AN EMPIRICAL ANALYSIS OF THE ROLE OF IMPORTS IN THE SOUTH AFRICAN ECONOMY

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ABSTRACT

It is generally acknowledged that there is no sufficient, exhaustive and elaborate empirical examination of the quantitative impact of policies pertaining to import demand and economic growth in South Africa. In order to arrive at conclusive, sagacious and applicable policies on the economic growth potential of an economy, it is imperative to evaluate, empirically, whether envisaged economic growth rates and employment creation are feasible, given the socio-economic circumstances.

The fundamental question of the constraint or rather effective constraints to high economic growth rates, measured by gross domestic product, has always desired urgent attention but has been neglected. There appears to be strong reasons to believe that the South African economy, like other middle-income developing economies, is subject to a *"powerful balance of payments constraint that effectively aborts the growth process before it is able to deliver rising per capita incomes"* (Industrial Strategy Project[1], 1995 :49).

Furthermore, although this issue is widely recognized, there has been little systematic analysis of this important question. Many writings which, implicitly or explicitly, note the foreign exchange shortages as adversely affecting the economy's growth capacity have tended to focus and give enormous emphasis on exports and export expansion as a means to eradicate this economic dilemma. However, together with exports the demand for imports clearly determines the behavior of the trade account of the balance of payments as a whole. *Consequently, this dissertation intends to consider one important aspect of the balance of payments constraint, namely, the determinants of the demand for imports in South Africa and the behavior of foreign trade.*

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[1] The Industrial Strategy Project (ISP) was authored by Joffe et al (1995). In this dissertation it is referred to as ISP (1995) although in the reference section I refer to Joffe et al (1995) as done in other publications. For instance, see Bell (1995). The same applies to the Normative Model Approach (NEM), in the text it is referred to as NEM (1993) while in the references it is reflected as Central Economic Advisory Services (1993).

This study briefly examines the theoretical foundations of the savings and foreign exchange constraints using the 'two-gap' model. In that the main lesson is that the economy characterized by foreign exchange bottlenecks and/or lack of savings will not accomplish its perceived growth capacity. This is the background and motivation for the study of import demand elasticities as it gives impetus to the importance of both imports and exports in an economy.

The dissertation derives the import demand function and employs the recent time-series techniques to modeling economic time-series. Prior to the empirical model, the study quantitatively describes the behavior of both imports, and exports, though more emphasis is placed on the former than the latter. In this section, simple quantitative techniques are utilized in order to determine the cyclical and trend behavior of import performance since the beginning of the 1970s. The study also briefly looks at the relationship between import of capital goods and investments into South Africa. Description of trade behavior involves examination of trade flows and their geographical destination by regional trading blocks.

That is followed by an extensive literature survey conducted on import demand elasticities in South Africa and trade elasticities in general. This analysis gives a strong background to the time-series model of import demand estimated in this work. Time-series analysis examines the import demand at both aggregate and sectoral levels. Prior to the empirical model chapter there is an overview of time-series econometrics with regards to co-integration, error correction and non-stationary data. Import performance and import demand functions were studied in an economic policy context and the analyses were in some cases restricted by data constraints. Import behavior patterns and empirical results of the import demand models are discussed and international comparisons are drawn.

There are a few basic points that emanate from the overall discussion. In the import performance section, it can be concluded that *(i) labour intensive commodities have the largest share in total imports as indicated by composition by main economic sectors and sub-sectors; (ii) South Africa exports relatively large volumes of capital intensive goods; (iii) There is a very steady, insignificant decline in import penetration ratios but these have increased lately; (iv) exports have slowly increased whereas the 1980/85 period shows overall negative growth rates for both imports and exports; (v) the import-investment relationship is tentatively confirmed; and (vi) the over all trade volumes have increased with the Southern African market taking an increasing share whilst other regional markets maintained relatively stable and sometimes steadily decreasing percentage shares.*

The description of studies or literature surveys shows that the demand for imports is largely influenced by economic activity as compared to relative prices. Some of the results are shown in the appendices and discussed in section 6.7, where comparisons are made between the results of different studies and the main findings of this dissertation. *Precisely, the major finding is that, as other studies concluded, the propensity to import with respect to income is more significant than the price elasticity of demand for imports.*

The import performance findings combined with time-series estimation results raise doubts to envisioned employment creation levels and economic growth rates in South Africa. This is questionable because South Africa's imports have been on an increase whilst exports have not performed well. From the time-series point of view and based on estimation results, the current economic strategies should also address the import demand question or foreign exchange and domestic economy development if the projected growth rates and employment levels are to be achieved.

DECLARATION

I declare that this dissertation is my own work, unaided work. It is submitted for the degree of Master of Commerce in the University of Durban – Westville, Durban. It has never been submitted for any degree or examination in any other University before.

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Chapter 1

Introduction

1.1 Introduction

It is widely believed today that South Africa's economic growth is impeded, among other things, by the foreign exchange constraint. This becomes even clearer if one looks at the current Macro-economic Policy Framework: Growth, Employment and Redistribution (Gear, 1996:3).

The document states that:

> The balance of payments remains a structural barrier to accelerated growth. The economy is depended on imported capital and intermediate goods and, as in the past, the cyclical upswing brings a deterioration in the current account...

This statement is partly an indication that there is consensus in policy circles that there is a very high probability that foreign exchange shortage effectively constrains the fast growth of the South African economy. Like Gear(1996), the Industrial Strategy Project (ISP, 1995:49) also reflects on this matter, as follows:

> We should emphasize that our trade performance is cause for considerable concern. The growth of the South African economy is subject to a powerful balance of payments constraint that effectively aborts the growth process before it is able to deliver rising per capita incomes.

Although this problem is acknowledged in many reports, documents and policy circles, it has not been offered the necessary attention it desires. This is witnessed by the lack of substantial systematic analysis of the foreign exchange constraint. The Central Economic Advisory Services' Normative Model Approach (hereafter referenced as NEM, 1993) has made some attempts to examine this issue but, like many other studies, falls into a trap that exports and export promotion will alleviate the current account deficits.

Since the beginning of 1970s there have been many developments in South Africa's foreign trade policy that, apparently, intended to boost economic growth following the Reynder's Commission on Export and Trade recommendations (1972). Recently, South Africa has embarked on various economic programs that, implicitly or explicitly, promote import liberalization and/or export promotion. The remaining main question, therefore, is whether or not export promotion alone really provides a sufficient remedy.

In brief, the present study acknowledges the importance of the issues raised above as well as others but these issues are beyond the scope of this study. The main objective of this dissertation, however, is to consider one important aspect of this fundamental question, namely, the determinants of the demand for imports in South Africa. Together with the behavior of exports, the demand for imports surely determines the behavior of the trade account of the balance of payments as a whole.

While the possible existence of the binding foreign exchange constraint is widely recognized, much emphasis are on export expansion as a means to eradicate this constraint. Consequently, this study makes considerable contribution to the entire question by examining the other side of the coin, import demand elasticities[1].

1.2   The Two-Gap Analysis

The two-gap model forms the backbone for the analysis of the economic constraints to economic growth. As this study maintains that foreign exchange and savings shortages hinder economic growth, it is therefore imperative to briefly evaluate these gaps systematically.

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[1] This is the main focus of this dissertation. The determinants of exports and/or export elasticities have widely been studied. See Bhorat (1998) for the very recent study of "Income and Price Elasticities in Manufacturing Exports".

The models presented in Bliss (1989) and Bacha (1990) suggest that there are strong reasons to believe that developing economies like South Africa are subject to at least one of the two major constraints, savings and foreign exchange. The basic national accounting identity represents the equality between income and absorption, as

$$I = (Y-C) + (M-X) \qquad (1.1)$$

Where I refers to fixed capital formation, Y is domestic output, C as total consumption, M as imports of both goods and non-factor services, and X referring to exports of goods and non-factor services.

In the context of the balance of payments:

$$M-X = F-J \qquad (1.2)$$

Where F and J refer to net capital inflows and net factor services to abroad, respectively. If (1.1) and (1.2) are combined so as to replace one another, we arrive at the savings constrained potential growth of output.

$$IS = (Y^*-C) + (F-J) \qquad (1.3)$$

In which case, income is at its potential level Y^* and consumption is given exogenously, therefore IS refers to savings constrained level of investments.

Given (1.2), imports can be divided into two components:

$$M = M_k + M_o \qquad (1.4)$$

Where M_k refers to complementary capital goods imports and M_o as other imports. In this regard,

$$M_k = mI \qquad (1.5)$$

where m is greater than zero but lesser than one, as an import content of investments, and therefore,

$$E = X - M_o \qquad \text{is the trade account.} \qquad (1.6)$$

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Taking (1.5) and (1.6) into (1.2), and assuming that the level of exports E^* is given by world demand, we therefore arrive at a foreign exchange constrained investment (IE):

$$IE = (1/m) [E^* + (F-J)]$$ (1.8)

Using the similar technique Bliss (1989) arrives at the same conclusion that both savings and foreign exchange, depending on conditions, will inevitably impact on economic growth. The basic idea, therefore, is that the shortage of either savings or foreign exchange strangles the growth of an economy.

1.3 Determinants of Imports

The models of the current account of the balance of payments have identified relative prices and real income as the main significant determinants of the demand for imports[2]. The demand for imports is determined by both economic and non-economic factors. These will, generally, include exchange rates and/or relative prices, economic activity, domestic and external economic conditions, production and/or labour costs, and political circumstances (World Bank, 1987). However, as argued by Erasmus (1978), relative prices and income remain the major factors significantly affecting the demand for imports and supply of exports. This issue is discussed more extensively in subsequent chapters.

The nature of an economy also impacts on its trade balance. For instance, it has been argued that, for historical reasons the South African economy is largely dependent on imported capital and intermediate capital commodities. Like some other economies, South Africa has, for decades, depended on primary sectors that meant that in the midst of industrialization it had to start by importing materials to building its industrial base. This point is discussed later in this study.

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[2] Williamson and Milner (1991), Sodersten (1982), Rivera-Batiz (1985) and others have discussed the mechanisms by which the balance of payments achieves equilibrium. The discussion in chapters 3 and 4 also allude to that.

Bell (1993, 1996) and others have examined this issue largely within the context of trade liberalization. Large imports coming into South Africa have, arguably, been motivated by trade liberalization that in turn reduces foreign exchange.

