between the Bretton Woods (60:I-71:III) and the 60:I-80:III periods, -0.532 and -0.705--the

⁴ As a measure of the price of domestically produced tradeable goods, the wholesale price index has some disadvantages. For instance, it includes imported goods and non-tradeable domestically produced goods. It is, nevertheless, the best available measure of domestic prices.

⁵ Because a unit value index measures changes in the average value of imports per physical unit, and given the heterogeneity of various categories of commodities used in import statistics, a change in the unit value index generally involves an unknown combination of price change and variation in the product mix. The problem is even more complicated when the currency denomination of import contracts is accounted for. Since exporters to the U.S. may attempt to absorb part of a devaluation of the dollar by reducing the local currency price of their exports, the price of the proportion of contracts denominated in U.S. dollars agreed upon following changes in the exchange rate may not respond as much as the proportion in terms of non-U.S. dollars. Despite these problems, researchers tend to agree that the import unit value index is the best proxy available for an import price variable.

latter encompassing a nine-year period of the floating exchange rate system--would endorse the notion that the floating exchange rate mechanism actually contributed to a greater degree of responsiveness in the import prices to changes in the exchange rates. Specifically, during the post-Bretton Woods period, a 10 percent decline in the exchange rate of the dollar caused import prices expressed in dollars to rise by 7-8 percent, leaving a 2-3 percent price-cut to be borne by exporters. The time period during which import prices respond to changes in exchange rates under fixed and flexible exchange rate environments are different and deserve an explanation.

During the fixed exchange rate period, the estimated coefficient of the first quarter lagged-term is found insignificant. This implies that changes in the exchange rate under the fixed rate regime could influence the import prices almost instantaneously, while for the floating-rate regime, the corresponding time period is four quarters (Table 10). This phenomenon might be considered as a reflection of the uncertainty involved with the floating exchange rate or simply the frequent changes in exchange value. Under the fixed exchange rate regime, one would expect that trade partners would take into account any exchange rate realignments almost as soon as they were established. Moreover, the new exchange rate would be utilized with a fair degree of confidence about the stability of the exchange market. On the contrary, the

unpredictability of the exchange market under the floating rate environment coupled with the frequent movements of exchange rates leads to sluggish import price responses.

Another outcome which deserves close attention is the differences in the time span during which the import price responded to changes in exchange rates and foreign wholesale prices. Except for the fixed exchange rate period, adjustment time following changes in exchange rate was longer than that for changes in the foreign wholesale prices. The different patterns of adjustment of the import price in response to changes in its determinants could be explained by nothing better than the fact that industrial countries' wholesale prices--as a proxy for their export prices--have been relatively more stable and therefore, to a certain degree, more easily predicted by the importing agents. For the entire time period (60:I-86:III), adjustment times following changes in foreign prices are shorter than are those following changes in exchange rates--one quarter vs. four quarters.⁶ It is interesting to note that the foreign price elasticity of the country's import price was close to unity for the entire period and the fixed/flexible periods as well. This implies that:

⁶ Similarly, a study by Deyak et al. (1990), "The Effects of Exchange Rate Changes on Prices and Quantities in U.S. Foreign Trade" for the 1958-85 period concludes that "changes in foreign prices appear to affect the price of imports much more quickly than changes in the exchange rate."

1) The foreign price elasticity of import price remained invariant with respect to different exchange rate regimes.

2) The country's import price rose nearly as much as the percentage increase in the industrial countries' wholesale price. Thus, to the extent that Iran's imports were semi-manufactured goods and production inputs, the total cost of output was driven up by the percentage increase in the industrial countries' wholesale price times the share of imported goods in total cost of production. In general, however, rises in the industrial countries' wholesale prices translate directly into inflation in Iran by the ratio of imports to GDP. There is, however, a difference between the ways in which changes in the dollar exchange rate and industrial countries' wholesale prices influence the country's import price. While exporters absorb 20 to 30 percent of changes in exchange rate, they do not share the burden in case of a general price rise.

With regard to the aggregate import demand equation, the estimates of the real GDP coefficient for the entire period, 61:II-86:I, as well as for the sub-periods have the correct sign and they are all statistically significant--the coefficient estimates range from 1.05 to 1.67. An income elasticity of 1.16 for the whole period indicates that imports are quite sensitive to changes in domestic real income. It could also be concluded that income affects volume of imports much more rapidly than does the exchange rate, if the latter

has any impact at all. Except for the long-run effect during the post-Bretton Woods period, the estimates of the short-run and the long-run effects of import price are found insignificant and with mixed signs.⁷ The outcome strongly suggests that the country's import demand is price inelastic. That is, import price caused neither a short-run nor a long-run impact on the country's import volume, implying either that domestic goods are not good substitutes for imported goods or that the volume of domestic output falls short of domestic needs.⁸ Finally, except for the 73:I-86:I period, the estimates of the long-run and short-run effects of domestic wholesale price on the country's volume of imports were found to be insignificant and to have mixed signs. Although the results derived from the quantity equations are not quite promising--at least because of relatively poor goodness-of-fit criteria--they should nevertheless suffice for the main purpose of this study, which is to determine whether and how import price and domestic wholesale prices do influence the volume of imports.

The results of the estimation of the aggregate export price--the export unit value index is used as a proxy--and

⁷ Except for the equations estimated over the Bretton Woods and the 61:II-80:III periods, the estimates of the long-run coefficient of import price carry unexpected signs.

⁸ It should be noted that, in international trade literature, high income elasticity and low or negligible price elasticity of demand for imports are quite common phenomena for developing countries.

aggregate quantity equations are shown in Tables 12-14. The exchange rate variable is identical to that used in the import price equation. Since for most of the 60:I-71:III period, the export unit value of the country remained constant--5.4 for 44 consecutive quarters of 60:I-70:IV and 6.0, 6.7 and 7.1 (index, 85=100) for the last three quarters until 71:III, the export price equation is not estimated over this time period. For the entire period as well as the post-Bretton Woods period, the long-run estimates of the coefficient of the domestic wholesale price index and of the exchange rate indicate that both of these variables do influence the export price of the country. The estimated coefficients of the lagged terms of the exchange rate suggest that, as in the case of import price, adjustment to such a change occurs within four quarters (Tables 12 and 14). The long-run relationship between the export price and the domestic wholesale price index is found positive and statistically significant for both the 60:I-85:IV and 71:IV-85:IV periods. The significant impacts of domestic wholesale price and the exchange rate of the dollar on export price seem to be inconsistent with the traditional wisdom about oil price determination in international markets. Since petroleum is normally priced and paid for in terms of U.S. dollars, it is therefore believed that oil prices may remain invariant with respect to changes in the dollar's value. Also, it is expected that individual oil exporting countries have only a minimal, if any at all,

Table 12. Iran, Export (60:I-85:IV)

Export Price¹

Long-Run Coefficient Estimates (60:I-85:IV)

Constant	Log E	Log IRWP	SSE/df	F-stat.	Reg	Rsqr
8.69* (4.075)	-2.70* (-6.00)	1.76* (17.39)	0.837/91	71.47		0.79
Lag Quarter	0	1	2	3	4	5
Log E	0.625* (2.313)	-0.346* (-2.365)	-0.911* (-4.98)	-1.07* (-5.39)	-0.832* (-3.63)	-0.17 (-0.421)
Log IRWP	0.77* (2.77)	0.409 (1.134)	0.582* (2.045)			

Aggregate Export Volume²

Long-Run Coefficient Estimates (62:I-83:IV)

Constant	Log	INGDP	DUMMY1	DUMMY2	Log EXUV	Log INPW	Reg	Rsqr
-10.99* (-2.98)	1.95* (2.84)	1.116* (2.25)	-0.706* (-2.018)	-1.58* (-3.96)	2.51* (2.339)			0.55
Lag Quarter	0	1	2					
Log EXUV	-0.612 (-1.244)	-0.213 (-0.357)	-0.754 (-1.67)					
Log INPW	-5.65 (-1.10)	8.16 (1.60)						

SSE/df = 9.212/78, F-Stat. = 13.97

1- A fixed/flexible exchange rate dummy variable is examined in order to test the stability of the intercept parameter when the Bretton Woods system came to an end. The coefficient of the dummy variable, however, turned out to be insignificant at the 10 percent level.

2- The dependent variable is defined as the logarithm of a country's merchandise export minus the logarithm of the aggregate export unit value index.

Definition of variables:

DUMMY1 = 73-74 oil-shock, DUMMY2= 79-80 oil-shock.

INGDP = Industrial Countries Gross Domestic Product at
Current Prices/ Industrial Countries GDP Deflator
(1980=100).

EXUV = Export Unit Value index of Iran (1985=100).

Table 13. Iran, Export (62:I-71:III)

Aggregate Export Volume¹

Long-Run Coefficient Estimates (62:I-71:III)

Constant	Log INGDP	Log EXUV	Log INPW	SSE/df	F-stat.	Reg Rsq
-12.70*	2.22*	0.288	1.56	1.619/35	63.82	0.78
(-6.32)	(2.38)	(0.364)	(0.75)			

D-W = 1.99

1- Lagged terms of EXUV and INPW are both found insignificant at the 5 percent level.

Table 14. Iran, Export (71:IV-85:IV)

Export Price

Long-Run Coefficient Estimates (71:IV-85:IV)

Constant	Log E	Log IRWP	SSE/df	F-stat.	Reg Rsq	
8.80*	-2.49*	1.54*	0.896/44	26.18	0.74	
(3.80)	(-4.54)	(10.17)				
Lag Quarter	0	1	2	3	4	5
Log E	0.645	-0.315	-0.873*	-1.029*	-0.783*	-0.135
	(1.55)	(-1.47)	(-3.28)	(-4.15)	(-4.017)	(-0.28)
Log IRWP	0.624	0.30	0.616			
	(1.362)	(0.50)	(1.312)			

Aggregate Export Volume

Long-Run Coefficient Estimates (73:I-83:IV)

Constant	Log INGDP	DUMMY2	Log EXUV	Log INPW	D-W	Reg Rsq
22.82*	-2.41*	-0.966*	-0.87*	1.80	1.97	0.82
(3.16)	(-2.46)	(-3.414)	(-2.29)	(1.80)		
Lag Quarter	0	1	2			
Log EXUV	0.346	-0.453	-0.762			
	(0.482)	(-0.515)	(-1.426)			
Log INPW	-9.75	11.55				
	(-1.49)	(1.78)				

SSE/df = 4.978/34, F-Stat. = 25.85

market power in dictating the price of their main export, petroleum, following changes in their domestic wholesale price level. Nonetheless, the results suggest that export (oil) prices are influenced both by changes in exchange rate of the dollar and domestic wholesale price. For instance, a drop in the value of the dollar with respect to other major currencies or a rise in the domestic rate of inflation--measured by a rise in the domestic wholesale price index--leads to a higher price of export from this country. More specifically, the magnitude of the long-run estimate of the coefficients of exchange rate of the dollar (-2.70) and of domestic wholesale price (1.76) for the 1960:I-1985:IV period indicates a more than proportionate response of the export price to the changes in these variables. Final judgement on this issue--whether or not such export price behavior prevails in other study group countries--remains pending until similar investigations are applied and results are obtained for the rest of the group countries.

As in the case of aggregate import volume, predicated export price, which is obtained from the price equation, is utilized in the regression equation of the aggregate export volume with two lagged terms. Since export unit value, as a proxy for export price, experienced no meaningful variation during the Bretton Woods period, it is utilized in the quantity equation in its original form. The estimated long-run coefficients of the export price have the expected sign

for the entire period as well as for the post-Bretton Woods era. The lagged terms coefficients of the export price are, however, insignificant for the entire period and for sub-periods as well. Consequently, export price influences the demand for the country's exports only in the long-run. From a different viewpoint, in the short-run, industrial countries' demand for petroleum from Iran is unresponsive to changes in oil price. The behavior of the export price during the Bretton Woods period as well as the observation that demand for exports from Iran remained invariant with respect to oil-export price and industrial countries' wholesale price (see Table 13) could be justified when these relationships are looked at from a historical perspective. During the 1960s and early 1970s, international oil companies holding oil concessions in the Middle East became increasingly concerned about the possibility of nationalization of oil industries by the host countries. The consequence of such circumstances (fear of losing property rights) led the companies to shift production from the future more toward the nearer term. From 1960 to 1972, OPEC crude oil production increased 3.39 times from 7.874 millions barrels per day to 26.711 mbd--a 10.7 percent compound annual growth rate. Such output increases were matched by worldwide growth in demand with virtually no increase in nominal oil price.⁹ The estimated long-run

⁹ Widespread nationalization of crude oil production took place in 1973. By the end of 1973, the host countries were in complete control of production and sale of

coefficient of the industrial countries' wholesale price index--as a proxy for the substitute commodity prices in these countries--shows the expected sign, but it is statistically significant when the estimation is carried over the entire period. The estimates of the short-run effects of the industrial countries' wholesale prices are found insignificant at the 5 percent level.

Estimates of the industrial countries' real income elasticity of demand for crude oil from Iran reveal a salient feature which needs explanation. The estimates of real income elasticities of demand are positive and notably high--1.95 and 2.22 when the equations are estimated over the 62:I-83:IV and 62:I-71:III periods respectively. The estimate of real income elasticity changes drastically, -2.41, when the export demand equation is estimated over the 73:I-83:IV period. The negative relationship between the industrial countries' real income and demand for oil appears as an exception to the prediction of the model set forth in chapter III. Nonetheless, regarding real income elasticity estimates, two tentative conclusions are in order:

- 1) Considering the size of industrial countries' real income, especially relative to the size of Iran's economy, this country must have benefited substantially from the industrial countries' growth when the Bretton Woods regime was

petroleum.

in practice.¹⁰

2) The substantial decline in real GDP elasticity from 2.22 to -2.41 could be explained by the continuous rising trend of Iran's export volume during the 1960-1973 period and a moderately declining trend thereafter until 1978:III. The declining trend of oil exports from this country which started in 1973-74, the first oil-price shock, could be attributed to some energy conservation measures in the industrial countries. However, the observed negative relationship between industrial countries' gross domestic product and Iran's export volume is primarily due to the interruptions of oil production and exports caused by the revolutionary upheavals of 1979:I and the Iran-Iraq war 1982-1988.

With respect to the merchandize trade balance adjustment (the J-curve phenomenon) several observations are in order. First, during the 60:I-71:III period, the export-unit value remained constant, conceivably invariant with respect to exchange rate movements. On the other hand, import price experienced negative exchange rate elasticities (see Table 9). Specifically, a 10 percent drop in the dollar's value immediately resulted in a 5 percent rise in imports bill.