Rivera-Batiz (1985) argues that the rise in economic activity would induce an increase in imports, the reason being that high incomes will promote consumption. In the case of South Africa, as income rises there is high probability that imports increase perhaps because of the need for those commodities or because of other factors. In that regard, there is direct connection between economic growth and the trade balance.

Micro-economic theory postulates the demand for any good to be a function of income and prices, *ceteris peribus*. In this context, relative price changes have, presumably, an impact on the current account balance through changes in import demand. In theory, an increase in relative prices should reduce the demand whereas a rise in income will increase the demand of a commodity[3].

According to Rangasamy (1990), effective exchange rates play a pivotal role in determining imports and exports of the nation. This leads us to the discussion of the 'Marshal-Lerner' condition which contends that for devaluation policies to be effective, import demand and export supply elasticities must exceed one. This shows the major role played by exchange rates in determining the magnitudes of both imports and exports. Holden (1990,1991) discusses this issue in larger detail in that the efficacy of any foreign trade regime relies on effective exchange rates as they fundamentally affect the trade balance.

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[3] The formal derivation of the import demand function in chapter six highlights an important theoretical point on how income and prices affect demand in the utility maximization context. The elasticity theory discussed in Williamson and Milner (1991) also alludes to income, relative prices and import demand relationships, especially in the context of

Political factors have also been identified to have an enormous impact on foreign trade regimes as argued by Rangasamy (1990). Moll (1990) argues that economic policies have been affected by the political conditions in that the former ideological apparatus influenced the workings of the South African economy for political reasons. However, these issues are beyond the scope of this study. This dissertation confines itself to the description of trade behavior and the statistical estimation of the magnitudes of import demand elasticities, thereby suggesting policies for the economy that emanate from subsequent analysis.

1.4   Format of the Study

The preceding discussion ascertains the need to model the import demand function for the economy. The efficacy of economic policy largely depends on the size and direction of its impact to the economy as a whole. In that regard, therefore, modeling import demand and precisely identifying the magnitude and direction of import demand elasticities, with respect to income and prices, would offer guidance in policy formulation in relation to foreign trade and the balance of payments.

The dissertation derives an import demand function and estimates the import demand elasticities. Prior to this, the literature, both on the South African economy and other economies, is reviewed. This gives background and direction to the model developed and estimated in the present study. Chapter two embarks on the descriptive quantitative discussion of import performance in South Africa dating back to the early 1970s. It evidently gives impetus to a myriad of crucial policy issues that are discussed in other chapters. The quantitative description of import behavior and exports adopts an approach of examining composition, growth rates, import penetration, import-demand, capital-labour and other important ratios relevant to the subject of the present study. In addition to that, chapter two also briefly discusses the relationship between imports and investment into South Africa. The direction and geographical destination of South Africa's trade flows are briefly sketched.

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exchange rates devaluation.

Chapter three examines a large number of published studies, other than South African, on trade elasticities. This chapter gives background to the model developed for the purposes of the present work. Chapter three is also accompanied by an appendix which shows some relevant results for the sake of comparability with results of studies of chapter four and the main results of the model of import demand designed and estimated for this study.

Chapter four describes studies done for South Africa on trade elasticities, and import demand elasticities in particular. The description examines methods, results and econometric issues raised by various authors. Like chapter three, this chapter is accompanied by an appendix that shows the results found by some of these studies with regard to import demand elasticities in South Africa.

After a thorough review of the published literature, including some relevant working papers, chapter five explores the recent time-series techniques that are applied in the empirical chapter. A fairly brief overview of time-series econometrics with specific focus on co-integration, error-correction models and non-stationary data is undertaken. This chapter also serves as an explanation of the techniques used in chapter six for the empirical model of the import demand in South Africa. Lastly, chapter seven draws together some concluding remarks.

Chapter 2

Import Performance in South Africa:
A Descriptive Analysis

2.1   Introduction

The following discussion focuses on the description of the behavior of South Africa's imports. The discussion also briefly alludes to the geographical destination of South Africa's foreign trade. The main objective of this chapter is to describe the import performance of the economy. This aim is accomplished through examination of the trends and cyclical variations in imports. This is made possible by assessing the composition of imports by main economic sectors and sub-sectors, rates of growth of imports, import penetration ratios and other relevant important data and calculations.

The description largely examines the import performance. The numerical magnitudes of import determinants and policy debates pertaining to import demand are dealt with in later chapters. This chapter intends to consolidate the historical developments on the import behavior, taking into account the factors that have had a considerable, significant impact on that trend. Because of the supposed theoretical relationship between import of capital goods and investment, a brief assessment of this relationship is done. The method of analysis is mainly descriptive similar to other parts of this chapter. Discussion of export performance is partially part of the present chapter. There is an extensive literature on export performance and trade policy issues.[4] Consequently, exports are only discussed in comparison with import performance where it becomes imperative. Trade, industrial policy and macro-economic issues are beyond the scope of the present chapter.[5]

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[4] Refer for instance to Rangasamy (1990), Holden (1991) and McCarthy (1996) for recent published literature on exports and related trade policy issues.

[5] For some illuminating recent trade policy analysis see, Holden (1990), Moll (1990), Bell (1993, 1996) and others, including conference papers. The other set of general papers include NEM (1993), ISP (1995) and Gear (1996). The World Bank Reports of 1981 and 1987, and IMF country studies (Michaely et al, 1991) also present interesting debates.

2.2 Data and Methods

There are a few important issues to be noted in relation to data and methods of analysis. The data used are taken from different sources and transformed to fit the current context of discussion. The primary data source of many trade series is the Department of Customs and Exercise.

These data are normally audited by the Central Statistical Service or Statistics South Africa. Sometimes the Policy Analysis Department of the Department of Trade and Industry also looks into these data. The Industrial Development Corporation (IDC), the South African Reserve Bank (SARB) and WEFA Southern Africa[6] also keep track of these data and use them for policy analysis of various kinds.

The first set of data used in the current chapter are taken from the IDC sectoral data produced in 1995. These data are for the years 1972 to 1993 and are available for 36 economic sectors. These data have not been up-dated for the years after 1993. This has been attributed to changes in ISIC codes that were taking place during the production of this study. WEFA has similar data for the period 1970 to 1995. However, these data are not entirely the same. The classification system is slightly different. WEFA industry data have not been up-dated for the years after 1995. This is also attributed to a changing classification system which makes the task of up-dating the series rather difficult.

This chapter, however, uses mainly IDC industry data because when the dissertation begun only these data were within reach and many calculations were done using IDC data. It is also because IDC has continued producing industry data which are slightly compatible with the IDC (1995) Industry Series.

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[6] WEFA use to stand for Walton Econometrics Forecasting Associates. However, it is now

Sectoral data from 1993 to 1997 have been taken from IDC and it is useful in describing trends after 1993. These data are not really compatible with the 1995 Industry series but they are quite closely related and give a broad picture of the trade trends after 1993.

Because of the lack of complete consistency of these data, only the composition of trade is examined after 1995. Other sources, including my own calculations, are used in explaining trends. The data from 1993 to 1997 have been converted to 1995 prices. These data have also been arranged in terms of capital-labour intensity. However, these can not be really compared to IDC 1995 data because of different reasons such as the different base-period and a slightly different classification system.

This chapter also briefly describes the relationship between import of capital goods and investments into South Africa. This is not part of this study but because of the importance of a theoretical link between import of capital goods and investment this relationship is roughly assessed. Most data used are own calculations from WEFA Southern Africa and the SARB (various issues). Data for the illustration of Investment behavior are extracted from the World Investment Report of the United Nations Conference on Trade and Development (1998) and from the South African Investment Report (1999) of Business Map. The investment study by Mhango (1999) was helpful in that regard. The approach used in discussing the relationship between investment and capital goods import is adopted from Hawkins (1997).

In addition, geographical destination of South Africa's trade flows is also briefly examined. This is crucial for policy making with regards to foreign trade. The data used for the calculation of the composition of South Africa's imports and exports to total trade, total imports and total exports respectively, are the un-audited Customs and Exercise trade data which comprise foreign trade data for 270 countries and 99 ISIC sectors.

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termed WEFA Southern Africa. This study will simply refer to WEFA.

These data given as numbers of quantities, monthly, were transformed firstly into yearly data and into rand millions. Countries were then aggregated into trading blocks, such as SACU, SADC, EU, NAFTA, APEC, PTA, ASEAN, MERCOSUR and others. The data were then converted into constant 1990 prices. After checking the series, trade shares and growth rates were calculated. These data were available for 1993 to 1997 and have been taken from the Policy Analysis section of the DTI. It only serves as an indication of how trade with regions and trade of certain commodities behaved during 1993/97.

These data can not as yet be used for sophisticated analysis as they are firstly not audited and secondly are available for only five years. They are used here for simple purposes of showing trade with regions and countries. This is done because the study examines the income and relative price elasticities of import demand for South Africa which is a foreign trade and economic growth issue. It is therefore important to know the markets for South Africa's exports and where imports come from, largely for policy-making purposes.

In short, this chapter largely describes import behavior in terms of sectoral composition and rates of growth of South Africa's imports in the period 1972 to 1993 using IDC 1995 trade data. Composition of imports is analyzed both by sectors and in terms of capital-labour intensity. The same is done for exports and employment for the same period. The analyses of 1972-93 period are extended for 1993-97 using IDC data slightly different from the 1995 industry series.

2.3   The Nature of South African Imports

Historically, South Africa can be classified as a minerals-based economy[7]. This means that for decades the economy has relied on exports of primary sectors[8]. However, this has been subject to debates (see, Ariovich, 1979, 1980 and Holden and Holden, 1991).

Table 2.1 shows the composition of total imports by main sector, for selected years, in current rand millions calculated as the percentage shares of each sector to total imports using IDC (Economic Analysis System, 1972- 1993). This table has been extended using sectoral data from IDC (1998).

Table 2.1: Composition of South Africa's Imports by Main Economic Sectors 1975 - 1997

Sector	1975	1980	1985	1990	1993	1997[9]
Agriculture	1.75	1.29	2.97	1.63	2.54	5.83
Gold mining	0.01	0	0	0	0	0
Other mining	12.27	17.01	11.16	10.57	9.05	18.74
Manufacturing	69.22	65.56	67.87	68.01	65.81	75.43
Services	16.76	16.13	18.78	19.79	21.6	-
Total	100	100	100	100	100	100

Source: IDC, 1995 and 1998

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[7] Own calculations, using the input-output tables for 1995, show that most sectors are natural-resource based. That is, for example, 16 of 23 manufacturing sectors each need more than 20% of inputs from primary sectors in order to sustain production.

[8] Fine and Rustomjee (1996) and Bell and Farrell (1997) present relevant interesting policy issues pertaining to the "Mineral's Energy Complex" and its impact to manufacturing performance.

[9] The 1997 figures are computed from the 1998 IDC sector data published in 'Trade for Growth' review. Services sector data were not available.

Table 2.1 shows that more than 60% of total imports are manufacturing imports, although this declined slightly between 1990 and 1993. There are myriad reasons, both economic and political, for this trend (i.e. import behavior) which will be discussed in sections below. Briefly, this is related to the historical development of industrialization in South Africa.

Table 2.1 also illustrates that the percentage share of manufacturing imports in total imports has relatively increased from 68.01% in 1990 to 75.43% in 1997. Similarly, the share of other mining imports from total imports has increased from 10.57% in 1990 to 18.74 in 1997. Over all, the share of each sector has increased, particularly since 1990. Data for the services sector is not available but it is safe to assume that the share of services has increased as well.

2.4   Cyclical and Secular Trends
2.4.1   Import Performance
In spite of some upturns and downturns in the SA trade balance, imports have shown a considerable increase during the period of analysis. This is clearly noticeable in the case of manufacturing where imports have increased. Table 2.2 below depicts total imports by main economic sectors in current rand terms for the period 1975 to 1997 using IDC sectoral data series (1995) and IDC (1998) sectoral data.

Table 2.2: South Africa's Imports 1975-1997 (Rm)

Sector	1975	1980	1985	1990	1993	1997
Agriculture	142.09	220.01	847.79	881.32	2697.28	5351.6
Gold mining	0.84	0.24	0	0	0	0
Other mining	996.92	2892.87	3186.43	5712.73	6891.3	17200.6
Manufacturing	5626.15	11151.3	19169.1	36757.6	50115.7	69243.47
Services	1362	2743.5	5342.65	10694.2	16450.6	-
Total Imports	8128	17008	28546.0	54046.0	76155.0	91795.6

Source: IDC, 1995 and 1998

However, table 2.2 does not illustrate growth rates *per se* but it simply gives an indication of the value of imports by different sectors in current terms. In current prices, table 2.2 tentatively shows that the total import performance since 1975 has increased with manufacturing leading the trend, followed by services, other mining, and then agriculture. In effect, imports have risen. Table 2.3 shows that growth rates for most manufacturing sub-sectors has been positive, except for some particular periods associated with external factors.

For instance, the economy desired more manufacturing commodities than primary goods for its development. Values of imports have risen continuously. The figures of 1993 to 1997 taken from IDC (1998) show that the level of imports has continuously increased since 1993. The total import figures have risen from 76155.0 in 1993 to 91795.6 in 1997. More specifically, the value of manufacturing imports was 58875.12 Rm in 1995 and was 69243.47 Rm in 1997.

2.4.2 Growth Rates of Imports

For most part of the period of the investigation import growth rates are predominantly negative. These negative growth rates can be attributed to the collapse of the Bretton Woods System which caused exchange rates volatility, external shocks such as oil price shocks, and sanctions. Perhaps political conditions and large debt burden also affected growth of imports particularly during the 1980/85 period. This point can also be elucidated by looking at disaggregated levels of the growth rates of manufacturing imports. Table 2.3 confirms the view that in 1980/85 the economy was a little unstable due to the factors named above.

Table 2.3: Growth Rates for each Sub-sector Imports 1972-1997 (constant 1993 prices)

Sector	1972/75	1975/80	1980/85	1985/90	1990/93	1996/97
Food	1.83	0.98	6.78	0.47	-0.92	11.35
Beverages	22.94	1.75	8.98	6.21	-2.84	3.22
Tobacco	-8.33	-12.51	4.32	-16.67	23.8	-
Textiles	-4.97	2.13	-0.69	-3.18	4.26	0.04

Sector	1972/75	1975/80	1980/85	1985/90	1990/93	1996/97
Clothing	-7.01	-0.15	-3.74	-4.49	29.55	-2.47
Leather	-6.22	-17.96	-1.84	26.98	-1.46	8.42
Footwear	4.37	2.67	6	-8.01	17.45	0.04
Wood	-14.96	-5.46	5.8	0.03	6.99	2.81
Furniture	0.92	-100	-100	38.27	12.41	6.69
Paper	12.51	0.11	-6.69	-3.55	-1.51	-0.86
Printing	-1.85	14.72	2.1	8.75	-10.08	-5.45
Chemicals	1.99	-0.4	-0.82	5.88	-1.28	-0.73
Rubber	7.47	5.23	7.47	8.72	-1.97	0.20
Plastic	-0.95	4.65	10.2	8.45	4.06	0.40
Pottery	13.07	-7.28	10.82	-8.05	9.27	-
Glass	-5.54	1.14	-0.11	-4.89	2.59	1.39
Non-metallic	29.25	-9.54	-2.9	2.26	5.2	0.21
Iron and steel	5.28	-20.14	-2.9	3.53	-13.59	2.00
Non-ferrous	-4.20	9.44	1.85	5.19	2.66	-1.07
Metals	7.31	0.99	-3.04	-0.28	-1.47	-1.12
Machinery	14.97	0.37	-4.69	0.84	-3.69	1.43
Elect. Machinery	12.03	0.96	0.54	1.28	-0.1	2.09
Transport equip.	3.60	4.37	-8.61	-1.19	2.45	-
Other Transport	19.18	-3.3	-7.18	2.59	3.78	-1.75
Other manufacturing	23.06	10.41	-6.44	10.08	2.16	2.79
Total manufacturing	7.53	0.65	-3.12	1.99	-0.68	0.22

Source: IDC, 1995 and 1998

A large number of subsectors show a drastic decline in their growth rates in 1980/85 and that is the period where both economic and political instability prevailed. However, this trend changes over time. For instance, certain sectors have been importing more whilst others reducing their imports. The entire growth of manufacturing imports has increased during 1996/97. Many sectors recorded positive growth rates in 1996/97. In terms of capital-labour intensity only labour-intensive sectors recorded positive growth rates whilst capital-intensive and intermediate capital-intensive sectors have continuously recorded negative growth rates.

The 1996/97 growth rates were calculated from IDC (1998) data and the classification is not entirely the same as the 1995 sectoral series. However, these data are used to give a broad indication of the import performance of sectors after 1993, as data for some sectors are not available.

2.5 Import Penetration and Import Demand

Looking at the period of 1946 to 1997 using the SARB data (various issues), the import-gross domestic product ratios and export-gross domestic product ratios have slightly declined in the 1980s and increased there after.

Table 2.4 shows that the merchandise import-gross domestic product ratio has increased from 19.77% in 1986 to 31.27% in 1996 whilst the total export-gross domestic product ratio decreased from 36.92% in 1986 to 31.86% in 1996. Import-gross domestic product ratios have continued to increase. For example, the import-penetration ratio of 1997 stands at 32.26% which is close to double the figure of 1986.

Table 2.4: Ratios (%) of Trade to Total Economy (1946 - 1997)

	1946	1956	1966	1976	1986	1996	1997
Imports – GDP	27.41	25.48	21.22	26.44	19.77	31.27	32.26
Exports – GDP	27.60	34.99	29.06	31.22	36.92	31.86	33.09
Total Trade - GDP	55.01	60.47	50.28	57.67	56.7	63.13	65.35

Source: SARB (various issues)

The trend above would suggest that there has been some degree of import replacement in the economy in the 1980s. This means that certain commodities originally imported have been produced in South Africa in the past two decades. However, there are problems with this conclusion because the decrease in the import-gross domestic product ratio may be from the reduction in imports as discussed in growth rates.

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In addition, it may be due to an increase in gross domestic product relative to imports. However, the analysis here takes cognizance of that. Lastly, there is wide consensus that this trend has changed. The import-gross domestic product ratio of 1996 was 31.27% and that of 1997 was 32.26%. There are reasons to believe that imports have grown more rapidly in 1997 and 1998 as the trade balance is reported to be widening further[10].

The import penetration ratios for manufacturing industry, in table 2.5, calculated as the ratio of imports to domestic demand (gross output plus imports less exports) multiplied by a 100, show that the import penetration to the economy has been relatively constant, although slightly decreasing and increasing in some years.

Table 2.5: Import Penetration for Manufacturing Sectors (1975 - 1995)

	1975	1980	1985	1990	1993	1995[11]
Capital-intensive Sectors	17.36	12.8	10.52	12.42	11.98	13.18
Intermediate Capital-intensive Sectors	19.19	17.33	14.25	12.87	14.37	21.47
Labour-intensive Sectors	28.98	25.42	25.72	25.93	25.7	31.58
Ultra labour-intensive Sectors	17.97	18.7	15.07	17.82	20.19	31.60
Total Manufacturing	21.67	18.76	16.44	16.83	17.27	24.46

Source: IDC, 1995, Bell and Cattaneo (1997: 16), and IDC, WEFA, 1998

In terms of capital-labour intensity for manufacturing alone, imports have concentrated to labour-intensive commodities. As shown, labour-intensive and ultra-labour-intensive sectors have more than 30% import penetration ratios in 1995, significantly high relative to other sectors' import penetration ratios. This also raises some policy questions since the manufacturing is the largest provider of employment and has a larger share of imports.

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[10] The latest trade balance statistics from the SARB Annual Economic Report (1998) show that the trade balance has widened to R14.1 billion in the last quarter of 1997 from R5.3 billion in the second quarter. The IDC's latest publication on 'Trade for Growth' (1998) explains the deficit in a little more detail. The basic point is that the deficit has continued to increase.

[11] The import penetration ratios for 1995 are calculated from WEFA industry trends data. These data are CSS (now termed SSA) and Customs and Exercise data. Import penetration ratios for the period after 1995 could not be calculated because the gross output variable was not available in the same classification.