¹⁰ For an extensive exploration of the mutual dependence of open economies, and in particular, the spill-over effect of economic growth, one might refer to Thirlwall's law. Thirlwall's law states that a nation's maximum growth without an international payments constraint depends on two things: first, the ratio between the country's real income elasticity of demand for imports and that for the rest of the world; second, the world growth rate.

This implies that, assuming trade is initially balanced, and before quantities are given time to respond, the country's trade balance must have worsened following a downward change in the dollar's value. Since import quantity is influenced neither in the short-run nor in the long-run by changes in its own price, an offsetting quantity response is not expected to follow in order to prevent the trade balance from worsening. In sum, during the Bretton Woods period, exchange rates of the U.S. dollar and Iran's merchandise trade balance should have moved together. Second, for the post-Bretton Woods period, the long-run exchange rate elasticities of import and export prices are estimated to be -0.775 and -2.49 , respectively. Since the exchange rate elasticity of export price in absolute terms is considerably greater than the corresponding figure for the import price, one may conclude that, before quantity adjustment takes place, and assuming that trade is initially balanced, trade balance improves until four to five quarters following a discrete decline in the dollar's value. But the pattern of trade balance movements would be unambiguously reversed when the positive long-run price elasticity of import and negative long-run price elasticity of export are taken into account. In other words, within four quarters after a 10 percent decline in the dollar's value, import and export prices rise by 7.75 and 24.9 percent respectively. Rise in the export price dampens demand for exports from this country, whereas the demand for imports keeps rising even with higher

import prices. Taking together the price and quantity responses, the depreciation of the dollar, assuming trade is initially balanced, causes the trade balance to improve up to 4-5 quarters and to decline thereafter. That is, the country's trade balance should have followed, *ceteris paribus*, an inverted J-curve pattern.

IV.2 Venezuela

The estimation of the aggregate import price and quantity equations of Venezuela is carried out by applying the same functional forms and procedure as those used for Iran. The statistical results of the estimation are presented in Tables 15-17.

To begin with the interpretation of the import price equations, it is interesting to observe that the results are fundamentally similar to those obtained from the analysis of Iran's trade flows. The estimates of the long-run effect of foreign wholesale price and exchange rate on import price both have the expected sign and they are statistically significant. The magnitude of the long-run exchange rate elasticity witnesses virtually no change from the Bretton Woods regime to the post-Bretton Woods era, -0.75 vs. -0.76. All of the short-run coefficient estimates of the exchange rate and foreign wholesale price show correct signs. The way in which the import price responded to an exchange rate stimulus is

Table 15. Venezuela, Import (60:I-86:III)

Import Price¹

Long-Run Coefficient Estimates (60:I-86:III)

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg Rsq
3.609*	-0.799*	0.987*	0.0061/94	1901	0.99
(21.181)	(-23.61)	(101.75)			

Lag Quarter	0	1	2	3	4	5
Log E	-0.219*	-0.198*	-0.167*	-0.126*	-0.075*	-0.014
	(-9.71)	(-19.71)	(-12.33)	(-8.92)	(-6.44)	(-0.61)
Log INWP	0.589*	0.313*	0.085			
	(5.93)	(2.75)	(0.88)			

Aggregate Import Volume

Long-Run Coefficient Estimates (61:II-86:III)

Constant	Log GDP ²	Log IMUV	Log VENWP	SSE/df	F-stat.	Reg Rsq
1.488	1.274*	0.562*	-0.44*	1.77/92	29.41	0.61
(1.846)	(3.939)	(2.00)	(-2.60)			

Lag Quarter	0	1	2
Log IMUV	-1.407	0.258	1.711
	(-0.941)	(0.102)	(1.104)
Log VENWP	-1.97*	1.53	
	(-2.043)	(1.584)	

1- A fixed(0)/flexible(1) dummy variable, fixed versus flexible exchange rate regime, is found insignificant at the 10 percent level.

2- Examination of lag structure on the GDP variable did not improve the present results.

Definitions of variables:

VENWP = Venezuela's Wholesale Price Index (1980=100). Other variables such as GDP and IMUV have the same definitions as given in Table 8, except that they belong to the country whose trade flow is under examination.

Table 16. Venezuela, Import (60:I-71:III)

Import Price

Long-Run Coefficient Estimates (60:I-71:III)

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg Rsq
3.66* (5.06)	-0.751* (-4.90)	0.914* (33.57)	0.0005/38	323.33	0.97
Lag Quarter	0	1	2		
Log E	-0.495* (-3.715)	-0.256 (-1.545)			
Log INWP	0.416* (3.196)	0.280 (1.86)	0.218 (1.62)		

Aggregate Import Volume

Long-Run Coefficient Estimates (61:II-71:III)

Constant	Log GDP ¹	Log IMUV	Log VENWP	D-W	F-stat.	Reg Rsq
15.42* (3.00)	3.57* (3.47)	0.778 (0.68)	-7.182* (-3.275)	2.45	11.75	0.62
Lag Quarter	0	1	2	3		
Log IMUV	7.186 (1.776)	-10.803* (-2.667)	-8.8* (-2.245)	13.195* (2.926)		
Log VENWP	-13.26 (-1.59)	6.078 (0.837)				

SSE/df 0.44/35

1- Examination of lag structure on the GDP variable did not improve the present results.

Table 17. Venezuela, Import (71:IV-86:III)

Import PriceLong-Run Coefficient Estimates (71:IV-86:III)

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg Rsq
3.635*	-0.76*	0.938*	0.0048/47	480.2	0.98
(18.768)	(-18.11)	(44.19)			

Lag Quarter	0	1	2	3	4	5
Log E	-0.215*	-0.193*	-0.161*	-0.119*	-0.067*	-0.005
	(-7.013)	(-14.385)	(-8.259)	(-4.94)	(-2.40)	(-0.114)
Log INWP	0.524*	0.328*	0.086			
	(3.493)	(2.026)	(0.632)			

Aggregate Import VolumeLong-Run Coefficient Estimates (73:I-86:III)

Constant	Log GDP ¹	Log IMUV	Log VENWP	SSE/df	F-stat.	Reg Rsq
-9.63*	4.49*	-0.581	-0.286	0.596/45	14.70	0.61
(-4.00)	(6.607)	(-1.50)	(-1.91)			

Lag Quarter	0	1	2
Log IMUV	-2.027	0.573	0.873
	(-1.337)	(0.239)	(0.614)
Log VENWP	-1.49	1.204	
	(-1.83)	(1.47)	

1- Examination of lag structure on the GDP variable did not improve the present results.

very similar to that which was found for Iran. Under the fixed exchange rate system, changes in exchange rate, or realignments of exchange rate through a policy action, appear to have affected the import price in a much shorter time period than under the post-Bretton Woods system. Also, except for the fixed exchange rate period, import price responded to changes in foreign price in a shorter time period than it did to changes in exchange rate. The long-run foreign wholesale price elasticity of import price was close to unity and remained invariant with respect to different exchange rate systems. Unitary foreign wholesale price elasticity of import price, however, is consistent with the small country proposition, as the country under investigation appears to be a price taker for the commodities it imports. Specifically, depending upon the extent of import as a percentage of Venezuela's GDP, rises in industrial countries' wholesale prices cause higher costs of production, and therefore inflation, in Venezuela.

Real income elasticities of aggregate demand for imports are all positive and statistically significant. The magnitude of the elasticities are much greater than are the corresponding figures for Iran. In common with Iran, however, the country's real income elasticity for the post-Bretton Woods era is found to be greater than that for the Bretton Woods period (see Tables 16 and 17). This result suggests that, over time, these economies have become more "open toward

the rest of the world" in sense of absorbing more imports.

Venezuela's domestic wholesale price, as a proxy for domestic substitutes, while having an unexpected sign, shows a long-run impact on the aggregate import volume when the estimation is carried over the entire period and the Bretton Woods system. In addition, the estimates of the short-run effects, except for the contemporaneous term under the entire period, are insignificant and carry mixed signs. With respect to estimates of the domestic wholesale price as well as import price, the only plausible conclusion that can be made is for the post-Bretton Woods period. That is, neither of these two variables has any long-run impact on the aggregate demand for imports.

Estimates of the import price elasticity of aggregate import demand are not considerably different from those obtained for Iran. In particular, the estimates of the short-run and the long-run effects of import price are either insignificant or have unexpected signs. The signs and significance levels of the short-run estimates of the import price are mixed and therefore difficult to interpret. It is safe, however, to conclude that during the Bretton Woods and post-Bretton Woods periods, the country's aggregate import demand has been unresponsive to changes in import prices. Price insensitivity of aggregate import demand, in turn, implies that changes in exchange rate directly influence the import bill with almost no impact on the quantity. Hence,

aside from the export side of the trade balance, depreciation of the dollar puts the country's merchandise trade balance (in terms of U.S. dollars) in jeopardy with no offsetting quantity effect to help the merchandise trade balance to rebound--an effect which has long been argued by the neoclassical theory. The higher cost of imports would be more acute when a substantial portion of the country's imports was contracted and paid for in terms of non-U.S. dollar currencies. Therefore, unless some trade policy measures are adopted, market forces may not bring about a sustained trade balance equilibrium in the event of changes in the value of the dollar.

For Venezuela, in addition to the data on total exports and the aggregate export-unit value index, data series on total exports of crude petroleum and export unit value index of oil are also available. In the context of this study, the application of total-oil-exports and an oil-export unit price index is expected to produce more reliable results concerning the effects of changes in exchange rates on the price and quantity of trade on this commodity. The results of the estimation of the oil-export price--the oil-export unit value index is used as a proxy--and total-oil-exports are shown in Tables 18-20. For the 60:I-71:III period, the country's export unit value is almost constant, therefore an export

Table 18. Venezuela, Oil-Export (60:I-86:III)

Oil Export Price¹**Long-Run Coefficient Estimates (60:I-86:III)**

Constant	Log E	Log VENWP	DUMMY ²	SSE/df	F-stat.	Reg	Rsqr
11.80*	-3.17*	1.49*	0.34*	1.54/90	230.79	0.94	
(7.52)	(-9.38)	(16.23)	(3.32)				
Lag Quarter	0	1	2	3	4	5	
Log E	0.822*	0.295*	-0.132	-0.459*	-0.686*	-0.813*	
	(2.96)	(2.61)	(-1.18)	(-2.71)	(-3.71)	(-5.44)	
	6	7	8				
	-0.840*	-0.767*	-0.594				
	(-10.17)	(-5.19)	(-0.16)				
Lag Quarter	0	1	2				
Log VENWP	1.69	-0.146	-0.053				
	(1.71)	(-0.13)	(-0.052)				

Aggregate Oil Export Volume³**Long-Run Coefficient Estimates (62:I-83:IV)**

Constant	Log INGDP	Log OEXUV	Log INPW	F-stat.	D-W	Reg	Rsqr
10.41*	0.25*	-0.20*	-0.424*	212.57	1.85	0.93	
(18.47)	(2.10)	(-2.84)	(-1.97)				
Lag Quarter	0	1	2				
Log OEXUV	-0.005	0.36	-0.555*				
	(-0.036)	(1.94)	(-4.42)				
Log INPW	-0.795	0.371					
	(0.651)	(0.304)					

SSE/df = 0.793/79

1- Dummy variables for the two oil-price shocks of 73-74 and 79-80 are incorporated into the oil export equation, but their estimated coefficients turned out to be insignificant at the

10 percent level.

2- This is a fixed/flexible exchange rate dummy variable.

3- The dependent variable is defined as the logarithm of the country's oil export minus the logarithm of the oil export unit value index.

OEXUV = crude petroleum Export Unit Value Index of Venezuela (1985=100).

Table 19. Venezuela, Oil-Export (62:I-71:III)

Aggregate Oil Export Volume¹

Long-Run Coefficient Estimates (62:I-71:III)

Constant	Log INGDP	Log OEXUV	Log INPW	F-stat.	Reg Rsq
8.73*	0.158	-0.209	-0.104	3.10	0.21
(13.57)	(0.611)	(-1.225)	(-0.176)		
Lag Quarter	0	1			
Log INWP	3.789*	-3.893*			
	(2.09)	(-2.08)			

SSE/df = 0.07/33

1- Lagged terms of the OEXUV did not improve the goodness-of-fit, and their coefficient estimates turned out to be insignificant at the 5 percent level.

Table 20. Venezuela, Oil-Export (71:IV-86:III)

Oil Export Price¹**Long-Run Coefficient Estimates (71:IV-86:III)**

Constant	Log E	Log VENWP	SSE/df	F-stat.	Reg	Rsqr
8.197*	-2.19*	1.16*	1.04/45	42.8	0.82	
(5.54)	(-5.91)	(10.15)				
Lag Quarter	0	1	2	3	4	5
Log E	1.287*	0.481*	-0.145	-0.591*	-0.857*	-0.943*
	(4.02)	(4.17)	(-0.97)	(-2.80)	(-4.27)	(-7.85)
	6	7				
	-0.849*	-0.575				
	(-6.64)	(-1.54)				
Lag Quarter	0	1	2			
Log VENWP	0.50	-0.369	1.03			
	(0.42)	(-0.26)	(0.88)			

Aggregate Oil Export Volume**Long-Run Coefficient Estimates (73:III-83:IV)**

Constant	Log INGDP	Log OEXUV	Log INPW	F-stat.	D-W	Reg	Rsqr
10.44*	0.40	-0.124	-0.61*	33.2	1.99	0.83	
(14.10)	(1.55)	(-1.015)	(-2.056)				
Lag Quarter	0	1	2				
Log OEXUV	-0.371	0.756*	-0.509*				
	(-1.46)	(2.07)	(-2.20)				
Log INPW	2.32	-2.93					
	(1.44)	(-1.78)					

1- A dummy variable for the oil-price shock of 79-80 is incorporated into the oil export equation, but its estimated coefficient turned out to be insignificant at the 5 percent level.

price equation is not estimated over this time period.¹¹ There is, however, a noticeable difference between the results obtained here and those derived from the study of Iran's trade flows when the estimation is carried over the entire as well as the post-Bretton Woods periods.

The time period in which the oil-export price responds fully to exchange rate stimulus is longer than the corresponding time period obtained for Iran, six quarters vs. four quarters. The difference is conceivably a reflection of utilizing data series pertaining to trade in oil rather than data series involving aggregate export. The long-run exchange rate elasticities are found statistically significant and of correct sign for the entire period and the post-Bretton Woods period. Except for the contemporaneous and the first-lagged terms, the coefficients of all lagged terms of the exchange rate bear the expected sign.

The estimated long-run elasticity of domestic wholesale price is found positive and significant over the entire period and the post-Bretton Woods period as well. A positive and statistically significant relationship between domestic wholesale price and oil-export price, as in the case of Iran, suggests that the latter adjusts to changes in wholesale price

¹¹ The exchange rate as the only explanatory variable of the price equation results in a very low value of goodness-of-fit ($\text{Reg Rsq} = 0.06$), and the contemporaneous term plus the first-lagged term of the exchange rate variable lead to $\text{Reg Rsq} = 0.11$, meaning that much is left unexplained by the regression.

in these countries. This phenomenon is an indication of an individual oil exporting country's power to influence its export price of oil.

With regard to the aggregate oil export regression equations, industrial countries' real GDP as well as oil-export price do carry expected signs. The real GDP elasticities are rather small and, except for the 60:I-86:II period, they are insignificant. In general the real income elasticity of demand for Venezuela's exports is either insignificant or significant but almost negligible.

The long-run own price elasticity of demand for oil from this country when the equation is estimated over the 62:I-83:IV is significant, but it is very small. Yet, the estimates of the short-run impact of oil-export price indicate that the quantity responds fully to changes in its own price within two quarters. Therefore, total adjustment to changes in exchange rate, including price and quantity adjustment periods, takes place within nine quarters. But, when the export demand equation is estimated separately over the Bretton Woods and post-Bretton Woods periods, the estimates of the long-run own price elasticities are not significantly different from zero.

Finally, the industrial countries' wholesale price index, as a proxy for their domestic substitutes, is found to have no long-run impact on these countries' demand for petroleum from Venezuela during the Bretton Woods period. On the contrary,

for the post-Bretton Woods period, the long-run coefficient estimate of industrial countries' wholesale price is found significant, but with an unexpected sign. Estimates of real income as well as wholesale prices of industrial countries for the post-Bretton Woods period indicate a very limited increase in demand for Venezuela's exports. One reason for such a situation might be the measures of energy conservation in industrial countries which were triggered by two oil price shocks during this period.

In estimating the aggregate oil export demand equation for the Bretton Woods period, the unit-value index of oil, rather than the predicted value of price of oil is utilized. After different lag lengths on independent variables were examined, the most simple one, the equation with only two lagged terms of the industrial countries' wholesale price variable, seems to outperform other alternatives. The result of this estimation is shown in Table 19. The long-run coefficient estimates of the industrial countries' real GDP, wholesale price index, and oil export unit value are found statistically insignificant. Moreover, the R-Squared value is remarkably low, $R^2 = 0.21$. The very low R-squared, however, is not surprising because the oil export unit value remains almost constant for the 60:I-73:III period. One possible explanation for this situation was the excessive production of oil by companies holding concessions in the Middle East and consequent pressure on the price. Such an excessive

production was continued by the Middle Eastern countries even after the establishment of OPEC which caused a setback in the Venezuelan rate of production. It was under this circumstance that Venezuela remained the most enthusiastic advocate of prorationing measures in order to stabilize prices or push them upward. In fact, inelastic long-run price elasticity of demand for Venezuela's exports was a powerful incentive for production cuts since price reduction would not open up significantly consuming nations' markets for additional imports from this country.¹²

With respect to the merchandize trade balance adjustment, or the J-curve phenomenon, several observations are in order:

First, during 60:I-71:III, export price remains invariant with respect to exchange rate movements. On the other hand, import price experiences negative exchange rate elasticity. Assuming that trade is initially balanced, this implies that the country's trade balance, *ceteris paribus*, must have deteriorated following a downward change in the value of the

¹² On one occasion, Venezuela reportedly threatened to resign from OPEC if it did not tackle the problem of output control. The result was Resolution VII. 50, passed in November 1964 at the seventh conference, which expressed OPEC's concern over the continued decline of crude oil prices. At the ninth conference meeting in Tripoli in July 1965, OPEC adopted as a "transitory measure" its first production program, though no actual proposal for curtailment of production was made, the conference, on an experimental basis, formulated a limited percentage increase for 1966. The member countries, however, ignored the limits on their production levels. By June 1967, OPEC had lost all hopes for the immediate implementation of prorationing as a measure to establish or increase prices.

dollar. The long-run price elasticities of demand for imports and exports suggest that the country's volume of import and export are irresponsive to changes in their own prices, implying that during this period, the trade balance should have moved unambiguously in the same direction as did the exchange rate of the dollar.

Second, for the post-Bretton Woods period, exchange rate elasticities of import and export price are estimated to be -0.76 and -2.19, respectively. With no offsetting quantity adjustment, and assuming that trade balance is initially balanced, dollar depreciation, all other things unchanged, improves the trade balance. Import price adjustment takes only four quarters while export price adjustment occurs within 6 quarters, with no induced long-run quantity responses. Since the exchange rate elasticity of export price is, in absolute terms, considerably greater than the corresponding figure for the import price, trade balance continues to improve until six quarters following declines in the dollar value. It should be emphasized, however, that export price is the main factor contributing to the trade balance improvement, as its effect not only offsets the negative effect of the import price, but extends beyond the import price effect. One other observation related to Venezuela's trade flows is the magnitude of the real GDP elasticity estimates. For all of the time periods over which export and import equations are estimated, the country's real income elasticities of demand

for imports are remarkably greater than industrial countries' real income elasticity of demand for its exports. From the real income elasticity viewpoint, Venezuela's economy has been much more open to the industrial countries than the latter countries were toward Venezuela.

IV.3 Saudi Arabia

The estimation results of the aggregate import price and quantity equations for Saudi Arabia are reported in Tables 21-23. In general, the estimation of import price equations yields results similar to those obtained for Iran and Venezuela. The estimates of the long-run effect of changes in foreign wholesale price and exchange rate of the dollar on import price have the expected signs, i.e., positive and negative, respectively. The estimates of the long-run response of the import price to changes in exchange rate are considerably different over the different time periods. During the fixed exchange rate period, the long-run effect of changes in exchange rate on the import price is found to be insignificant, implying that the import price remained invariant with respect to changes in exchange rate of the dollar (Table 22). In contrast, during the flexible exchange rate period, changes in exchange rate do influence the import price and the full impact occurs within four quarters (Table 23). Moreover, changes in industrial countries' wholesale

Table 21. Saudi Arabia, Import (60:I-86:III)

Import Price¹**Long-Run Coefficient Estimates (60:I-86:III)**

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg Rsq
3.38*	-0.74*	0.98*	0.01035/94	940	0.98
(13.96)	(-15.46)	(66.39)			

Lag Quarter	0	1	2	3	4	5
Log E	-0.183*	-0.16*	-0.136*	-0.112*	-0.088*	-0.063
	(-6.16)	(-11.60)	(-7.00)	(-4.55)	(-2.78)	(-1.22)
Log INWP	0.694*	0.371*	-0.084			
	(5.37)	(2.54)	(-0.67)			

Aggregate Import Volume**Long-Run Coefficient Estimates (68:I-86:II)**

Constant	Log GDP ²	DUMMY1	Log IMUV	Log SAUCPI	F-stat.	Reg Rsq
- 2.56*	0.916*	-0.227*	-0.004	1.67*	315	0.97
(-6.87)	(3.99)	(-2.815)	(-0.014)	(8.66)		

Lag Quarter	0	1	2
Log IMUV	0.386	-1.58	1.19
	(0.50)	(-1.38)	(1.68)
Log SAUCPI	0.628*	1.048*	
	(2.307)	(4.031)	

SSE/df = 0.286/65

1- A fixed(0)/flexible(1) dummy variable, fixed versus flexible exchange rate regime, is found insignificant at the 10 percent level.

2- Examination of lag structure on the GDP variable did not improve the present results.

DUMMY1 = 73-74 oil-shock dummy variable.

SAUCPI = Saudi Arabia's Consumer Price index (1980=100).

Table 22. Saudi Arabia, Import (60:I-71:III)

Import Price

Long-Run Coefficient Estimates (60:I-71:III)

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg Rsq
1.53 (1.44)	-0.163 (-0.727)	0.724* (16.22)	0.000558/37	70.2	0.90

Lag Quarter	0	1	2
Log E	-0.19 (-1.29)	-0.084 (-0.475)	0.111 (0.622)
Log INWP	0.328* (2.46)	0.238 (1.58)	0.158 (1.126)

Aggregate Import Volume

Long-Run Coefficient Estimates (68:I-71:III)

Constant	Log GDP ¹	LogIMUV	LogSAUCPI	D-W	F-stat.	Reg Rsq
11.339* (3.16)	1.06* (3.53)	-5.146* (-4.07)	2.61* (4.343)	2.55	898.2	0.99

Lag Quarter	0	1	2	3
Log IMUV	2.369* (2.209)	-0.188 (-0.176)	-2.565* (-2.144)	-4.762* (-6.376)
Log SAUCPI	4.518* (7.499)	-1.909* (-4.214)		

SSE/df = 0.000303/8

1- Examination of lag structure on the GDP variable did not improve the present results.

Table 23. Saudi Arabia, Import (71:IV-86:III)

Import Price

Long-Run Coefficient Estimates (71:IV-86:III)

Constant	Log E	Log INWP	SSE/df	F-stat.	Reg	Rsqr
3.519*	-0.758*	0.967*	0.0098/47	235.2		0.96
(13.306)	(-13.20)	(33.31)				
Lag Quarter	0	1	2	3	4	5
Log E	-0.203*	-0.167*	-0.135*	-0.107*	-0.083*	-0.063
	(-4.647)	(-8.984)	(-5.31)	(-4.04)	(-4.109)	(-1.53)
Log INWP	0.748*	0.395	-0.176			
	(3.472)	(1.688)	(-0.904)			

Aggregate Import Volume¹

Long-Run Coefficient Estimates (73:I-86:II)

Constant	Log GDP ²	LogIMUV	LogSAUCPI	SSE/df	F-stat.	Reg	Rsqr
-4.48*	2.139*	-0.539	1.40*	0.1281/43	81		0.90
(-5.27)	(6.44)	(-1.84)	(6.60)				
Lag Quarter	0	1	2	3			
Log IMUV	-0.005	-0.763	-0.514	0.743			
	(-0.007)	(-1.65)	(-1.10)	(1.35)			
Log SAUCPI	0.693*	0.706*					
	(2.53)	(2.589)					

1- The estimated coefficient of the 73-74 oil-shock dummy variable is found insignificant at the 10 percent level; therefore it is dropped from the regression equation.

2- Examination of lag structure on the GDP variable did not improve the present results.

prices do influence the import price both in the short-run and the long-run. The time necessary for a full impact is very short and in no case exceeds one quarter. The estimate of the long-run effect of industrial countries' wholesale prices on the import prices is close to unity and, it shown no meaningful variation with respect to the different exchange rate systems. The results concerning the impact of foreign wholesale prices on Saudi Arabia's import price are similar to those obtained for Iran and Venezuela. That is, inflation in industrial countries, as measured by rises in wholesale prices, almost immediately causes a higher import bill for the group countries. Consequently, inflation in industrial countries gives rise to price level in the group countries by as much as the ratio of imports to their GDPs.

With regard to the aggregate import demand equation, the estimates of the real GDP coefficients are all positive and statistically significant over all periods. The real income elasticity of demand for imports for the post-Bretton Woods period is considerably greater than that for the fixed rate period. The estimated long-run effect of the import price has a negative sign and it is significant only during the Bretton Woods period. Short-run estimates of the import price show mixed signs; but they suggest, however, that own prices have been crucial in determining quantity of import during the fixed rate system. It is safe to conclude that after the breakdown of the fixed rate system, this country's demand for

imports has been insensitive to changes in its own price.

Finally, the estimated long-run coefficients of domestic consumer price index (as a proxy for domestic substitutes) do carry the expected (positive) sign and they are all statistically significant.¹³ Estimates of the short-run effects are also significant and the time during which the full impact of changes in consumer price on quantity of import takes place is only one quarter.

The results of the estimation of the aggregate export price and aggregate export quantity equations are reported in Tables 24-26. Because the export unit value index shows almost no change during the 60.I-71.III period, the export price equation is not estimated over this time period. The results derived from the estimation of the export price over the 63.I-85.IV and 71.IV-85.IV periods reveal that changes in exchange rate of the dollar are irrelevant for explaining variations in the export price of the country under investigation. The estimates of the long-run exchange rate coefficients are all notably small and statistically insignificant. Also, the short-run impacts of exchange rate are insignificant. That is, the export price responds to changes in exchange rate neither in the short-run nor in the long-run. This observation suggests that Saudi Arabia absorbs the exchange rate risk by keeping export price constant.

¹³ Since domestic wholesale price index is not available for this country, the consumer price index is utilized instead.

Table 24. Saudi Arabia, Export (63:I-85:IV)

Export Price ¹

Long-Run Coefficient Estimates (63:I-85:IV)

Constant	Log E	Log SAUCPI	SSE/df	F-stat.	Reg Rsq
-5.28*	-0.04	2.15*	1.176/85	92.89	0.76
(-2.61)	(-0.10)	(16.15)			

Lag Quarter 0 1

Log E	0.42	-0.463
	(0.96)	(-1.05)
Log SAUCPI	0.967*	1.18*
	(2.295)	(2.816)

Aggregate Export Volume²

Long-Run Coefficient Estimates (62:I-83:IV)

Constant	Log INGDP	Log EXUV	Log INPW	F Stat.	Reg Rsq
11.62*	2.6*	0.85*	-2.79*	105	0.87
(11.67)	(11.94)	(7.39)	(-7.36)		

Lag Quarter 0 1 2

Log EXUV	1.326*	-0.611	0.138
	(6.207)	(-1.82)	(0.632)
Log INPW	-1.95*	-0.84	
	(-2.34)	(-0.98)	

SSE/df = 0.393/80

1- The coefficient estimate of a fixed/flexible exchange rate dummy variable is found insignificant at the 10 percent level.

2- The coefficient estimate of a 73-74 oil-shock and of the 79-80 oil-shock dummy variables are found insignificant at the 10 percent level.