Table 2.6 shows that although manufacturing provides a large share of employment it also imports the largest share of labour-intensive commodities. This is not really clear in this table. However, the employment statistics from CSS have always depicted manufacturing as a largest provider of employment, although non-agricultural employment has been drastically decreasing lately[12].

Table 2.6: Percentage Shares of Sub-sectors' Employment to Total Manufacturing Employment (Capital-Labour Intensity) 1975 - 1997

	1975	1980	1985	1990	1993	1997[13]
Capital-intensive Sectors	19.33	19.91	20.92	20.21	20.44	19.44
Intermediate Capital-intensive Sectors	27.47	26.84	27.29	26.56	26.33	25.74
Labour-intensive Sectors	34.19	33.91	31.72	32.55	33.08	34.62
Ultra labour-intensive Sectors	19	19.32	20.05	20.66	20.33	20.19
Total	100	100	100	100	100	100

Source: IDC, 1995 and 1998

However, this argument is subject to scrutiny because these tables do not offer conclusive evidence as to whether manufacturing really takes the largest share of employment provision. It would have been more convincing if total employment figures comprised of all other sectors were available.

2.6 Import of Capital Goods

Although this study mainly focuses on import performance and import demand elasticities, brief attention is given to the analysis of an investment component of imports[14]. As a result, this section briefly, mainly descriptive, highlights the relationship between imports and fixed investment.

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[12] The latest employment survey (1999) by CSS shows that more than half-a-million jobs have been lost in the non-agricultural sector.

[13] This calculation is based on IDC data published in the October 1998 'Trade for Growth' review.

[14] Equation 1.4 in the discussion of the two-gap model reflects on the investment component of

In practice, particularly for small open economies like South Africa, the share of capital goods imports to total imports is generally above the shares of other commodities. If, as commonly postulated, capital goods imports represent investment into the small open economy it is therefore imperative to assess the nature of the relationship between imports of capital goods and investment in South Africa. This will be done very briefly because this is not necessarily part of the present study. As explained in an introduction, this study focuses on import demand elasticities using recent time-series methods. The study is based on microeconomic demand theory which attributes changes in the demand of any commodity to income and prices.

As a result, the discussion of investment is additional because South Africa, as a small open economy, imports relatively large amounts of capital goods. There are other complex issues that come out of this relationship which are not part of this research. For instance, the multiplier effects of changes in import of investment goods to the economy through changes in the balance of payments are not part of this study. This study assumes that imports of any goods, capital or otherwise, affect the current account of the balance of payments, particularly if the growth of exports is poor.

Traditionally, imports are viewed as a function of income, with the marginal propensity to import given by m. Hence, the change in income resulting from an initial change in autonomous expenditure is of the form: $1/(1 - c + m)$; where c represents the marginal propensity to consume. However, this formulation has been challenged by Kennedy and Thirlwall (1979: 173) in that it presumes that import coefficients are the same for all components of autonomous expenditure. Furthermore, this formulation supposes that the foreign trade multiplier is the same for all coefficients in the foreign trade equation.

As noted in Hawkins (1997), the Kennedy et al. model, which attributes an import component to each item of expenditure, makes the import content of the multiplicand explicit in the multiplier. The result is that a change in income resulting from a change in investment is of the size: $1 - mi / (1 - c (1 - mc)$; where mi represents the import coefficient of investment and mc the import component of induced consumption. This formulation shows the significance of the investment component of imports. Hawkins (1997: 269) contends that the process of importation of capital goods benefits the foreign nation and fails to stimulate domestic effective demand. It is also argued that an increase in capital stock resulting from changes in investment, tends to depress the rate of profit, and that there is a potential for conflict between balance of payments equilibrium and other national policy objectives.

Hawkins (1997: 280) concludes that, based on the input-output formulation, "importing capital goods stimulates imports relative to exports", and the balance of payments comes under pressure. Consequently, an adjustment in the balance of payments involves a reduction in investment, retarding effective demand, income and employment.

The above discussion motivates a need to look into the investment component of South African imports. It should, however, be noted that Hawkins' (1997) analysis is based on certain implicit assumptions. Also, the Kennedy et al model sustains some shortcomings. These authors, including Hawkins (1997) treat investment as a homogenous entity.

There are numerous forms of investment that may behave differently from the manner suggested by Kennedy et al. model. The discussion of capital goods imports as investment commodities needs to be handled with care. Certain capital goods can be imported by consumers for personal consumption and private utility. For Hawkins (1997), investment plays the major role in influencing the balance of payments. This depends on many other factors such as the inability of exports to grow fast enough to balance the trade account.

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The analysis of the effects of importation of investment goods should be viewed from both the short-term and the longer-term. For instance, Hawkins (1997: 280)' conclusion that importing investment goods puts the balance of payments under pressure may not hold in the long run. Imported investment goods may be used for production for an export market or to increase self-sufficiency.

The following sections attempt to draw descriptive correlation between import of capital goods and investment. It should be acknowledged that investment as a research topic is broad and complicated such that this study can not do justice to the intricate issues of investment. The current study mainly focuses on import demand elasticities and consequently issues of investment-import, import-export, and other relationships are beyond the scope of this dissertation. The import-investment relationship is discussed here because it is relevant given that South Africa is a small open economy.

2.6.1 Overview of Investment Flows in South Africa

As briefly highlighted above, there are different forms of investments. In most cases, by investment one refers to fixed investment. In addition to the conventional items such as machinery and equipment, fixed investment also relates to some form of private foreign capital.

In this section, attention is given to mainly foreign direct investment (FDI). FDI entails the purchase of any equity stake. The South African Reserve Bank Quarterly Bulletin (various issues) describes foreign direct investment to South Africa as the investment of foreigners in undertakings in South Africa in which they have at least 10% of the voting rights.

Figure 1 shows FDI into South Africa. According to the World Investment Report (1998) of the United Nations Conference on Trade and Development (Unctad), during 1994 – 1998 FDI in South Africa amounted to US $5 billion, growing at an average of 46% per annum (Mhango, 1999).

Figure 1: FDI in South Africa
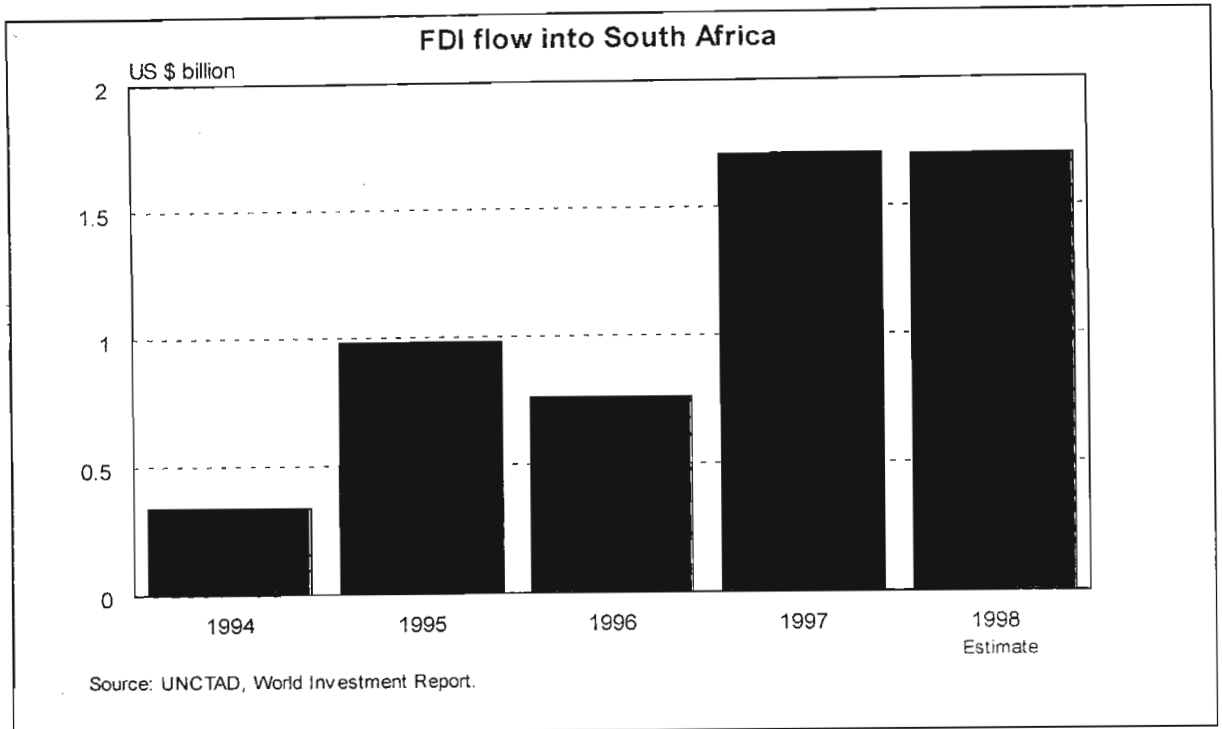
The above figure illustrates that there have been some slight improvements in the inflow of FDI into South Africa. However, in comparison with other transition economies South Africa has performed poorly in terms of attracting FDI.

The World Investment Report (1998) shows that many other countries have attracted bigger amounts of FDI. For instance, for a similar period, Indonesia attracted US $23 billion, India has accumulated US $ 12 billion, and China has attracted a huge US $ 203 billion. This compared to only US $ 5 billion attracted by South Africa, shows that South Africa is lagging behind. This comparison should be interpreted carefully because the economies compared have different gross national income.

Using investment statistics from the South African Investment Report (1999), some interesting results need attention. Apparently, during 1994 – 1998, investments have mostly been attracted to intermediate capital goods sectors. It is however not very clear because some capital goods sectors are mixed with others.

Figure 2 shows that a number of intermediate capital goods sector have generated some investments. For instance, motor and components sector has accumulated more than 10% of the total FDI.