Table 25. Saudi Arabia, Export (62:I-71:III)

Aggregate Export Volume

Long-Run Coefficient Estimates (62:I-71:III)

Constant	Log INGDP	Log EXUV	Log INPW	SSE/df	F-stat.	Reg Rsq
-5.01*	1.31*	1.68*	2.2*	0.0069/32	416.5	0.98
(-3.42)	(9.28)	(3.54)	(6.38)			
Lag Quarter	0	1				
Log EXUV	-0.67	2.35				
	(-0.917)	(1.98)				
Log INPW	1.01*	1.1				
	(2.07)	(1.8)				

Table 26. Saudi Arabia, Export (71:IV-85:IV)

Export Price

Long-Run Coefficient Estimates (71:IV-85:IV)

Constant	Log E	Log SAUCPI	SSE/df	F-stat.	Reg Rsq
-5.258*	0.14	1.95*	1.128/50	21.19	0.55
(-2.021)	(0.269)	(7.627)			

Lag Quarter	0	1
Log E	0.556 (0.979)	-0.417 (-0.735)
Log SAUCPI	0.846 (1.52)	1.107* (2.04)

Aggregate Export Volume¹

Long-Run Coefficient Estimates (71:IV-83:IV)

Constant	Log INGDP	Log EXUV	Log INPW	SSE/df	Reg Rsq
15.815*	1.459*	0.996*	-3.15*	0.2578/39	0.78
(9.99)	(3.136)	(6.99)	(-6.89)		

Lag Quarter	0	1	2
Log EXUV	1.607* (6.152)	-0.977* (-2.426)	0.366 (1.398)
Log INPW	-2.68* (-2.54)	-0.466 (-0.432)	

F Stat. = 30.50

1- The coefficient estimate of a 73-74 oil-shock and of the 79-80 oil-shock dummy variables are found insignificant at the 10 percent level.

Price moderation through absorbing exchange rate risk is expected to ensure more sales and to expand market share, particularly in European and Asian markets. Such a pricing strategy is not an unexpected behavior when the following facts regarding the Saudi economy are considered:

1) Table 27 illustrates the group countries' market share--measured by the individual country's crude oil production as a percentage of OPEC's total production for the 1972-1990 period. Although Saudi Arabia's market share increased from 21.46 percent in 1972 to 42.44 percent in 1981 and declined thereafter, the trend of market share has been rising throughout the 1972-1990 period. During the last ten years, Saudi Arabia's crude oil production has settled to around 25 percent of OPEC production, indicating Saudi Arabia's ability to vary production and consequently to influence OPEC's posted prices (at least in the short run). In contrast, Iran's, and to a lesser extent, Venezuela's market shares have been declining during this period. From 1972 to 1990, for instance, Saudi Arabia's market share increased by 27.73 percent while Iran's and Venezuela's market shares declined by 28.71 and 23.9 percent respectively.

The analysis of the record of the market share may not be independent of the group countries' crude oil reserves. Saudi Arabia absorbs the exchange rate risks in order to expand its market share as this country possesses virtually one third of OPEC's oil resources (see Table 28). In 1991, while Saudi

Table 27. Market Share
(Crude Oil Production Percentage of OPEC)

Year	Saudi Arabia	Iran	Venezuela
1972	21.46	18.81	12.05
1973	23.67	18.91	10.86
1974	26.70	19.59	9.68
1975	25.10	19.67	8.63
1976	27.31	19.39	7.51
1977	28.69	18.14	7.12
1978	28.09	17.14	7.13
1979	29.93	10.25	7.62
1980	35.75	6.17	8.04
1981	42.44	6.09	9.29
1982	33.49	12.08	10.02
1983	27.75	14.21	10.15
1984	25.48	12.54	10.40
1985	20.41	14.01	10.06
1986	26.62	10.41	8.50
1987	22.90	13.80	8.85
1988	25.94	11.55	8.40
1989	22.60	13.17	7.90
1990	27.41	13.41	9.17

Source: Basic Petroleum Data Book, Petroleum Industry Statistics, Volume XI, Number 3, September 1991.

Table 28. Crude Oil Reserves

(Percentage of OPEC Reserves)

(Annually as of January 1)

Year	Saudi Arabia	Iran	Venezuela
1960	25.45	17.82	9.16
1961	24.88	17.41	9.20
1962	24.27	16.33	8.19
1963	23.64	16.82	7.73
1964	25.76	15.88	7.30
1965	25.37	15.93	7.13
1966	25.04	16.69	7.20
1967	23.66	15.85	6.24
1968	24.95	14.63	5.68
1969	23.60	16.55	4.75
1970	35.74	14.04	3.77
1971	29.75	16.21	3.24
1972	34.17	13.05	3.27
1973	29.77	14.02	2.95
1974	31.29	14.22	3.32
1975	33.92	13.61	3.09
1976	33.03	14.34	3.93
1977	34.38	14.31	3.47
1978	34.10	14.09	4.14
1979	37.24	13.26	4.05
1980	37.50	13.31	4.10
1981	38.00	13.24	4.13
1982	37.71	13.06	4.65
1983	36.48	12.42	4.83
1984	37.03	11.38	5.54
1985	35.49	10.18	5.43
1986	35.53	10.08	5.37
1987	34.85	10.21	5.33
1988	24.91	13.85	8.40
1989	25.16	13.74	8.60
1990	33.25	12.11	7.63
1991	33.28	12.00	7.63

Source: Basic Petroleum Data Book, Petroleum Industry Statistics, Volume XI, Number 3, September 1991.

Arabia maintained 33.28 percent of OPEC's reserves, Iran and Venezuela possessed only 12 and 7.63 percent respectively. Despite its potential power to influence price, Saudi Arabia seems to be concerned with the expansion of market size through acquiring higher marketshare by taking it away from other OPEC members.¹⁴ Comparing the magnitude of Saudi Arabia's crude oil reserves with those of other countries reveals Saudi Arabia's interest in producing substantial quantities of oil through absorbing the exchange-rate risk of the dollar. On the contrary, Iran and Venezuela produce less oil by relying on a short run price inelasticity of demand for petroleum to obtain the required revenues by adjusting their oil-export prices to decline in the exchange rate of the dollar.¹⁵

2) In addition to the production and oil-reserve potential arguments, Saudi Arabia's international reserve holdings may help to explain this country's support of the

¹⁴ In response to disruption of supply of crude oil from Iran due to the 1979 political situation and the Iran-Iraq war in 1980 and consequent price hike, Saudi Arabia raised its production to one of its highest levels in 1979-1981 (see Table 20).

¹⁵ This result is consistent with the analytical distinction between two groups of OPEC members namely "savers" and "spenders"--with Saudi Arabia in the first category and Iran and Venezuela in the second. A saver maintains a lower price in order to maximize long-run return, whereas a spender prefers large revenues in the short run by choosing higher prices even if it means smaller revenues later. The former prefers a policy in favor of present income, i.e., "price moderately and sell now," (Mead 1979).

dollar. Table 29 shows the group countries' international reserves as a cushion against price variation and the possibility of loss of revenue for the 1973-1990 period. Saudi Arabia could be distinguished from the other members by its huge amount of international reserves, an average of \$ 22.36 billions-worth during the 1978-1990 period. Since a large portion of its assets are denominated in U.S. dollars, Saudi Arabia is a nation which suffers the most from a decline in dollar's value. This situation explains Saudi Arabia's attitude in supporting the dollar. In this regard, the Saudi Arabian Oil Minister, Mr. Yamani's statement (May 4, 1978) in the midst of the dollar's continuous decline is self-explanatory:

It is in our interest not to take any action that may cause a further fall in the dollar rate. This explains the attitude of Saudi Arabia that you hear about regarding the question of the dollar. It is a sound attitude despite the great loss and despite the fact that it contradicts the attitude of other oil-producing countries. But it is an attitude that stems from Saudi interest.

Peter Osmos and David B. Ottaway quoted Mr. Yamani saying that:

Despite heavy pressure from most other oil exporting countries, Saudi Arabia continues to support the pegging of oil prices to the U.S. dollar, thus helping maintain the value of the American currency. In addition, it has been investing billions of its surplus oil dollars in U.S. banks and industry--in effect recycling American energy costs.

Saudi Arabia has no need to produce as much oil as it does today and could finance its ambitious economic development program with an output of only 5 million barrels a day instead of the present 8 million.

Table 29. Total Reserves Minus Gold¹
(Millions of U.S. Dollars, end of Period)

Year	Saudi Arabia	Iran	Venezuela
1973	3,747	1,078	1,940
1974	14,153	8,223	6,034
1975	23,193	8,744	8,403
1976	26,900	8,681	8,124
1977	29,903	12,106	7,735
1978	♦19,200	11,977	6,035
1979	19,237	15,210	7,320
1980	23,437	10,174	6,604
1981	32,236	...	8,164
1982	29,549	...	6,579
1983	27,287	...	7,643
1984	24,748	...	8,901
1985	25,005	...	10,251
1986	18,324	...	6,437
1987	22,684	...	5,963
1988	20,553	...	3,092
1989	16,748	...	4,106
1990	11,668	...	8,321

Source: IMF, IFS Various Issues.

1) International Reserves = SDRs + Reserve Position in the IMF + Foreign exchange.

♦ : a break in the comparability of data. Hence, data after this symbol do not form a consistent series with those for earlier dates.

... : data are not available.

In fact, he said, his country was losing money by producing so much oil to meet Western needs instead of leaving it in the ground where its value appreciates much faster than any dollar investment. Referring to the loss of revenue due to such high production paid for mostly in dollars, Yamani said, "it is on the whole not a pleasant thing to do" (see U.S. Congressional Record-Extensions of Remarks, May 4, 1978, pp. E2342-E2344).

3) Finally, it is worthwhile to investigate the trade balance surplus which can influence Saudi Arabian pricing behavior. Although a persistent surplus is not a desirable goal from the viewpoint of international liquidity, the surplus, or availability of foreign exchange, enables a country to finance its current and future trades without being compelled to raise its export price in order to meet foreign exchange demand. Table 30 shows the group countries' trade balances. Saudi Arabia's trade balance surplus, an average of \$ 24.5 billion per year over the 1972-1987, is substantially greater than the corresponding figures for Iran and Venezuela. Given the vast amounts of foreign exchange accumulated during the 1970s and 1980s it is not surprising to see that in several instances Saudi Arabia's production/pricing decisions were against the joint interests of other OPEC members.¹⁶ The relationship between export price and domestic consumer price is found to be positive and statistically significant for both

¹⁶ The difference in the trade balance surpluses among the group countries is better understood when the size of these countries, measured by population, is taken into account. In 1980, for instance, the population of Iran, Venezuela, and Saudi Arabia were 38.79, 15.62, and 9.23 millions respectively (United Nations, World Population Prospects, No. 86, 1985).

Table 30. Trade Balance¹
(Millions of U.S. dollars)

Year	Saudi Arabia	Iran ²	Venezuela
1972	2,714	1,376	930
1973	5,636	2,136	2,095
1974	26,563	14,100	7,209
1975	21,290	7,534	3,391
1976	25,246	10,859	1,916
1977	25,653	7,358	-638
1978	16,973	5,872	-2,150
1979	34,569	15,650	4,155
1980	75,155	1,450	8,174
1981	81,942	-1,307	7,840
1982	39,432	7,900	2,748
1983	12,444	3,480	8,162
1984	8,865	2,358	8,581
1985	7,029	...	7,130
1986	3,059	...	1,260
1987	4,854	...	1,735
1988	...	...	-1,347

Source: IMF, IFS, Yearbook 1990.

1) Trade balance = Merchandise Export f.o.b - Merchandise Import f.o.b (minus sign indicates debit).

2) Year beginning March 21.

... : Data are not available.

63:I-85:IV and 71:IV-85:IV periods. Similar results were found from the export price equations of Iran as well as Venezuela. The positive-significant relationship between domestic wholesale prices or consumer price index and export price is similar to the relationships which were found between industrial countries' wholesale prices and the group countries' import price. That is, domestic price levels in the industrial countries and the oil exporting countries alike do influence export prices.

With regard to estimation of the aggregate export equation, it is necessary to note that since the export price is not influenced by changes in the exchange rate of the dollar, the export unit value index is utilized instead. The estimated long-run coefficients of the export unit price have unexpected signs (positive) over all of the different time periods. That is, export demand rises following an increase in the export unit price. The adjustment of export volume, however, takes a maximum of one quarter to complete. Since not all of the short-run coefficients are positive, the only meaningful conclusion is that a long-run positive relationship exists between the export price and export volume. This relationship is primarily the result of Saudi Arabia's willingness to keep the export price of oil constant with respect to changes in the exchange rate of the dollar in order to benefit from higher sales.

The estimated coefficients of the industrial countries'

wholesale price index show that this variable does influence the volume of exports from this country both in the short run and the long run. Estimates with unexpected (negative) signs are derived when the equation is estimated over the 62:I-83:IV and the post-Bretton Woods periods. In contrast, the short-run and long-run estimated coefficients of the industrial countries wholesale price are significant and positive for the 62.I-71.III period. In all cases the full impact takes place within one quarter.

The industrial countries' real income elasticity of demand for this country's exports is positive and significant over different time periods. The industrial countries' estimated real income elasticity of demand for this country's exports show only a minor change over the Bretton Woods and post-Bretton Woods periods. However, the elasticities are much greater than are the corresponding figures for Venezuela. This occurrence will be discussed later in the next section.

Since changes in exchange rates do not affect this country's export price, the import side, that is the import price/import quantity is the only channel through which changes in exchange rate cause movement in the trade balance. In addition, during the Bretton Woods period, the estimated long-run effect of changes in exchange rate on the import price is also insignificant (Table 22); therefore, the merchandise trade balance remains unaffected by changes in exchange rate. In contrast, however, during the post-Bretton

Woods period, changes in exchange rate do influence import price. The negative short-run and the long-run effects of exchange rate indicate that changes in exchange rate and trade balance move in the same direction. That is, assuming that trade is initially balanced and before quantity response becomes effective, dollar depreciation causes the trade balance to deteriorate. The full impact, which is 76 percent of changes in exchange rate (Table 23), takes place in about four quarters. For the second part of a full transmission process, the estimates of the short-run and long-run impacts of changes in import price on the quantity of imports are all insignificant. Consequently, the import price is left as the only channel through which changes in exchange rate could influence the trade balance. Thus, dollar depreciation gives rise to the import price, and a rise in import price translates into a trade balance deterioration.

The final observation related to Saudi Arabia's trade flows is the real GDP elasticities. Similar to the results obtained for Iran and Venezuela for the post-Bretton Woods period, Saudi Arabia's real income elasticity of demand for imports is considerably greater than industrial countries' real income elasticity of demand for this country's exports.

IV.4 Comparison

This section pulls together the major results derived in this chapter so that the similarities and dissimilarities of the results can be discussed. This section, in essence, paves the path for presentation of the overall results and final conclusion.

Table 31 is a list of estimates of the long-run exchange rate elasticity of import and export prices. Columns 1, 2, and 3 display the estimates obtained from regressions over the entire period, the Bretton Woods and post-Bretton Woods periods, respectively.

Estimates of the long-run exchange rate elasticity of import-price are all negative and, except for Saudi's import-price estimated over the Bretton Woods period, statistically significant. Moreover, elasticities range from -0.53 to -0.82 and are settled around -0.75. The time period in which import prices respond to changes in exchange rates differs between the fixed and flexible rate regimes. During 60:I-71:III, import prices responded to changes in exchange rate of the dollar almost immediately, while for the 71:IV-86:III period, such a response took place within four quarters. The relatively sluggish response of the import price during the floating rate system could be mainly attributed to the uncertainty involved with the exchange rates, such that, at any given time, the next movement of the exchange rate was

Table 31. Estimates of the long-run Exchange Rate
Elasticities of Import and Export Prices

		Entire Period	B-W Period	Post B-W Period
Iran	Import	-0.82* (-29.63) (60:I-86:III)	-0.53* (-3.86)	-0.78* (-18.87)
	Export	-2.70* (-6.00) (60:I-85:IV)	-	-2.50* (-4.54)
Venez.	Import	-0.80* (-23.61) (60:I-86:III)	-0.75* (-4.90)	-0.76* (-18.11)
	Export	-3.17* (-9.38) (60:I-86:III)	-	-2.19* (-5.91)
Saudi Arabia	Import	-0.74* (-15.46) (60:I-86:III)	-0.163 (-0.727)	-0.76* -13.20)
	Export	-0.04 (-0.10) (63:I-85:IV)	-	0.14 (0.27)

unpredictable for traders.

Except for Saudi Arabia, estimates of the long-run exchange rate elasticity of export-price (Columns 1 and 3) are also negative and statistically significant. Long-run exchange-rate elasticities of export price are considerably greater than the corresponding figures of the import price elasticities. The major inconsistency in the results is Saudi Arabia's export-prices which are exchange rate unresponsive. The exchange-rate elasticity results could be stated simply in different words. For instance, during the post-Bretton Woods period, a 10 percent depreciation of the dollar caused import prices expressed in dollars to rise by 7.6 to 7.8 percent in the group countries, leaving a 2.4 to 2.2 percent export price cut by exporters who invoice in terms of currencies other than the U.S. dollar. In contrast, the same amount of dollar depreciation leads to a 25 to 22 percent rise in the export prices of Iran and Venezuela, and zero percent in Saudi Arabia. Table 32, which is generated from Table 31-column 3, shows the Pass-through figures for the post-Bretton Woods period.

In general, statistical results support a partial exchange rate Pass-through on the group countries' import prices--76-78 percent. With regard to the export prices, however, a distinction should be made among importing countries because of their domestic currencies. For the United States, for instance, a rise in its import prices from

Table 32. Percentage Change in Import and Export
Prices from a 10 percent Dollar Depreciation

Import Price Measured in:			Export Price Measured in:	
	Dollar	Other Currencies	Dollar	Other Currencies
Iran	+7.8	-2.2	+25	+15
Venez.	+7.6	-2.4	+22	+12
Saudi	+7.6	-2.4	0	-10

Iran, Venezuela, and Saudi Arabia following a 10 percent dollar depreciation would be 25, 22, and 0 percent, respectively. For countries other than the U.S., on the other hand, the change in their import prices would be 10 percent less than the figures for the U.S., +15, +12, and -10 percent. The figure for Saudi Arabia implies that since this country's export price of oil does not respond to changes in the dollar's exchange rate, the domestic currency price of imports from this country for importing countries other than the U.S. falls as much as the dollar depreciates. The stability of Saudi Arabia's export price, therefore, leads to more sales in countries other than the U.S. As we observe, for the cases of export prices, the Pass-through effect of dollar depreciation, instead of being partial, is considerably more than proportional--1.5 and 1.2 times the changes in exchange rates for exports from Iran and Venezuela. Whether this response is a result of rising prices of imports, in particular imported inputs for oil industry in these countries, or just pricing strategies, is not known from our results. But, clearly, the magnitude of export price responses is much greater than necessary as an adjustment to offset rises in import price or, in general, to keep these countries' export prices constant in terms of a basket of foreign currencies. The consequence of such a change in export price, as explained before, is, of course, loss of their market share to a country that absorbs the entire exchange rate fluctuations. The way in which

export prices respond fully to changes in the exchange rate of the dollar is quite similar to the pattern of exchange rate response of import prices--except for Saudi Arabia whose export price remains insensitive to changes in the exchange rate of the dollar.

Table 33 illustrates estimates of the long-run price elasticity of demand for imports and exports. In general, unlike the results obtained from the estimation of import and export price equations, the results of demand equations are less satisfactory, as 50 percent of the estimates are insignificant and have mixed signs. Specifically, interpretation of the results of import demand appears to be more troublesome than that of export demand. One could, however, easily distinguish cross country differences in responses of export demand to changes in own price. Export demand equations of Iran and Venezuela estimated over most of the time periods display the expected negative signs; in particular, they are significant for the entire period (column 1). In contrast, the estimates of the long-run price elasticity of demand for Saudi's exports are significant with positive signs over all of the time periods. This finding is the second aspect of Saudi Arabia's trade which differs from those of the other group countries. This result, however, may not be independent from Saudi Arabia's strategy toward absorbing fluctuations in the exchange rate of the dollar--what came to be known as price moderation. It is this

Table 33. Estimates of the long-run Price Elasticity
of Demand for Imports and Exports

		Entire Period	B-W Period	Post B-W Period
Iran	Import	0.58 (1.69) (61:II-86:I)	-1.23 (-0.48)	1.29* (2.25)
	Export	-1.58* (-3.96) (62:I-83:IV)	0.288 (0.364)	-0.87* (-2.29)
Venez.	Import	0.56* (2.00) (61:II-86:III)	0.78 (0.68)	-0.58 (-1.50)
	Export	-0.20* (-2.84) (62:I-83:IV)	-0.209 (-1.23)	-0.124 (-1.015)
Saudi Arabia	Import	-0.004 (-0.014) (68:I-86:II)	-5.15* (-4.07)	-0.54 (-1.84)
	Export	0.85* (7.39) (62:I-83:IV)	1.68* (3.54)	1.00* (7.00)

attitude of Saudi Arabia that makes it a preferred source of purchase when there is a price increase everywhere in oil-exporting countries.

Estimates of the exchange rate elasticities of import and export prices as well as of price elasticities of import and export demands can be used together to show the magnitude and length of movement in trade balances in response to changes in exchange rate. In doing so, first the sign, magnitude, and duration of impacts of changes in the exchange rate of the dollar on import and export prices are considered; second, the induced quantity responses are taken into account.

During the Bretton Woods period, quantities of imports and exports of Iran as well as of Venezuela remained unresponsive to changes in relative prices; therefore, changes in prices of traded goods were responsible for movement in nominal trade balances. In this period, depreciation of the U.S. dollar is found to have caused trade balances of Iran and Venezuela to decline almost immediately through higher prices of imports, while they exerted no impact on Saudi Arabia's trade balance (see Table 31, Column 2). However, during the post-Bretton Woods era, Iran is the only country whose import and export prices as well as quantities were instrumental in transmitting the influence of the exchange rate into the trade balance. As explained earlier, following depreciation of the dollar, this country's trade balance improved initially up to 4 quarters and worsened thereafter. For Venezuela, the

initial improvement took a longer time--6 quarters and, more importantly, the trade balance did not decline after the initial rise. Saudi Arabia's balance showed a substantially different response. The trade balance declined initially (up to 4 quarters) because of higher import prices. Yet the trade balance did not improve as quantity of imports failed to respond to offset the initial decline. This result is quite contrary to the cases of Iran and Venezuela, as this country's trade balance deteriorated following a decline in the dollar's value. Saudi Arabia's nominal trade balance response to changes in the exchange rate of the dollar as well as its international reserve holdings--predominantly in terms of U.S. dollars--justify this country's support of the U.S. dollar. In sum, while changes in the exchange rate of the dollar do influence these countries' trade balances in terms of U.S. dollars, the balances follow different adjustment patterns. That is, responses of the trade balances to changes in the exchange rate of the dollar are not identical among the group countries. In addition, each country's trade balance follows different adjustment patterns under the fixed and flexible exchange rate regimes. More specifically, this study does not support the J-curve phenomenon for any of the study group countries.

Estimates of real income elasticities of demand for imports and exports reveal expected (positive) signs and most

of them are statistically significant (see Table 34).¹⁷ Real income elasticities during the post-Bretton Woods period are greater than those in the corresponding figures for the Bretton Woods period. For Saudi Arabia, for instance, real income elasticities of demand for imports were 1.06 and 2.14 for the Bretton Woods and post-Bretton Woods periods respectively. This implies that during the post-Bretton Woods period, the shares of increases in real income spent on imports were greater than those in the previous period. In other words, over time, as economies grew, they become more interdependent. During the post-Bretton Woods period, the group countries' real income elasticities of demand for imports are greater than elasticities of demand for exports from these countries (see column 3); for Venezuela, real income elasticities of demand for imports have been greater than were the corresponding figures for export demand during both periods. That is, the proportion of income growth which was spent by the group countries on imports of manufactured and semi-manufactured commodities from industrial countries is greater than was the corresponding number spent by the industrial countries on exports from the group countries. The elasticity figures, taken as measure of dependency imply that, over time, the group countries have become relatively more dependent on imports from industrial countries than have

¹⁷ The negative real income elasticity of demand for Iran's exports is an exceptional case which was explained before.

Table 34. Real Income Elasticities of
Demand for Imports and Exports

		Entire Period	B-W Period	Post B-W Period
Iran	Import	1.16* (8.87) (61:II-86:I)	1.05* (2.80)	1.67* (3.22)
	Export	1.95* (2.84) (62:I-83:IV)	2.22* (2.38)	-2.41* (-2.46)
Venez.	Import	1.274* (3.94) (61:II-86:III)	3.57* (3.47)	4.49* (6.61)
	Export	0.25* (2.10) (62:I-83:IV)	0.158 (0.611)	0.40* (1.55)
Saudi Arabia	Import	0.92* (3.99) (68:I-86:II)	1.06* (3.53)	2.14* (6.44)
	Export	2.60* (11.94) (62:I-83:IV)	1.31* (9.28)	1.46* (3.14)

industrial countries for imports of oil from the group countries.

Estimates of the long-run import-price elasticity of the industrial countries' wholesale prices as well as the long-run export-price elasticity of domestic wholesale prices are our final subjects of discussion. The elasticity of import-price with respect to industrial countries' wholesale prices is almost unity (see Table 35). This feature is robust across the group countries and over all of the time periods. That is, over a period not exceeding two quarters, the group countries' import prices rise virtually as much as the industrial countries' wholesale prices do. Hence, depending upon the share of imports in the group countries' GDP, a rise in the industrial countries' wholesale price leads to inflation in the group countries. Table 36 shows the ratios of imports to GDP for the group countries as well as the oil-exporting countries during the 1960-1986. For the oil-exporting countries, during the 1970s and 1980s, the ratio was roughly around 20 percent, implying that a 5 percent increase in the industrial countries' wholesale prices led to a 1 percent inflation in the group countries.

Table 37 illustrates the estimates of the long-run export-price elasticities with respect to the group countries' wholesale prices. All of the estimates carry positive signs, and are statistically significant. Contrary to the view that prices of primary commodities including oil are neither firm

Table 35. The Long-Run Import Price Elasticity of
Industrial Countries' Wholesale Prices

	Entire Period	B-W Period	Post B-W Period
Iran	0.99* (107.76)	1.013* (35.19)	0.942* (45.29)
Venezuela	0.987* (101.75)	0.914* (33.57)	0.938* (44.19)
Saudi Arabia	0.98* (66.39)	0.724* (16.22)	0.967* (33.31)

Table 36. Ratio of Imports to GDP

Year	Saudi Arabia	Iran	Venezuela	Oil Exporting Countries
1960	...	12.9	15.5	20.9
1961	...	13.2	14.9	19.6
1962	...	11.0	14.7	15.5
1963	16.6	10.1	12.7	15.0
1964	19.0	11.7	15.2	16.5
1965	21.9	13.6	16.3	17.2
1966	22.3	13.5	15.3	16.8
1967	19.7	14.7	15.5	16.3
1968	17.8	16.8	16.5	16.1
1969	21.6	14.4	16.5	15.8
1970	18.4	16.3	15.9	16.0
1971	16.0	14.6	16.1	15.9
1972	16.7	15.1	17.4	16.7
1973	18.0	13.2	16.5	17.0
1974	10.2	11.9	16.0	14.9
1975	10.6	19.9	21.8	20.2
1976	18.7	19.3	24.3	20.6
1977	25.2	17.4	30.2	22.7
1978	30.7	17.3	29.9	23.7
1979	32.9	10.8	22.0	20.0
1980	26.0	12.5	20.0	20.5
1981	22.9	11.8	19.7	22.2
1982	26.6	9.3	19.1	22.7
1983	32.6	11.5	12.9	20.7
1984	31.9	9.2	13.0	18.0
1985	25.9	6.9	13.3	15.3
1986	24.7	...	15.7	20.6

Source: IMF, IFS, Supplement on Trade Statistics, No. 15, 1988.

... : Data are not available.

Table 37. The Long-Run Export-Price Elasticity
of Domestic Wholesale Price¹

	Entire Period	Post B-W Period
Iran	1.76* (17.39) 60:I-85:IV	1.54* (10.17) 71:IV-85:IV
Venezuela	1.49* (16.23) 60:I-86:IV	1.16* (10.15) 71:IV-86:III
Saudi Arabia	2.15* (16.15) 63:I-85:IV	1.95* (7.63) 71:IV-85:IV

1- In the case of Saudi Arabia, instead of wholesale prices, the consumer price index has been utilized.

nor country specific, the export prices from the group countries are, in the long run, reflective of changes in domestic wholesale prices of these countries. Consequently, rises in the group countries' wholesale price led to inflation in the industrial countries through higher export price of oil; the magnitude of such an inflation depends, of course, on the share of oil-imports to the industrial countries' GDPs. Based on this result it is justified to conclude that:

1) Price levels in trading countries are linked to each other. In other words, for open economies, inflation in each country can be a domestic as well as a global phenomenon, or a combination of these two phenomena.