Figure 2: The Percentage Share of Sectors in Total Investment

Electronic and Electrical
Information Technology
Consultancy
Investment Holdings
Manufacturing- Metals
Clothing and Textiles
Engineering
Media and Publishing
Construction and Materials
Agriculture, Forestry and
Fishing
Services
Retail and Wholesale
Packaging and Paper
Industrial Holdings

Financial Services 2.8 %
Property 3.0 %
Transport 2.8 %
Hotel & Leisure 4.1 %
Pharmaceutical 2.5 %
Other Manufacturing 5.8 %
Telecommunication 17.5 %
Mining and Quarrying 6.1 %
Chemicals and Plastics 7.6 %
Other Sectors 15.2 %
Food and Beverages 10.4 %
Energy and Oil 11.4 %
Motor and Components 10.7 %

Source: Mhango (1999: 4)

Furthermore, sectors such as telecommunications have a larger share of total fixed investment. There are certain non-capital goods that have attracted investments. For example, food and beverages sector which is purely non-durable consumer goods sector has a share of more than 10% of the total fixed investment.

2.6.2 Composition of Imports by Type of Commodity

This section highlights the trends in import behavior of certain commodities. The standard categorization is used (i.e. capital goods, intermediate goods, and consumer goods). The discussion will focus on the descriptive trends that associate imports and investment in South Africa.

Using WEFA Southern Africa databank, sectors have been classified into capital goods sector, intermediate goods sector, and consumer goods sector. Percentage shares of each category from total imports were calculated using the same data set.

Table 2.7 shows the composition of imports by commodity types. As argued in Hawkins (1997), the share of import of capital goods has been relatively higher than the share of other goods. It has in some way remained constant starting at 57.84% in 1985 to 57.63% in 1998 (selected years).

Table 2.7: The Percentage Share of Imports to Total Imports – Selected Years (1975 - 1998)

	1975	1980	1985	1990	1995	1998
Capital Goods	62.14	62.22	57.84	57.52	58.24	57.63
Intermediate Goods	24.95	24.56	27.06	29.57	27.03	24.84
Consumer Goods	12.91	13.23	15.10	12.90	14.73	17.52
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: Calculations from WEFA Southern Africa databank (various issues)

It is also important to note that the share of imports of other sectors, particularly consumer goods have been slightly increasing. For example, consumer goods share starts from 12.91% in 1975 to 17.52% in 1998.

Graph 1: Composition of Total Imports by Type of Commodity
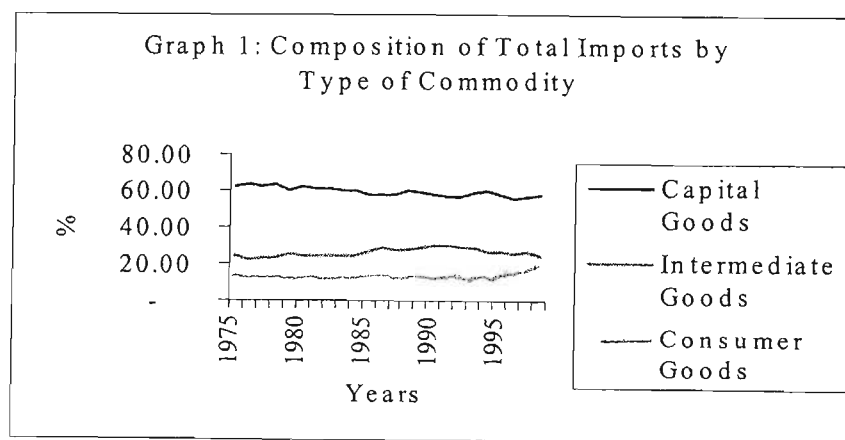
Graph 1 indicates that the gap between the share of intermediate goods imports and consumer goods imports is narrowing. Assuming that imports of capital goods reflect investment into South Africa, it means that investment has remained unchanged. A glance at figure 1 disputes this as fixed investment alone has been on an increase. The constant nature of the capital goods share of total imports explains the continuous importation of such goods. This is typical of small open economies because scale difficulties compel them to import such materials rather than producing them domestically.

2.6.3 The Import - Investment Relationship

Given the theoretical discussion in section 2.6, imports of capital goods are used as a proxy of investment. This section mainly describes this relationship, but the multiplier effects of such relationships to the balance of payments are beyond the scope of this study. The analysis is premised from the view that all imports, capital or otherwise, do affect the current account of the balance of payments. It is noted that many other factors matter.

Graph 2 shows that investment in the form of gross domestic foreign investment (GDFI) is related to imports. Using SARB data at an aggregate level, GDFI schedule moves closely and in a similar direction with imports schedule.
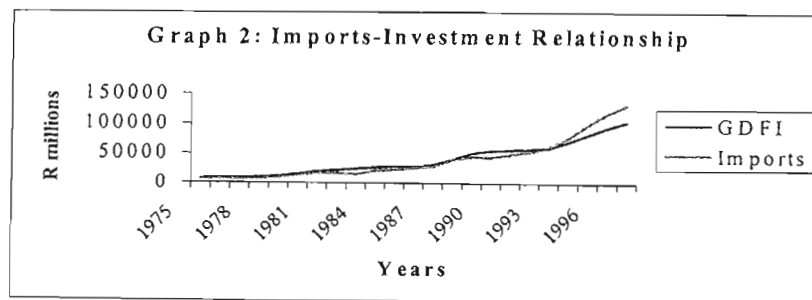
From 1993 onwards, total imports exceed GDFI. One hypothesis is that the South African economy has been in a recovery phase beginning around 1993.

The results of an empirical model in chapter 6 show that an increase in economic activity stimulates imports. In graph 2 imports are above investment from 1993 onwards which shows that South Africa does not import only capital goods.

Taking one particular sector's investment and comparing that with imports of capital goods, the link between capital goods and investment is further confirmed. Graph 3 shows the schedules of capital goods and investment in machinery and transport equipment. Investment in machinery and transport equipment is correlated to imports of capital goods, using the data taken from the SARB quarterly bulletin.

Graph 3: Import of Capital Goods and Investment in Machinery and Transport Equipment
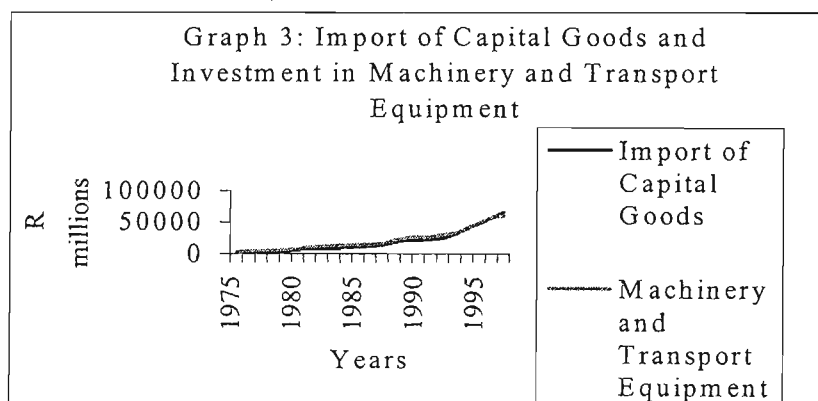
The link is so close such that one is convinced to think that the import of capital goods is largely imports of machinery and transport equipment. This somehow substantiates the finding of Hawkins (1997).

The discussion here needs to be treated with care. It should be noted that explaining relationships by mere trends might give misleading information. As discussed in the literature sections, unrelated variables may appear to be related but not in a true economic sense. The analysis here acknowledges shortcomings of the approach used but it seemed the only possible means to describing import-investment relationships.

In terms of the focus of this study, the discussion of imports-investment nexus further proves the significance of imports and import demand for the balance of payments. As noted earlier, this simply sketches a possible relationship but has no specific addition to the findings of the study. Tentatively, the link between imports and investments is highlighted.

In concluding this section, the Kennedy et al (1979) model is put into question because of its assumptions. Although the microeconomic demand model where the empirical analysis of this study is based upon also has limitations, it seems the best and widely used in international trade relationships[15].

Hawkins (1997) findings are subject to debate. For instance, it does not follow that the decrease in investment is the decrease of imports of capital goods or vice versa. This depends on other factors, particularly the form of investment under investigation.

Descriptive analysis based on current price ratios, as in Hawkins (1997), can not properly inform policy decisions about imports or a related subject. Similarly, this section is not in a position to advance any policy issue about the balance of payments, except that there are signs of a correlation between imports of capital goods and investments[16]. Supposedly, this has implications for the balance of payments, economic growth and employment but these are issues beyond the focus of the current study. As clearly shown in chapter 6, the study bases its analysis on the microeconomic demand function which forms part of the aggregate demand analysis.

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[15] For all studies reviewed an import demand equation is derived from microeconomic utility theory. Refer to chapter 4.

[16] The discussion of this relationship is implicit in most part of the dissertation. For example, in the two-gap model analysis allusion to the investment component of imports is made. Also, the sectoral analysis of import demand functions takes an approach which separates sectors along the lines of capital and labour intensity, resource and non-resource based, and import competing and export oriented. Composition of imports by factor intensity in this chapter proceeds along similar lines.

The model therefore is not an investment function because the study focuses on import demand of any commodity. The aggregate import demand model encompasses national income which is highly correlated with investment and other variables. The impact of investment goods imports to the trade balance, as described in Kahn (1992), needs further thorough investigation, rather than describing trends[17].

2.7   Export Performance

Exports have steadily increased over time, especially for manufacturing. For instance, the share of manufacturing sector exports to total export is 29.68% in 1985 compared to 36.80% in 1997. Gold mining export share slightly increased from 25.7% in 1990 to 27.59% in 1997. Other mining export share increased from 18.02% in 1985 to 28.65% in 1997.

Table 2.8: Composition of South Africa's Exports by Main Economic Sectors 1975 – 1997

Sector	1975	1980	1985	1990	1993	1997[18]
Agriculture	7.04	5.25	2.58	2.36	3.34	6.97
Gold Mining	34.17	45.75	38.4	25.7	23.96	27.59
Other Mining	12.78	13.68	18.02	20.82	25.06	28.65
Manufacturing	29.17	24.87	29.68	37.1	34.25	36.80
Services	16.85	10.44	11.31	14.01	13.39	-
Total Exports	100	100	100	100	100	100

Source: IDC, 1995 and 1998

The case of mining must be noted because for decades South Africa has exported large volumes of minerals including gold. This has been the largest source of income and growth for South Africa. However, this has been subject to various forms of external and policy shocks that have reduced the vibrancy of the mining output.