2) In the long run, to the degree of the elasticity estimates summarized in Table 34, the export price of oil is influenced by individual oil-exporting countries' domestic price levels. This result indicates that individual oil-exporting countries are sovereign nations each following its own revenue maximization path by influencing export price of oil. This outcome, therefore, contrasts with the "price fixing cartel" view of OPEC attempting to maximize its members' profits.

CHAPTER V

Summary and Policy Implications

Any trade policy measure designed for treatment of trade imbalances requires diagnosis of the elements responsible for the problem. Also, distinctions should be made among trade imbalances which arise under different circumstances. In particular, there may be cases of trade deficits caused by the processes of domestic factors of a developing economy and those beyond its control. Not only is such a knowledge crucial for domestic policymakers, but it is also instrumental to trade-related international organizations as well. For instance, the fact that some disturbances of trade balances are from external sources is acknowledged by the International Monetary Fund (IMF) and a compensatory financing facility has been adopted. In addition, to prevent trade balances from fluctuating following a long-run appreciation or depreciation of the U.S. dollar against other major currencies may force policymakers to react by shifting their demand for imports from one country to another.

This study is an empirical investigation of the effect of changes in the effective exchange rate of the U.S. dollar on the merchandise trade balances of three oil-exporting countries, Iran, Venezuela and Saudi Arabia for the period

1960 through the 1980s (as much of the 1980s as the data allow). The fundamental criterion for the choice of these countries is the fact that their export receipts are almost entirely in terms of U.S. dollars. Changes in the exchange value of the U.S. dollar against other major currencies, therefore, are expected to affect these countries' trade flows and merchandise trade balances in terms of U.S. dollars. To account for changes caused by different behaviors of the exchange rate, the investigation is carried over two quite distinct periods--the fixed and flexible exchange-rate systems characterized by long-run relative stability vs. frequent fluctuations. Within the exchange rate Pass-through framework, the full impact of changes in exchange rates on the trade balance is examined in two stages: first, the impact of exchange rate changes on prices of traded goods, and second, the impact of changes in the prices of traded goods on the trade volume.

In general, changes in the exchange rate of the dollar affected prices of imports in a notably shorter time during the Bretton Woods than the post-Bretton Woods period. The same outcome holds for the relationship between exchange rate and export prices--with the exception of Saudi Arabia, whose export price is not affected under any circumstances by changes in exchange rate of the dollar. Aside from the Bretton Woods period that the full impact of exchange rate changes on import price takes place very quickly, the time

period necessary for industrial countries wholesale price to influence import prices is shorter than the time necessary for changes in exchange rate of the dollar.

The results of statistical estimation indicate that the group countries experience a partial Pass-through effect of changes in the effective exchange rate of the U.S. dollar over their import prices. The estimates of the Pass-through effect carry expected signs (negative) and they are statistically significant across all of the group countries and periods. During the post-Bretton Woods period, magnitudes of the Pass-through effect are 76-78 percent, which are fairly consistent with the results obtained from studies of U.S. trade. For instance, the study by Hooper and Mann (1989:I) suggests a Pass-through estimate of 50-60 percent for manufactured import prices for the beginning of 1973 through July 1988, and Krugman and Baldwin (1987:I) suggest an estimate of 98 percent for non-oil import prices for the 76:2-85:1 period.

During the fixed-exchange-rate system, export-unit values of the group countries were virtually constant, implying that export prices remained invariant with respect to changes in exchange rate of the U.S. dollar. This observation is consistent with the increase in output by international oil companies holding oil concessions in the Middle East during the 1960s and early 1970s. Substantial output increases were matched by worldwide growth in demand with almost no increases in nominal price. On the contrary, during the post-Bretton

Woods period, the estimates of the long-run exchange rate elasticity of export prices of Iran and Venezuela are negative and statistically significant. The magnitudes of export-price responses, -2.5 and -2.19 for Iran and Venezuela, are remarkably greater than an adequate price adjustment to offset rise in import prices, or to keep export prices constant in terms of a basket of major currencies, or, in general, to provide a constant international purchasing power. Saudi Arabia is the only country whose export price remained irresponsive to changes in the dollar exchange rate during the flexible-exchange-rate system as well. That is, Saudi Arabia absorbed the exchange-rate risk (fluctuations of the U.S. dollar exchange rate) by keeping export prices constant. This country's pricing policy, or support of the U.S. dollar, is consistent with its own interest, i.e., revenue maximization through expansion of market share. This policy of Saudi Arabia is reflective of its economic and financial conditions such as oil reserve potentials, international financial reserves, as well as long-run surplus in trade balance.

The results obtained from the estimation of the effect of changes in import and export prices on the volume of traded goods are very diverse. The estimates of the long-run price elasticity of demand for exports from Iran, Venezuela, and Saudi Arabia are -1.58, -0.20 and +0.85, respectively (Table 26, column 1). The estimates of the long-run price elasticity of demand for Saudi Arabia's oil are significant and positive

for the entire period, the Bretton Woods, and the post-Bretton Woods periods. The insignificant long-run exchange rate elasticity of export price and positive-significant price elasticity of demand for Saudi Arabia's exports are the special features of its trade. That is, this country's export price does not increase following a decline in the value of the dollar, but industrial countries' demand for its exports becomes even higher when the price of oil rises in the group countries. Specifically, the long-run price elasticities of demand for exported oil from the group countries indicate that industrial countries shift their demand away from Iran and Venezuela in favor of Saudi Arabia when there is a rise in price of oil. With regard to these countries' export price/quantity strategies, estimates of the long-run exchange rate and export price elasticities indicate that Iran and Venezuela are price maximizers, while Saudi Arabia is concerned primarily with its market share. This result is consistent with the "absence of a unified OPEC policy" view which is based mainly on a distinction between Saudi Arabia's supply behavior and other OPEC members' price maximization decisions. Saudi Arabia's supply behavior, however, is not consistent with the "dominant producer model" of OPEC on the following grounds:¹

¹ One interpretation of OPEC is that the dominant producer member, Saudi Arabia, sets the price and allows other OPEC producers to sell all they want, while Saudi Arabia itself supplies the remaining demand. Saudi Arabia is therefore the "swing producer," absorbing demand and

1) Saudi Arabia's market share does not vary with demand for OPEC oil. In fact, this country's market share has witnessed a moderate upward trend during the last two decades, while Iran's and Venezuela's market shares have been declining (see Table 20). This record is not the kind of pattern one would expect to find under a dominant producer model. A cartel is supposed to benefit from higher prices, and the dominant producer is supposed to help maximize profits for the group. Saudi Arabia has not only been uninterested in raising prices, but has on several occasions decided to raise output in an attempt either to prevent the prices from rising or actually to force them down. Throughout 1979-1982, Saudi Arabia played a critical role by increasing its production to a record level conducive to oil price change within the range best for its own interests.

2) The differential between the long-run dollar exchange rate sensitivities of Saudi Arabia and Iran-Venezuela's export prices indicates that the latter countries are not price takers--that they do not simply accept a price chosen by Saudi Arabia to meet its own best interests.

3) The group countries' export price response to the

supply fluctuations in order to maintain the monopoly price. Thus, market share variability ought to result with the Saudi's market share declining during periods of falling demand for OPEC oil and rising during periods of growing demand. This would not be the pattern for other producers who, as price takers, have incentives to produce at substantial capacity levels whenever the dominant producer sets a high price and accepts declining future market share.

domestic wholesale price indicates that the export price of oil is, to some degree, reflective of changes in the exporting countries' domestic price levels.

The estimates of the real income elasticity of demand for imports and exports are, with only one exception, positive, and for most cases statistically significant for the group countries and industrial countries alike. Income effect is found to influence volume of trade in a much shorter time than do the exchange rate, import prices, or export prices. During the post-Bretton Woods period, the group countries' estimated real income elasticities of demand for imports were found to be considerably greater than were industrial countries' real income elasticity of demand for these countries' exports. Moreover, during the post- Bretton Woods period, real income elasticity figures have been greater than the corresponding figures during the earlier periods (with the exception of industrial countries' income elasticity of demand for Iran's exports during the post-Bretton Woods period). These findings imply that, over time, as economies grew, they spent higher shares of income growth on imports. In other words, the nations became further interdependent along the path of their economic growth. Further, the percentages of income growth which were spent by the group countries on imports from industrial countries have been greater than the corresponding figures for income spent by the industrial countries on exports from the group countries. Whether this situation is

the result of energy conservation measures by industrial countries or of increased demand by the group countries for imports, it implies that the group countries have become relatively more dependent on imports from industrial countries than have industrial countries for import of oil from the group countries.

Regarding merchandise trade balance movements of the group countries we conclude:

First, while changes in the exchange rate of the dollar do influence these countries' merchandise trade balance in terms of U.S. dollars, each country's trade balance illustrates different responses under fixed and flexible exchange-rate regimes.

Second, cross-country responses of trade balances to changes in the exchange rate of the dollar are not identical, even among the countries which are exporting the same highly homogeneous commodity.

Third, the J-curve phenomenon is not observed for any of the group countries.

Based on the findings of this study, the following conclusions and policy implications are in order:

1) Flexible exchange rates, in particular, fluctuations of the U.S. dollar exchange rate, cause the group countries' trade balances to deviate from their balanced position. Moreover, declines in the exchange rate of the dollar lead to higher costs for oil imports from Iran and Venezuela. Were it

not for Saudi Arabian price moderation/market-share expansion policies, industrial countries, especially the U.S., would have to incur higher costs of oil from the group countries following a decline in the exchange rate of the dollar.

2) It appears, therefore, that a fixed exchange rate environment can secure relatively more stable import and export prices for the group countries and industrial countries alike. Thus, the fixed exchange rate not only enables the group countries to maintain balanced trade positions, but it also leads to a stable energy price for industrial countries. Alternatively, indexation of the price of oil to a market basket of major currencies would ensure stable energy costs in oil importing countries (except the U.S.) and secure stable purchasing power for oil-exporting countries. Such a policy, of course, may not be a desirable one for the United States or for Saudi Arabia as it diminishes the dollar's dominance in international markets, leads to unstable energy costs in the U.S., and eliminates the fluctuating exchange rate as a factor being used by Saudi Arabia to expand its market share. It is, therefore, conceivable that the idea of oil price indexation to a basket of major currencies would get support as well as rejection from some oil-exporting and oil-importing countries alike.

3) In the past, OPEC has not been successful in practicing a coordinated production/pricing policy to maximize members' joint revenue. OPEC's inability to set a coordinated

pricing policy or to establish an effective output quota system in order to attain a sustainable price is primarily due to the positions taken by individual members. In particular, Saudi Arabia's market expansion (or price moderation) policy has not been consistent with other members' interests. Indeed, by shifting demand away from Iran and Venezuela in favor of Saudi oil, following a rise in oil prices, industrial countries have actually been encouraging Saudi's supply decisions, thereby deepening the differences among OPEC members' positions.

4) Despite Saudi Arabia's power to influence the market price of oil, other members of OPEC such as Iran and Venezuela could counteract its excessive unilateral oil production decisions by reducing their market shares. In other words, OPEC members excluding Saudi Arabia can not only prevent Saudi Arabian price reducing policies, but may also be able effectively to cause the price to rise.

5) Lack of a price coordination and output (market-share) arrangement among OPEC members are signs that reject the assumption of a collusive agreement between member countries. As it is shown in this study, OPEC member countries are not identical entities as their reactions differ substantially to a given external factor such as the exchange rate of the U.S. dollar. Clearly, OPEC members are sovereign states--with different resource endowments, different political views, and different capabilities of being able to influence other

members' decisions. The governments of OPEC member countries have always placed their national economic and political considerations above the common economic interests of the group. In an investigation on the international oil market, designing a cartel model of OPEC seems therefore as inappropriate as assuming perfect competition. An oligopolistic non-cooperative scheme with a game-theory approach seems closer to reality than the do collusive models in the literature.

6) The interdependency between industrial countries and the group countries is explored explicitly through price linkages and real income spillovers. Rises in domestic wholesale prices of the group countries as well as in industrial countries give rise to their export prices, and consequently, to higher price levels in their trade partner countries. While a coordinated price increase by the group countries, or OPEC in general, would lead to inflationary pressure and, at the same time, slowdown in real GNP growth of the industrialized countries, these developments would translate into higher import prices and a lower demand for the group countries' exports. Likewise, restrictive policies by industrialized nations, such as tariff or other policies that directly or indirectly dampen demand for oil from OPEC, will put pressure on OPEC-member countries' demand for manufactured commodities from industrial countries.

Since the demand for oil continues to be a function of

the real income growth of the world economy, and, in particular, that of industrial countries, given the current state of the world economy, a rising demand for oil is not expected for the foreseeable future. A price decline could take place in the near future if the major industrial economies fail to rebound from the current recession. Any coordinated attempt by OPEC members to regulate output in order to raise prices excessively would further worsen the world economy. However, based on experience in the past, there is no reason to expect that any deliberate attempt by OPEC to regulate the outflow of oil will succeed in the future. As a matter of fact, given the current state of political hostilities among the Persian Gulf members of OPEC, desperate war-induced financial needs as well as the recognition by high-reserve OPEC members that their long-run interests are better achieved by maintenance and gradual expansion of market shares than price maximization at the risk of losing market shares, an oversupply of oil and stagnant, if not a declining, oil prices--especially when Iraqi and Kuwaiti production of oil are resumed--are more likely than the otherwise.

REFERENCES

REFERENCES

Abrams, Richard K., "International Trade Flows Under Flexible Exchange Rates," Economic Review, Federal Reserve Bank of Kansas City, Vol. 65, March 1980, pp. 3-10.

Ahluwalia, Isher J. and Hernandez-Cata E., "An Econometric Model of U.S. Merchandise Imports Under Fixed and Fluctuating Exchange Rates," Staff Papers, IMF, Nov. 1975, No. 22, pp. 791-824.

Anderson, Gerald H., Karamouzis Nicholas V., and Skaperdas, Peter D., "A New Effective Exchange rate Index for the Dollar and its Implications for U.S. Merchandise Trade," Economic Review, Federal Reserve Bank of Cleveland, Quarter 2, 1987, pp. 2-23.

Augustine, Arize and Afifi, Rasoul, "An Econometric Examination of Import Demand Function in Thirty Developing Countries," Journal of Post Keynesian Economics, Vol. 1X, No. 4, Summer 1987, pp. 604-616.

Bahmani-Oshooee, Mohsen, "Determinants of International Trade Flows: The Case of Developing Countries," Journal of Developments Economics, Vol. 20, 1986, pp. 107-123.

Bahmani-Oskooee, Mohsen, "Devaluation and the J-Curve: Some Evidence from LDCs," The Review of Economics and Statistics, Vol. 67, Nov. 1984, pp. 500-504.

Balassa, Bela, "Export Incentives and Export Performance in Developing Countries: A Comparative Analysis," Weltwirtschaftliches Archive, Vol. 114, No. 1, 1978a, pp. 24-61.

Baldwin, R., "Hysteresis in Import Prices: the Beachhead Effect," American Economic Review, 78, 1988, pp. 773-785.

Baron, David P., "Fluctuating Exchange Rates and the Pricing of Exports," Economic Enquiry, No. 14, 1976, pp. 425-438.

Basevi, Giorgio, Cocchi, Daniela, and Lischi, Pier Luigi, "The Choice of Currency in the Foreign Trade of Italy," in Hodgman, Donald R. and Wood, Geoffrey E. (eds.), Monetary and Exchange Rate Policy, The MacMillan Press LTD, 1987.

Boylan, T. A., Cuddy, M. P., and O'Muircheartaigh, J., "The Functional Form of the Aggregate Import Demand Equation: A Comparison of Three European Economies," Journal of International Economics, Vol. 10, Nov. 1980, pp. 531-566.

Carse, Stephen, Williamson, John, and Wood, Geoffrey E. The Financing Procedures of British Foreign Trade, Cambridge University Press 1980.

Carse, Stephen and Wood, Geoffrey E., "Currency of Invoicing and Forward Covering," in Martin, Johan P. and Alasdair, Smith (eds.), Trade and Payments Adjustment Under Flexible Exchange Rates, London, Trade Policy Research Center, 1979, pp. 174-198.

Caves, R. and Jones, R., World Trade and Payments, 4th edition, Boston: Little, Brown, 1985.

Chow, Gregory C. and Lin, An-Loh, "Best Linear Unbiased Estimation of Missing Observations in an Economic Time Series," Journal of the American Statistical Association, Vol. 71, No. 355, Sept. 1976, pp. 719-721.

Clark, Peter B., "The Effects of Recent Exchange Rate Changes on the U.S. Trade Balance," in Clark, P.B., Logue, D.E., and Sweeney, R.J. (eds.), The Effects of Exchange Rate Adjustment, Washington: Dept. Treasury, 1977.

Cushman, David O., "The Effects of Real Exchange Rate Risk on International Trade," Journal of International Economics, Vol. 15, August 1983, pp. 45-63.

Cushman, David O., "US Bilateral Trade Flows and Exchange Risk During the Floating Period," Journal of International Economics, Vol. 24, 1988, pp. 317-330.

De Grauwe, Paul and Bernard de Bellefroid, "Long-Run Exchange Rate Variability and International Trade," in Arndt, Sven W. and Richardson, David J. (eds.), Real Financial Linkages Among Open Economies, Cambridge: MIT Press, 1987, pp. 193-212.

Dell, Sidney Samuel and Roger, Lawrence, The Balance of Payments Adjustment Process in Developing Countries, New York: Pergamon Press, 1980.

Deppler, Michael C., "Some Evidence on the Effect of Exchange Rate Changes on Trade," Staff Papers, IMF, No. 21, Nov. 1977, pp. 605-636.

Deppler, Michael P. and Ripley, Duncan M., "The World Trade Model: Merchandise Trade," Staff Papers, IMF, Vol. 25, No. 1, March 1978, pp. 147-206.

Deyak Timothy A., Sawyer Charles W., and Sprinkle Richard L., "The Effects of Exchange Rate Changes on Prices and Quantities in U.S. Foreign Trade," The International Trade Journal, Vol. 5, No. 1, Fall 1990, pp. 77-92.

Deyak Timothy A., Sawyer Charles W., and Sprinkle Richard L., "An Empirical Examination of the Structural Stability of Disaggregated U.S. Import Demand," The Review of Economics and Statistics, Vol. 71, 1989, pp. 337-341.

Di Liberto, Maryann F., "A Test for Structural Change in U.S. Real Trade and Trade Prices: Fixed Exchange Rate Period Vs. Flexible Exchange Rate Period," The International Trade Journal, Vol. 2, 1988, pp. 337-375.

Dooley, Michael P., "The Role of Reserves in the International Monetary System," in Michael, Posner (ed.), Problems of International Money, 1972-1985, IMF, 1985, pp. 97-112.

Dunlevy, James A., "A Test of the Capacity Pressure Hypothesis within a Simultaneous Equations Model of Export Performance," The Review of Economics and Statistics, 1980, pp. 131-135.

Farrell, Victoria S., De Rpsa, Dean A., and McCown, Ashby T., "Effect of Exchange Rate Variability on International Trade and Other Economic Variables: a Review of the Literature," Staff Studies, Board of Governors of the Federal Reserve System, No. 130, Dec. 1983.

Feinberg, Robert M., "The Effects of Foreign Exchange Movements on U.S. Domestic Prices," Review of Economics and Statistics, Vol. 71, 1989, pp. 505-510.

Fisher, Eric O'N., "A Model of Exchange Rate Pass-Through," International Finance Discussion Papers, Board of Governors of the Federal Reserve System, No. 302, Feb. 1987.

Froot, Kenneth A. and Klemperer, Paul D. , "Exchange Rate Pass-Through When Market Share Matters," American Economic Review, Vol. 79, 1989, pp. 637-654.

Gagnon, Joseph E. and Knetter Michael M., "Pricing to Market in International Trade: Evidence from Panel Data on Automobiles and Total Merchandise," International Finance Discussion Papers, Board of Governors of the Federal Reserve System, No. 389, Oct. 1990.

Gagnon, J., Knetter M., "Pricing to Market in International Trade: Evidence From Panel data on Automobiles and Total Merchandise," International Finance Discussion Papers, Board of Governors of the Federal Reserve System, No. 389, Oct. 1990.

Ghoshal, Animesh and Snyder, James, W., "Flexible Exchange Rate and International Trade: An Empirical Investigation of Bilateral Trade Flows," The International Trade Journal, Vol. 1, 1986, pp. 27-46.

Goldstein, Morris and Khan, Mohsin, "Large Versus Small Price Changes and Demand for Imports," Staff Papers, IMF, Vol. 23, March 1976, pp. 200-225.

Goldstein, Morris and Khan, Mohsin, "The Supply and Demand for Exports: A Simultaneous Approach," The Review of Economics and Statistics, Vol. 60, May 1976, pp. 275-286.

Goldstein, Morris, and Khan, Mohsin, "Income and Price Effects in Foreign Trade," in Jones, R.W. and Kenen, P.B. (eds.), Handbook of International Economics, Vol. 2, Elsevier Science Publishers B. V., 1985.

Gotur, Padma, "Effects of Exchange Rate Volatility on Trade," Staff Papers, IMF, Vol. 32, Sept. 1985, pp. 475-512.

Grassman, Sven, Exchange Reserves and the Financial Structure of Foreign Trade, Saxon House, D. C. Heath Ltd., 1973.

Grassman, Sven, "A Fundamental Symmetry in International Payment Patterns," Journal of International Economics, May 1973, pp. 105-116.

Grassman, Sven, "Currency Distribution and Forward Cover in Foreign Trade: Sweden Revisited," Journal of International Economics, May 1976, pp. 215-222.

Grossman, Gene M., "Import Competition From Developed and Developing Countries," The Review of Economics and Statistics, Vol. 64, pp. 271-281, August 1981.

Haynes, Stephen E. and Stone, Joe A., "Specification of Supply Behavior in International Trade," The Review of Economics and Statistics, Vol. 65, 1983b, pp. 626-631.

Haynes, Stephen E., Hutchinson, Michael M., and Mikessell, Raymond F., "U.S.-Japanese Bilateral Trade and the Yen-Dollar Exchange rate: An Empirical Analysis," Southern Economic Journal, Vol. 52, 1986, pp. 923-932.

Helkie, William L. and Hooper, Peter, "The U.S. External Deficit in the 1980s: An Empirical Analysis," International Finance Discussion Papers, Board of Governors of the Federal Reserve System, No. 304, Feb. 1987.

Himarios, D., "The Effects of Devaluation on the Trade Balance: A Critical View and Re-examination of Miles's New Results," Journal of International Money and Finance, Dec. 1985, No. 4, pp. 553-563.

Hoopre, Peter, "Forecasting U.S. Export and Import Prices and Volumes in a Changing World Economy," International Finance Discussion Papers, Board of Governors of the Federal Reserve System, No. 99, Dec.1976.

Hooper, Peter and Mann, Catherine L., "Exchange Rate Pass-through in the 1980s: The Case of U.S. Imports of Manufactures," Brookings Papers on Economic Activity, 1:1989, pp. 297-337.

Hooper, Peter and Kohlhagen, Steven W., "The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade," Journal of International Economics, Jan. 1978, pp. 485-511.

Houthakker, Hendrik S. and Magee, Stephen P., "Income and Price Elasticities in World Trade," The Review of Economics and Statistics, May 1969, pp. 111-125.

Johany, Ali D., "OPEC is not a Cartel: A Property Rights Explanation of the Rise in Crude Oil Prices," Ph.D. Dissertation, University of California, Santa Barbara, 1978.

Johnston, John, Econometric Methods, New York: McGraw-Hill, 1984.

Junz, Helen B., Rhomberg, Ruddolf R., "Price Competitiveness in Export Trade Among Industrial Countries," American Economic Review, Vol. 63, May 1973, pp. 412-418.

Justice, G., "The Impact of Exchange Rate Variability on International Trade Flows," Discussion Paper (Technical Series), Bank of England, London, No.4, Dec. 1983.

Katseli, Louka T., "Discrete Devaluation as a Signal to Price Setters: Suggested Evidence from Greece," in Sebastian, Edwards and Liaquat, Ahamed (eds.), Economic Adjustment and Exchange Rates in Developing Countries, The University of Chicago Press, 1986, pp. 296-331.

Kenen, Peter B. and Dani Rodrik, "Measuring and Analyzing the Effects of Short-Term Volatility in Rate Exchange Rates," The Review of Economics and Statistics, Vol. 68, May 1986, pp. 311-315.

Khan, Mohsin S. and Ross, Knud Z., "Cyclical and Secular Income Elasticities of the Demand for Imports," The Review of Economics and Statistics, Vol. 57, August 1975, pp. 357-361.

Khan, Mohsin S., "Import and Export Demand in Developing Countries," Staff Papers, IMF, Vol. 21, 1974, pp. 678-693.

Khan, Mohsin S. and Ross, Knud Z., "The Functional Form of the Aggregate Import Demand Equation," Journal of International Economics, Vol. 7, 1977, pp. 149-160.

Khan, Mohsin S. and Knight, Malcolm D., "Import Compression and Export Performance in Developing Countries," The Review of Economics and Statistics, Oct. 1987, pp. 315-321.

Kmenta, Jan, Elements of Econometrics, New York: Macmillan publishing Co., Inc., 1971.

Knetter, M., "Price Discrimination by U.S. and German Exporters," American Economic Review, 79, 1989, pp. 198-210.

Koch, Paul D. and Rosenewieg, Jeffrey A., "The U.S. Dollar and the Delayed J-Curve," Economic Review, Federal Reserve Bank of Atlanta, July-August 1988, pp. 2-15.

Koch, Paul D. and Rosenewieg, Jeffrey A., "The Dynamic Relationship Between the Dollar and Composition of U.S. Trade," Journal of Business and Economic Statistics, Vol. 8, No. 3, July 1990, pp. 355-364.

Kreinin, E. Mordechai, "Price Elasticities in International Trade," The Review of Economics and Statistics, Nov. 1967, pp. 510-516.

Kreinin, E. Mordechai, "Disaggregated Import Demand Functions--Further Results," Southern Economic Journal, July 1973, pp. 19-25.

Kreinin, E. Mordechai, "The Effect of Exchange Rate Changes on the Prices and Volume of Foreign Trade," Staff Papers, IMF, Vol. 24, 1977, pp. 297-329.

Kreinin, E. Mordechai, International Economics, A Policy Approach, Fourth Edition, Harcourt Brace Jovanovich, Inc., 1983.

Krueger, Anne O., Exchange-Rate Determination, Cambridge University Press, 1983.

Krugman, Paul R. and Baldwin, Richard E. "The Persistence of the U.S. Trade Deficit," Brooking Papers on Economic Activity, No. 1, 1987, pp. 1-55.

Krugman, Paul R., "Pricing to Market When the Exchange Rate Changes," in Arndt, S.W. and Richardson, J.D. (eds.), Real-Financial Linkages Among Open Economies, MIT Press, Cambridge, 1987, pp. 49-70.

Krugman, Paul, "Vehicle Currencies and the Structure of International Exchange," Journal of Money, Credit and Banking, XII, 3, August 1980, pp. 513-526.

Krugman, Paul, "The International Role of the Dollar: Theory and Prospect," in Bilson, John F.O. and Marston, Richard C. (eds.), Exchange Rate Theory and Practice, The University of Chicago Press, 1984, pp. 261-278.

Lastrapes, William D. and Koray, Faik, "Real Exchange Rate Volatility and U.S. Bilateral Trade: A VAR Approach," The Review of Economics and Statistics, 1989, pp. 708-712.

Litterman, Robert B., "A Random Walk, Markov Model for the Distribution of Time Series," Journal of Business and Economic Statistics, Vol. 1, No. 2, April 1983, pp. 169-173.

Magee, Stephen P. and Rao, Ramesh K. S., "Vehicle and Non-Vehicle currencies in International Trade," American Economic Review, LXX, 2, May 1980, pp. 368-373.

Magee, Stephen P., "Currency Contracts, Pass-through and Devaluation," Brooking Papers on Economic Activity, 1:1973, pp. 303-325.

Magee, Stephen P., "Prices, Income and Foreign Trade: A Survey of Recent Economic Studies," in Kenen, P.B. (ed.), International Trade and Finance: Frontiers for Research, Cambridge: Cambridge University Press, 1975, pp. 175-252.

Magee, Stephen P., "U.S. Import Prices in the Currency-Contract Period," Brookings Papers on Economic Activity, 1:1974, pp. 117-167.