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[17] Econometric tests of such an hypothesized relationship may be done. For policy purposes, careful analysis of the relationship between imports and investment through assessment of factors affecting investment and imports is important. Most importantly, the mechanism by which investment affect the current account of the balance of payments should be properly shown. Descriptive analysis of trends remains inconclusive.

[18] Calculations based on current terms data from IDC, 1998. Services sector data was not available.

The case of mining must be noted because for decades South Africa has exported large volumes of minerals including gold. This has been the largest source of income and growth for South Africa. However, this has been subject to various forms of external and policy shocks that have reduced the vibrancy of the mining output.

Table 2.9: Growth Rates of South Africa's Exports by Main Economic Sectors 1972 - 1993 (US $)

Sector	1972/75	1975/80	1980/85	1985/90	1990/93
Agriculture	5.14	6.36	-22.68	4.07	12.29
Gold mining	16.3	19.53	-13.93	-2.23	-2.29
Other mining	8.33	14.3	-5.81	9.05	6.4
Manufacturing	5.6	9.22	-7.66	10.78	-2.6
Services	11.99	2.46	-9.43	10.57	-1.46
Total	10.26	12.75	-10.87	5.95	0.03

Source: IDC, 1995 and Bell and Cattaneo(1997: 2)

The important feature of table 2.9 is that during the period 1980/85 growth rates of exports were negative. In general, exports have not performed well. For instance, except for agriculture, all other exports have diminished compared to the 1970s and early 1980s. Lastly, large part of SA manufactured exports have been capital and intermediate capital commodities. Table 2.10 illustrates that point.

Table 2.10: Composition of Manufacturing Exports in terms of Capital-Labour Intensity 1975 – 1997

	1975	1980	1985	1990	1993	1997
Capital-intensive Sectors	29.46	40.89	51.92	54.48	51.84	55.69
Intermediate Capital-intensive Sectors	40.96	28.30	21.59	20.31	22.24	16.73
Labour-intensive Sectors	21.35	19.87	15.50	17.04	16.80	16.65
Ultra labour-intensive Sectors	8.21	10.93	10.97	8.15	9.11	10.97
Total Manufacturing	100	100	100	100	100	100

Source: IDC, 1995, Bell and Cattaneo (1997: 11) and IDC, 1998

It was pointed out earlier, under the discussion of imports, that South African imports a large amount of labor-intensive commodities. Therefore, the textbook story of the

In table 2.10 above, exports of capital intensive commodities is higher than export of other products. Also, exports of capital intensive goods seem to have increased whilst exports of other goods remained relatively stable and some declined during the period under investigation. Another interesting point is that export-gross domestic product ratios have virtually remained static over time. In fact, there are no remarkable increases in export-gross domestic product ratios. As a result, the argument of export growth for faster economic growth is questionable.[19]

2.8   Trade Flows for South Africa[20]

There are a few basic points that need attention with regards to the geographical destinations of South Africa's trade flows. In terms of trading blocks shown below in table 2.11, large volumes of South Africa's imports come from the European Union (EU), followed by Asia, North America and North Africa and Middle-east.

Table 2.11: Composition of South Africa's Imports by Regions and Countries 1993 – 1997 (1990 prices)

	1993	1994	1995	1996	1997
SADC	4.08	2.16	1.78	1.92	1.83
Other African Countries	1.19	0.96	0.90	0.95	1.31
North Africa and Middle East	1.36	4.53	7.64	7.89	11.20
North America	14.76	14.16	13.38	13.52	13.63
EU	43.36	47.26	45.34	44.33	43.37
Other European Countries	0.71	0.71	0.99	0.50	1.90
Latin America and the Caribbean	2.47	2.98	2.92	2.64	3.09
Asia	27.05	25.30	24.01	24.73	20.94

[19] There is vast literature on the export-growth debate. See, amongst others, Dornbursch (1992), Howard (1989), Michaely et al (1991), World Bank Reports (1981, 87), Balassa (1978), Bhagwati (1988), Chow (1988) and Corden (1987).

[20] Various sources have been used in grouping regional blocks. Amongst others, the World Bank and the International Monetary Fund publications were used. Holden (1996) paper on the SADC regional integration was very useful. Other sources also provided insightful guide.

	1993	1994	1995	1996	1997
Australia	1.18	1.53	1.76	2.46	2.52
Other Countries	0.31	0.15	0.14	0.17	0.20
Unallocated	3.53	0.25	1.14	0.90	-
Total	100.00	100.00	100.00	100.00	100.00

Source: DTI, Pretoria

SA imports from the EU have remained above 40% of the total imports since 1993, although the share of the EU imports have slightly decreased from 45.34% in 1995 to 43.37 in 1997. Asia's share is above 20% and it has also marginally decreased from 24.01% in 1995 to 20.94 in 1997.

The share of North America, the North Africa and the Middle-east has increased. For example, in 1995 the share of North America was 13.38% of the total and this figure slightly increased to 13.63% in 1997 whilst the share of North Africa and the Middle-east rose from 7.64% in 1995 to 11.20% in 1997. From the previous discussion of imports, it is clear that imports in real terms have increased.

Examining the direction of SA imports from a different angle the trend remains the same. Looking at Table 2.12 below, the share of the EU is still leading followed by the Asia Pacific Economic Cooperation (APEC) and the North America Free Trade Agreement (NAFTA).

Table 2.12: Composition of South Africa's Imports by Regional Trading Blocks 1993 – 1997 (1990 prices)

	1993	1994	1995	1996	1997
NAFTA	13.52	13.11	13.10	13.18	13.98
EU	39.62	43.56	43.95	42.96	47.57
APEC	36.32	34.78	34.68	35.67	32.99
SADC	3.72	1.99	1.73	1.86	0.08
PTA	1.40	0.71	0.73	0.89	0.87
PTA less SADC	0.19	0.13	0.19	0.17	0.80
ASEAN	3.54	3.61	3.52	3.39	3.28

	1993	1994	1995	1996	1997
MERCOSUR	1.69	2.10	2.10	1.89	2.16
TOTAL	100.00	100.00	100.00	100.00	100.00

Source : DTI, Pretoria

The shares of the EU, NAFTA, and MERCOSUR have marginally increased whilst the shares of other regional blocks such as APEC have remained around the same levels. The Southern Africa Development Community (SADC) and the Preferential Trade Arrangement (PTA or COMESA) supply virtually no imports to South Africa.

As far as exports are concerned the trend is almost the same. The EU, Asia and the North America have relatively higher shares on total exports of South Africa. These shares have remained high and increasing. One very interesting result is that about 11 – 13% of South Africa's exports go to SADC and close to 4% of total exports go to Other African Countries and more than 4% goes to North Africa and the Middle-east.

Table 2.13: Composition of South Africa's Exports by Regions and Countries 1993 – 1997 (1990 Prices)

	1993	1994	1995	1996	1997
SADC	11.21	11.86	10.38	10.94	13.28
Other African Countries	3.21	4.59	3.83	3.61	3.77
North Africa and Middle East	3.39	3.50	2.88	3.09	4.25
North America	10.39	11.12	8.50	8.65	10.42
EU	42.21	38.71	29.85	30.04	38.62
Other European Countries	2.16	1.39	1.20	0.84	2.22
Latin America and the Caribbean	2.23	3.06	2.18	2.41	3.15
Asia	21.33	22.08	18.09	19.65	22.63
Australia	0.90	1.10	1.06	1.38	1.46
Other Countries	2.70	2.59	2.04	0.58	0.20
Unallocated	0.30	0.00	19.99	18.80	-
Total	100.00	100.00	100.00	100.00	100.00

Source : DTI, Pretoria

The market share of the South African exports to SADC have increased from 10.38% in 1995 to 13.28% in 1997 and the same applies for the share of the North Africa and the Middle-east which increased from 2.88% in 1995 to 4.25% in 1997. The same picture holds when examining the trend from a different angle (table 2.14).

Table 2.14: Composition of South Africa's Exports by Regional Trading Blocks 1993 – 1997 (1990 Prices)

	1993	1994	1995	1996	1997
NAFTA	9.54	9.86	9.60	9.47	10.61
EU	38.21	33.60	33.24	31.93	39.05
APEC	29.84	30.22	30.36	31.85	31.79
SADC	10.15	10.30	11.56	11.63	11.70
PTA	8.03	8.95	8.12	8.21	10.22
PTA less SADC	1.12	2.63	2.32	1.87	8.53
ASEAN	2.00	3.15	3.29	3.65	3.84
MERCOSUR	1.12	1.29	1.51	1.40	1.68
TOTAL	100.00	100.00	100.00	100.00	100.00

Source : DTI, Pretoria

In fact, it seems that South Africa has a relatively large market for exports within the region and particularly to African countries. In Table 2.14, PTA's share on South Africa's total exports has increased to more than 10% in 1997. Taking PTA less SADC countries, the export share has risen markedly from 1.12% in 1993 to a remarkable 8.53% in 1997. For commodities, the data pose some difficulty in terms of making conclusive points about the composition of imports and exports to total imports and exports, respectively, by type of good. The data are far disaggregated and not audited. It however seems that the share of consumer goods in total imports is as significant as the share of capital goods to total imports.

2.9   Concluding Remarks

There are a few important points worth mentioning. One is that labour-intensive commodities have the largest share in total manufacturing imports, as shown by composition by main economic sectors and sub-sectors. In addition, the share of import of capital goods is higher than the share of imports of other commodities.

Secondly, there has been diminishing growth rates of imports, though growth of imports compared to that of exports remained significant, during the period under examination. Import penetration ratios and import-gross domestic product ratios have steadily decreased during 1972-93 but increased afterwards.

Thirdly, manufacturing industries provide the larger share of employment, compared with other industries. Fourthly, there are negative growth rates for both exports and imports during 1980/85. Fifthly, there has been moderate rise in total exports compared with occasional significant increases in total imports. Sixthly, South Africa exports large amounts of capital-intensive goods compared to high import volumes of labour-intensive commodities. In addition, the relationship between import of capital goods and fixed investment is illustrated. Lastly, EU, APEC, NAFTA, SADC and PTA are the top South Africa's trading partners, with SADC and PTA and other African Countries increasingly importing from South Africa.

These summary points emanating from the analysis above have serious policy suggestions, especially in the midst of trade policy reforms. A concluding chapter will discuss some policy issues relevant to the subject. Lastly, data constraints restricted the choice of issues to be discussed under this subject. However, it is hoped that other relevant important issues and results of the analysis in terms of foreign trade trends will instill further research. For example, some of the data used can be utilized, once enough data observations are available, to calculate trade elasticities in terms of specific countries and/or group of countries, trading blocks, and commodity groups. These data can also be used to calculate South Africa's trade balance in the same fashion.

Chapter 3

Prices, Income and World Trade:

Literature Survey

3.1 Introduction

Over the past sixty years or so, and especially since the second World War, economists have long been concerned with statistical estimates of the numerical values to be assigned to "structural parameters governing international trade relationships"(Cheng, 1959: 107). According to Magee (1975: 175), attention given to international trade relationships or econometric trade models is characterized by both normative and positive reasons. International trade models are said to be useful in measuring the welfare costs of fluctuations in international trade, the welfare effects of macroeconomic restrictions on trade, effects of international trade on domestic growth, policies to obtain internal or external balance, and policy effects of exchange rate changes and trade restrictions on external balance, amongst others (Magee, 1975: 176).

Noting the vast interest that economists have shown in international trade modeling, Goldstein and Khan (1985: 1042) cite the availability of data, understanding or ability to understand the underlying theoretical framework for the determination of trade volumes and prices, and wide applications of estimated income and price elasticities to a host of crucial macro-economic issues, as the main reasons for the unusual degree of attention devoted to trade elasticities.

This refers to a rich data base[21] on the value of imports and exports for many countries and commodities, the familiarity of consumer demand and production theory, and the application of trade elasticities to international transmission of changes in economic activity and relative prices, the impact of expenditure-switching and expenditure-reducing policies, welfare and employment effects of changes in trade restrictions, and other policy implications. Miller and Fratianni (1973: 191) also cite "theoretical apparatus as well as the nature of data variables" to be the main factors shaping the choice of both variables and modeling approach. Some of these reasons have been questioned by other authors (see, Magee, 1975: 187). For Goldstein and Khan (1985: 1098), empirical research on trade elasticities does not take into account the links between financial and real economic sectors. This implies that many empirical trade models do not consider both financial and real economic variables when estimating regressions. For example, many trade regressions include real imports, real exports, relative prices, and real income but exclude capital flows.

In addition to that, the efficacy of international trade policy largely depends upon the size and significance of both import and export price and income elasticities. This implies that, for instance, when a relative price elasticity to import is bigger and significant, policy makers could modify exchange rates so as to affect imports. Consequently, economists have devoted an enormous amount of attention to the estimation of trade elasticities.[22] However, assignment of statistical and numerical values to international trade relationships has been characterized by both econometric and specification controversies. Mutti (1977: 73) argues that there is no homogenous approach to estimating import demand equation, and that more general functional forms, which may require more data, should be adopted because many import demand equation specifications are not "applicable in all situations".

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[21] However, availability of appropriate data remains a problematic in estimating a disaggregated import function and also separating between long term stable and short term, cyclical relationships. Refer to Orcutt(1950), and Houthakker and Magee (1969) on the limitations emanating from data constraints.

[22] This further confirms the significance of the study on this subject. Views on the importance of trade elasticities are clearly expressed in all studies reviewed in this section. See, for example, Houthakker and Magee (1969), Murray and Ginman (1974), and Thursby and Thursby (1984).

There are many disagreements on the common approach to estimation of trade elasticities. As a result, this chapter intends to discuss both theoretical and econometric issues that prevail in many studies and have not been settled.

This chapter discusses all relevant issues as they relate to the scope of this dissertation. Considerable attention is given to studies that have not been extensively reviewed. Other surveys of this nature exist. For example, Cheng (1959), Magee (1975), Goldstein and Khan (1985) and others have reviewed most earlier literature on this subject. This chapter adopts an approach used by Magee (1975) and hence frequent reference to Magee (1975). Issues examined include the theoretical background for import demand estimation, choice and expected signs of the variables entering the import demand equation, import demand equation specification, time lags and dynamics, use of dummies, indices and proxy variables, cyclical and secular factors, levels of disaggregation, simultaneity, stability of trade relationships, methods of measurement, policy conclusions, and suggested future research[23]. However, this study does not dwell on a critique of broad theoretical and practical shortfalls of international trade models. The main focus for this study is import demand, and as a result emphasis is given to import demand elasticities and not broad international trade models.[24]

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[23] The debate on appropriate methods or techniques of estimation remains unsettled. Some of the main studies that extensively discuss modeling techniques and disagreements are Orcutt (1950), Magee (1975), Murray and Ginman (1976), Thursby and Thursby (1984), Golstein and Khan (1985), and more recently Stock and Watson (1987), Pagan and Wiggins (1989), McCallum (1993), Maquez (1994) and Senhadji (1997).

[24] These issues, including qualities of perfect versus imperfect substitutes approach, various world trade models, competing balance-of-payments theories, and others are not the subject of the current study, although reference to these issues is frequently made as studies engage with them [see, Magee (1975) and Goldstein and Khan (1985) for an exhaustive debate around these controversies].

3.2   Methods of Measurement

As indicated above, methods of measurement of trade elasticities in general and import demand elasticities in particular differ significantly. There has been a frequent use of Ordinary Least Squares (OLS) in estimation of import demand elasticities with respect to income and relative prices.

This method has been criticized in many respects. The criticisms for this approach include its failure to deal adequately with time-series data and dependency on a large number of questionable assumptions. It is assumed, for instance that exporters and importers are always in the long-run equilibrium, supply price elasticities of imports are infinite, and that consumer money illusion does not exist. These assumptions and other shortfalls of OLS methods may result to 'spurious' and unreliable estimated outcomes.

Fairly recently, Maquez (1994) shows that Full Information Maximum Likelihood performs better than OLS, and Senhadji (1997) proves that Fully Modified (FM) estimators using the Monte Carlo methods out-perform OLS. However, many authors have continued using the OLS approach arguing that it is relatively easier and convenient. Houthakker and Magee (1969: 111) acknowledge the bias that may be associated with results obtained through the use of ordinary least-squares method in estimating income and price elasticities in world trade.

Magee (1975: 183) opts for the simultaneous-equation approach combined with the use of instrumental variables as it improved demand elasticities. For Khan (1974), a two-stage least squares method proved superior to OLS as it offered significant price elasticities of the demand for imports and a higher coefficient of determination. However, it is unclear whether a method *per se* or other factors influence the significance of results. For instance historical data mis-observation or mis-capturing may affect model results, not the method used (see, Orcut, 1950). There may, thus, still be a case for ordinary least squares methods of estimation.

Criticisms based on its dependency on assumptions such as those noted above, and failure to capture data problems in a time-series context, can be dismissed by the fact that a combination of OLS with various diagnostic checks of the series should offer a good result or at least give a broad picture of the nature of economic relationships.

The choice of the method of estimation depends on the purpose of estimation and data availability. As noted above, Mutti (1977: 73) contends that there is no universally accepted, homogenous manner of estimating import demand elasticities. Other studies have used the Gross National Product Framework and the Aggregator Function where imports and exports are modeled simultaneously with the demand and supply functions of domestic factors {see, Kohli, 1978) and Lawrence, (1989) }.

3.3   Import Demand Function(s)

Specification and estimation of the import demand function largely rely on micro-economic consumer demand and production theory. Miller and Fratianni (1973: 191) conclude that the import demand function derived from the utility function has both theoretical and empirical standing.

The demand for any commodity depends on relative prices and real income. Consequently, the import demand is viewed, *ceteris paribus,* as a function of relative prices and real income (Erasmus, 1978: 27). In nearly all studies, real income refers to real gross domestic expenditure or real gross domestic product minus exports. This variable, according to Magee (1975) captures domestic economic activity or what Goldstein and Khan (1985: 1056) term the 'scale variable'. Relative prices refer to the ratio of import prices to domestic wholesale prices. Based on the utility maximization function, this specification is standard and frequently used (see, Miller and Fratianni, 1973).

All other studies adhere to this specification, except for the GNP framework approach. However, Khan (1974) questions the use of only two variables in an import demand function. Price and Thornblade (1972) argue that import demand models should consider other factors that influence import demand. As argued in Khan (1974: 692) other factors such as trade restrictions, world economic conditions, the historical dynamics of a country, and the general features of a nation affect its import demand, especially in the case of developing economies.

3.4   Theoretical Expectations[25]

Magee (1975) and Goldstein and Kahn (1985) have examined the theoretical expectations of relative price and income variables signs. In almost all studies on this subject, relative price variable has been reported to have a negative sign and income variable has a positive sign. This means that import demand or volume of imports responds negatively to prices and positively to economic activity.

There are many reasons to believe that import volumes diminish as price increases. However, it is questionable whether this sign should always be negative. There may be an instance where a particular commodity or sector does not depend on prices *per se*. There are exceptions to demand and supply mechanisms.

Certain commodities are continuously consumed in spite of price changes. For instance, a developing economy undergoing trade policy transformation requires certain commodities, such as capital equipment, in order to construct its industrial base. Consequently, when the world price of these commodities relative to domestic prices increases the developing nation is left with no choice other than to import the commodity as a basic need. However, there is a debate, as presented in Magee (1975), concerning the real sign and level of significance of relative price elasticity of the demand for imports.

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[25] Refer to appendix I for some selected empirical results of import demand elasticities, including both developed and developing economies, and for South Africa in particular.

In certain instances, both world prices and domestic prices may be rising and the effect of that on the demand for imports may go either way depending on the rate of increase for each price [see Houthakker and Magee's (1969) price elasticity of the South African import demand, Table 2 in appendix I].

Theoretically, economic activity is postulated to increase consumption. In the case of import demand, one expects import demand to increase as real income rises and almost all studies reviewed reported a positive relationship between income and import demand. However, Magee (1975) questions this relationship.

According to Magee (1975: 188), the sign of the income coefficient is not necessarily positive as the importable could be superior in consumption such that its consumption rises whilst a consumption for the other commodity diminishes. Magee (1975: 191) cites some possible reasons why there are hardly any negative income elasticities.