Mann, Catherine L., "Prices, Profit Margins and Exchange Rates," Federal Reserve Bulletin, No. 72, 1986, pp. 366-379.

Marquez, J., "Bilateral Trade Elasticities," Review of Economics and Statistics, 72, 1990, pp. 70-77.

Marquez, J. and McNeilly, C., "Income and Price Elasticities for Exports of Developing Countries," Review of Economics and Statistics, 70, 1988, pp. 306-314.

Marston, R., "Pricing to Market in Japanese Manufacturing," Journal of International Economics, 29, 1990, pp. 217-236.

McKinnon, Ronald I., Money in International Exchange, The Convertible Currency System, Oxford University Press, Inc. 1979.

Meade, Ellen E., "Exchange Rates, Adjustment, and the J-Curve," Federal Reserve Bulletin, Oct. 1988, pp. 633-644.

Mead, Walter J., "An Economic Analysis of Crude Oil Price Behavior in the 1970s," Journal of Development and Energy, Spring 1979, pp. 213-228.

Miles, Marc A., "The Effects of Devaluation on the Trade Balance and the Balance of Payments: Some New Results," Journal of Political Economy, Vol. 87, June 1979, pp. 600-620.

Moffett, Michael H., "The J-Curve Revisited: An Empirical Examination for the United States," Journal of International Money and finance, Vol. 8, 1989, pp. 425-444.

Murray, Tracy and Ginman, Peter, "An Empirical Examination of the Traditional Aggregate Import Demand Model," The Review of Economics and Statistics, Vol. 58, Feb. 1976, pp. 75-80.

Mutti, John H., "The Specification of Demand Equations for Imports and Domestic Substitutes," Southern Economic Journal, No. 44, July 1977, pp. 68-73.

Page, S. A. B., "Currency of Invoicing in Merchandise Trade," National Institute Economic Review, London, No. 81, August 1977, pp. 77-81.

Page, S. A. B., "The Choice of Invoicing Currency In Merchandise Trade," National Institute Economic Review, London, No. 98, Nov. 1981, pp. 60-72.

Pauls, Dianne B., "Measuring the Foreign-Exchange Value of the Dollar," Federal Reserve Bulletin, June 1987, pp. 411-422.

Phaup, E. D., "The Demand for Imports, Estimates of Bilateral Trade Flows," Journal of Macroeconomics, Vol. 3, 1981, pp. 97-115.

Price, James E. and Thornblade, James B., "U.S. Import Demand Functions Disaggregated by Country and Commodity," Southern Economic Journal, Vol. 38, July 1972, pp. 46-57.

Ridler, Duncan and Yandle, Christopher A., "A Simplified Method for Analyzing the Effects of Exchange Rate Changes on Exports of a Primary Commodity," Staff Papers, IMF, Vol. 19 Nov. 1972, pp. 559-578.

Sebastian, Edwards, "Commodity Export Prices and the Real Exchange Rate In Developing Countries: Coffee in Colombia," in Sebastian, Edwards and Liaquat, Ahamed (eds.), Economic Adjustment and Exchange Rates in Developing Countries, The University of Chicago Press, 1986, pp. 235-266.

Spitaller, Erich, "Short-Run Effects of Exchange Rate Changes on Terms of Trade and Trade Balance," Staff Papers, IMF, 27, 2, June 1980, pp. 320-348.

Stein, Robert M., Jonathan Francis, and Bruce Schumacher, Price Elasticities in International Trade: An Annotated Bibliography, London: Macmillan Press, 1976.

Stern, Robert M., Baum, Christopher F., and Greene, Mark N., "Evidence on Structural Change in the Demand for Aggregate U.S. Imports and Exports," Journal of Political Economy, Vol. 87, 1979, pp. 179-192.

Stone, Joe A., "Price Elasticities of Demand for Imports and Exports: Industry Estimates for the U.S., The EEC and Japan," Review of Economics and Statistics, Vol. 61, May 1979, pp. 306-312.

Sultan Jahangir, "Transaction Exposure, the Choice of an Invoicing Currency, and the Effects on the Balance of Trade," Ph.D. Dissertation, Arizona State University, Dec. 1986.

Tavlas, George and Yuzuru, Ozeki, "The Increasing International Role of the Japanese Yen," IMF Survey, April 1. 1991.

Thirlwall, A. P. and Nureldin, Hussain M., "The Balance of Payments Constraint, Capital Flows and Growth Rate Differences Between Developing Countries," Oxford Economic Papers, November 1982.

Thursby, L. and Thursby, M., "How Reliable are Simple, Single Equation Specification of Import Demand?" Review of Economics and Statistics, 66, 1984, pp. 120-128.

Thursby, Jerry G., "A Test Strategy for Discriminating between Autocorrelation and Misspecification in Regression Analysis," The Review of Economics and Statistics, No. 63, Feb. 1981, pp. 117-123.

Thursby, Jerry G., "Alternative Specification Error Tests: A Comparative Study," Journal of the American Statistical Association, No. 74, March 1979, pp. 222-225.

Thursby, Jerry G. and Thursby, Marie C., "Bilateral Trade Flows, the Linder Hypothesis and Exchange Rate Risk," The Review of Economics and Statistics, Vol. 69, August 1987, pp. 488-495.

Thursby, Jerry G. and Thursby, Marie C., "The Uncertainty Effects of Floating Exchange Rates: Empirical Evidence on International Trade Flow," in Arndt, et al. (eds.), Exchange Rates, Trade and the U.S. Economy, Cambridge, MA: Ballinger Publishing Co., 1985, pp. 153-166.

Tyler, William G., "Growth and Export Expansion in Developing Countries: Some Empirical Evidence," Journal of Development Economics, Vol. 9, 1981. pp. 121-130.

Warner, Dennis and Kreinin, Mordechai E., "Determinants of International Trade Flows," The Review of Economics and Statistics, Vol. 65, Feb. 1983, pp. 96-104.

Wilson, John F. and Takacs, Wendy, "Differential Responses to Price and Exchange Rate Influences in the Foreign Trade of Selected Industrial Countries," The Review of Economics and Statistics, Vol. 61, May 1979, pp. 267-279.

Wilson, John F. and Takacs, Wendy, "Expectations and the Adjustment of the Trade Flows Under Floating Exchange Rates: Leads, Lags, and the J-Curve," International Finance Discussion Papers, Board of Governors of the Federal Reserve System, No. 160, April 1980.

Yoonbai, Kim, "Exchange Rates and Import Prices in the United States: A Varying-Parameter Estimation of Exchange-Rate Pass-through," Journal of Business and Economic Statistics, Vol. 8, No. 3, July 1990, pp. 305-315.

APPENDICES

Appendix: A

Sources of Data

Quarterly data series for the 1960 through the 1980s were taken from the sources published by:

1. International Monetary Fund (IMF):
 - a. International Financial Statistics, various monthly issues as well as the Yearbook.
 - b. Supplement on Trade Statistics, No. 4, 1982 and No. 15, 1988.
 - c. Supplement on Exchange Rates, No. 1, 1981 and No. 9, 1985.
 - d. Supplement on Price Statistics, No. 2, 1981 and No. 12, 1986.
 - e. Direction of Trade Statistics, various issues.
2. Organization for Economic Cooperation and Development (OECD):
Statistics of Foreign Trade, Series A, B and C.
3. United Nations:
International Trade Statistics, Yearbook.
4. The Board of Governors of the Federal Reserve System:
Federal Reserve Bulletin, various issues.

Appendix: B

For most developing countries, time series data for some variables such as real GDP, import unit value indices, or wholesale prices are either not available on quarterly basis or they are discontinued. Quarterly data series utilized in this study were generated from annual data series by applying "PROC EXPAND PROCEDURE," SAS/ETS User's Guide, Version 6, First Edition, 1988. The expand procedure converts time series from one sampling interval or frequency to another, from higher frequency to lower one and vis-a-versa. By default, the procedure fits cubic spline curves to the non-missing values of variables to form continuous-time approximations of the input series. Output series are then generated from the spline approximations. Figure 13 shows a graphic example of the performance of this procedure. Data series utilized in this example are obtained from IFS, Supplement on Price Statistics, IMF, No. 12, 1986.

Definitions of the variables are as follows:

VENWP = Venezuela's quarterly wholesale price index
(80=100) for the 72:I-78:I period.
PROCWP = quarterly values of the wholesale price index
produced from annual data series.

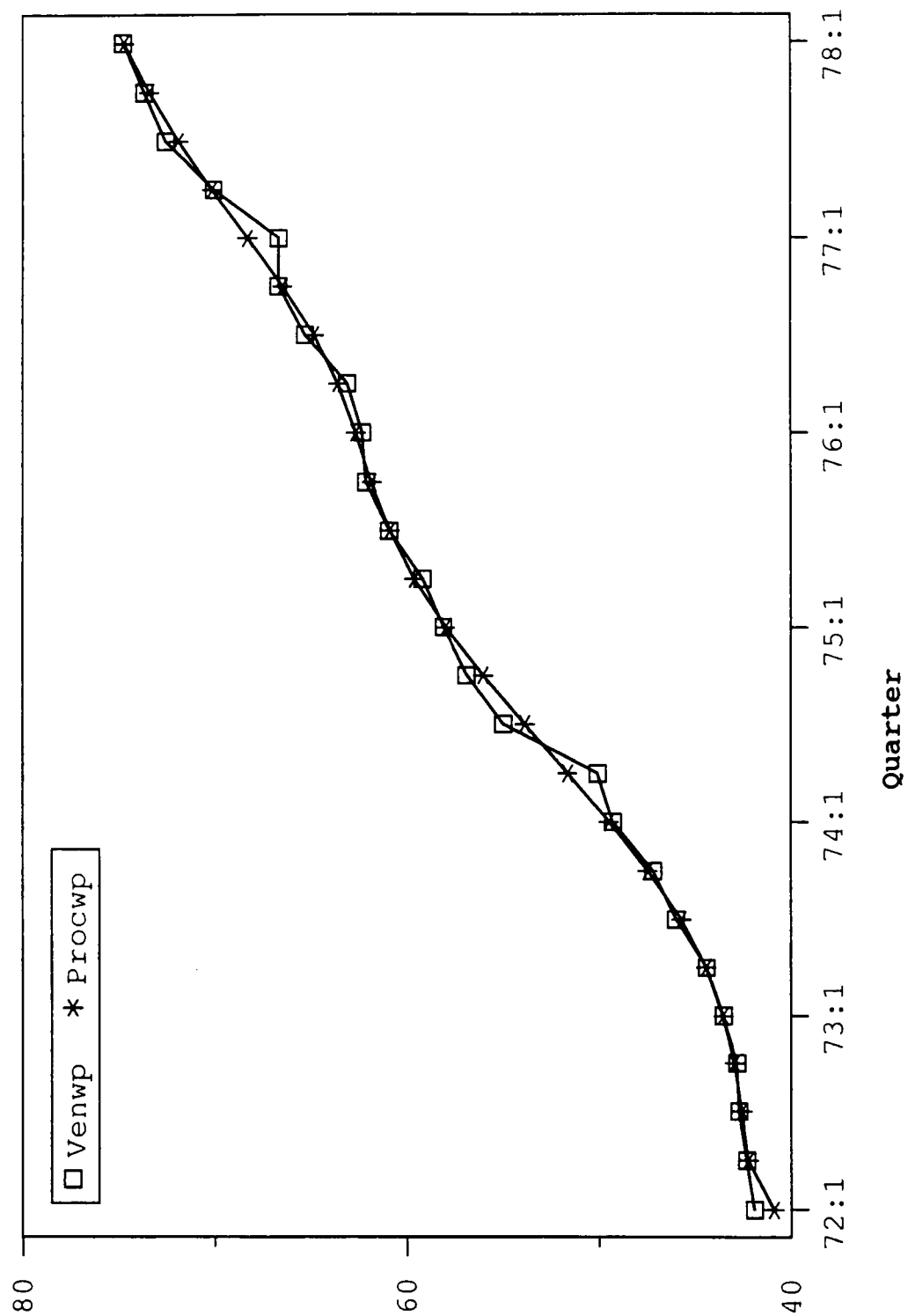


Figure 13. The graphic performance of the "PROC EXPAND PROCEDURE"
(1980 = 100)

Appendix: C

The Federal Reserve Board's index of the weighted-average exchange value of the U.S. dollar is an index of the average exchange value of the dollar that summarizes in one number the various individual exchange rates of the dollar against currencies of the G-10 countries. The weight for each of the 10 currencies is the 1972-76 average world trade of that country divided by the average world trade of all 10 countries combined. The base period of the index is march 1973, the beginning of the period of generalized floating exchange rates system. The formula used to calculate the value of the index at time t is defined as follows

$$100 \exp \sum_{i=0}^m W_i \text{Log}_e R_{it}$$

where

R_{it} = based period exchange rate of currency i divided by exchange rate of currency i at time t , with all exchange rates expressed in U.S. cents per unit of foreign currency.

W_i = weight for currency i .

The base period exchange rates and weights are given below

Country/Currency	March 1973 base period exchange rate ¹	Weight in index
Germany/deutsche mark	35.548	.208
Japan/yen	0.3819	.136
France/franc	22.191	.131
United Kingdom/pound	247.24	.119
Canada/dollar	100.33	.091
Italy/lira	.176	.090
Netherlands/guilder	34.834	.083
Belgium/franc	2.5377	.064
Sweden/krona	22.582	.042
Switzerland/franc	31.084	.036
Sum		1.000

1- Cents per unit of foreign currency.

VITA

Ayoub Yousefi Asr was born in Hamadan, Iran in 1953. After graduating from high school, he attended the college of education in Hamadan for two years and received an Associate degree in Science Education in 1973. In 1976, he entered The University of Tehran and received the Bachelor of Arts degree in Economics in August, 1982. Before graduate study, he worked at the Central Bank of Iran from 1978 through 1986.

In the Summer of 1987, he entered the graduate program in Economics at The University of Tennessee, Knoxville. During his graduate study as a graduate teaching assistant, he taught several courses in Microeconomics as well as International Economics. From August, 1989 until December, 1991, he served as a graduate research assistant at the Center for Business and Economic Research, in the College of Business Administration, at The University of Tennessee, Knoxville. He was awarded the Ronald H. Wolf Excellence in Economics Fellowship for three consecutive years of his study. He received the Master of Arts degree with a major in Economics in August, 1989 and the Doctor of Philosophy degree with a major in Economics in May, 1992.