These include reluctance on the part of researchers to report negative elasticities, systematic tendencies in the growth patterns of demand and supply, mis-specification of import demand functions, and the lack of distinction between short and long term elasticities. Magee's(1975) critique has resulted in better estimates, as various empirical studies have attempted to improve research on trade elasticities by taking cognizance of the theoretical and econometric shortfalls raised.

3.5   Specification Issues

As reflected above, methods of estimation are subject to intense debate. Consequently, various authors have devised better ways to deal with problems associated with mis-specification. Bias and errors inherent in OLS method have resulted in attempts to at least better equation specification. According to Houthakker and Magee (1969: 111), the use of double-logarithmic equations is preferred because "of their general superior fit and easy interpretation".

Murray and Ginman (1976: 75) state that the traditional log-linear model is incorrectly specified. According to Khan (1974: 680), specification of import demand equation in logarithmic form allows imports to react in proportion to a rise and fall in the explanatory variables and also avoids, in a context of constant elasticities of substitution, drastic falls in the elasticity as imports rise. Khan and Ross (1975: 358) present evidence of the appropriate functional form of the import demand equation. Goldstein and Khan (1985: 1044) contend that equation specification depends, amongst other things, on the type of good traded, the end-use to which the traded commodity is put, the institutional framework under which trade takes place, the purpose of the modeling exercise and sometimes on the availability of data. The imperfect and perfect substitute models have dominated empirical literature on trade modeling. Many studies have adopted the imperfect substitutes approach in that they assume no substitutability between imports and exports, except Kohli (1978), Lawrence (1989) and others as they use the GNP and aggregator function which estimates both imports and exports simultaneously.

Specification problems were noticed as early as the 1950s by Orcutt (1950). According to Orcut (1950: 122), estimates of price elasticity of the demand for imports have been questionably low due to errors and bias emanating from mis-specification, mis-observation, improper historical data and failure to separate cyclical effects from equilibrium relationships of import demand equations. Since then, studies have continuously explored better specification and logarithmic expression of an equation combined with better estimation techniques. This, arguably, has reduced some specification errors.

3.6   Time Lags and Dynamics

In practice, the effect of a policy shift normally takes time to come through. This is the argument that many studies of import demand elasticities present and follow. According to Leamer (1973), Yadav (1975) and Goldstein and Khan (1985) it takes time for import demand to respond to changes in real income and relative prices. Magee (1975: 235) concludes that "price effects can work for up to six years while income effects are probably shorter".

For Goldstein and Khan (1985: 1066), importers and exporters will not always be on their long run demand and supply schedules. However, the decisions on the number of lags to be included and which variable(s) to lag in an equation, remain to be considered. According to Thursby and Thursby (1984: 120), equations with a lagged dependent variable perform better than other equations that do not include a lagged dependent variable. The studies should somehow take into account economic events and policy shifts that have happened and predict the time period when an effect filters through. Knowledge about the country being studied is imperative.

3.7   Dummies, Indices and Proxy Variables

Many studies make use of dummies to capture policy changes and structural shifts. This idea is connected to specification issues in that the import demand model is prone to bias and errors if structural shifts are not considered. Consequently, during validation period, researchers should ensure that the series are carefully analyzed such that any anomalies are taken into consideration.

According to Thursby and Thursby (1984: 121), the effects of the breaking of the Bretton Woods system, oil price shocks, and other structural changes must be represented by dummies as they had an enormous impact on international trade. For instance, Price and Thornblade (1972) used seasonal dummies to smooth or capture seasonal patterns of the series. The GNP function framework largely make use of indices, such as an index of technology in order to capture the effect of technological changes (Kohli, 1978). According to Leamer (1973: 443), empirically weighted indices are useful in estimating the import demand function because they trace responses of each commodity or sector, ranging from material extraction to final demand, to changes in real income and relative prices. However, use of indices has been challenged in that they may not reflect true relationships between estimated relationships, especially if incorrectly constructed.

Leamer (1973: 449) acknowledges difficulties in constructing correct indices and presumes that "the difficulties may eventually be resolved". Relative prices and gross domestic product less exports have been largely used as proxy variables for exchange rate effects and economic activity, respectively(Senhadji, 1997). In instances where appropriate data is not available, certain relevant, closely similar factors are frequently utilised. For example, Kreinin (1973) uses the index of industrial production as a proxy for domestic output and demand.

There may be problems with this approach because the effect is not exact as in the case where an appropriate variable is tested. However, this approach can be seen as second best which gives a picture of the nature of investigated relationships, especially within the context of data constraints discussed above. Houthakker and Magee (1969: 122) acknowledges the " limitations imposed by short time-series and inadequate data" in the process of estimating price elasticities of the demand for imports. Mutti (1977: 73) warns policy markers that model results should be interpreted with some degree of caution, and that researchers should concentrate on a few manageable critical variables to maintain the usefulness of the model through simplification of reality.

3.8   Statistical Theory

The import demand model specified and estimated must fulfill the requirements of both economic theory and statistical significance. Import demand elasticities could either be statistically significant or insignificant and that gives impetus to clear-sighted trade policy recommendation. For example, Houthakker and Magee (1969: 121) conclude that the differences in countries' income elasticities of demand will inevitably result to a different trade balance performance for those countries. In this regard, it is crucial to know exactly by how much a country's volume of imports responds to either relative price or real income changes. Many studies have found that import demand responds more significantly to economic activity than to prices (Magee, 1975).

There are questions with this finding as argued in Goldstein and Khan (1985) in the sense that results may not necessarily be meaningful due to the lack of coherent estimation approach that integrates financial and real sectors; link macro-economic theory with economic events, and separation of long and short-run elasticities. Orcut (1950) debated the correctness and usefulness of price elasticities of demand for imports because of historical data, and aggregation and simultaneity problems in model estimation. In practice, for instance, prices and quantities can move in the same direction, data may be incorrectly observed, and price elasticities can be higher for larger price changes and lower for small price changes. This leads to questionable results, even though model results are 'statistically' significant (see, Magee, 1975: 214-218 and Goldstein and Khan, 1985: 1071- 1075 on simultaneity, orcuttization, and quantum effects, amongst others). The significance of an equation in this context refers to anything that is statistically different from zero. For example, Khan (1974) found that the import demand equation estimated for developing countries gave elasticities that meant that an increase in economic activity would significantly raise import demand. Studies reviewed above, with the exception of a few, depicted significant elasticities, and therefore authors were able to make policy recommendations. This involves a good coefficient of determination, reasonably high t-values, low auto-correlation and other statistical criteria.

For example, Khan and Ross (1975: 359) praise the import demand elasticities obtained in their model as very good as " judged by generally high values obtained for the R-squared". However, the statistical significance of any model is subject to scrutiny as econometric controversies, including an appropriate modeling strategy, have not been entirely resolved.

3.9   Cyclical and Secular Relationships

Magee (1975: 191) argues that one of the major problems with trade elasticities is that studies do not distinguish between short term and long term relationships. This debate is also discussed in Miller and Fratianni (1973), Khan and Ross (1975), Hughes and Thirlwal (1977), and Goldstein and Khan (1985).

According to these authors, it is of primary importance to separate secular from cyclical factors in the import demand function. This has fundamental policy implications such that policy markers have to know how import demand responds to relative prices and income both in the short and long run. For example, the effects of exchange rate changes have to be understood within that framework. According to Khan and Ross (1975: 357), ignoring the role of secular factors would result in a misleading impression of the import demand elasticity and may also involve the estimation of a mis-specified equation. Studies that do not distinguish short-term and long-term elasticities have been seriously criticised (see Magee, 1975, and Goldstein and Khan, 1985, and section 3.10)

3.10   Levels of Aggregation

Murray and Ginman (1976: 75) question the use of the aggregate import demand model in that "empirical results support rejecting the traditional specification of the import demand model". The main shortcoming of an aggregate model is that it may not capture the dynamics of the relationships inherent in certain sectors. In a way, it gives a broad picture of the direction of the relationship between variables under investigation although the picture could be mis-leading, as argued in Khan and Ross (1975:357).

Questions relating to aggregate versus disaggregated import demand models are discussed in many articles, including Kwack (1972), Price and Thornblade (1972), Kreinin (1973), Miller and Fratianni (1973), Leamer (1973), Yadav (1975), Murray and Ginman (1976), Weisskoff (1979) and more specifically in Magee (1975) and Goldstein and Khan (1985). Estimation of a disaggregated import demand function by sector, commodity and country has accelerated in the past two decades following Murray and Ginman's (1976) article which casts doubts on the aggregate import demand function. Decision about the level of disaggregation, consideration of cyclical and secular factors, choice of variables, the type of the model and the method of estimation largely depend on the availability of data and the purpose of estimation (Goldstein and Khan, 1985: 1056).

3.11   Policy Conclusions

The considerable attention given to the estimation of trade elasticities, especially import demand elasticities, is arguably motivated by the importance of trade elasticities on policy issues and foreign trade. It is fundamental to understand the nature of foreign or international trade relationships if foreign trade policy is to be effective. According to Houthakker and Magee (1969: 111), the direction in which the trade balance moves critically depends on "each country's income elasticity of demand for imports and on the rest of the world's income elasticity of demand for each country's exports".

Magee's (1975: 176) positive and normative reasons for studying international trade flows also substantiate the policy impact of trade elasticities. Orcut (1950: 117) reveals the fact that relative price changes in an international context have policy implications for trade. For instance, for a devaluation policy to be effective, it is imperative to ascertain the magnitude of the effects that relative price changes instill to the volume of imports and exports.

Khan (1974: 692) points out that the Marshall -Lerner condition, which makes a devaluation policy effective, depends on the sizes of both import and export elasticities. In the context of import demand, the level of economic activity or real income is important for foreign exchange accumulation. This can be interpreted in many ways. If import demand responds significantly positive to real income, this means that economic growth will accelerate imports which may erode foreign exchange thereby constraining faster growth of an economy.

On the other hand, this may further improve the domestic economy if imports are of important value to an economy and if exports rise faster than imports, *ceteris paribus*. In addition to that, a reduction of trade restrictions will increase trade, normally the volume of imports in the case of a developing nation, which may exacerbate or worsen the balance of payments constraint.

Khan (1974: 679) maintains the view that for developing economies quantitative restrictions play a pivotal role in developing countries and that eradication thereof increases volume of imports. In this context, trade policy reforms may arguably have a detrimental effect, at least in the short-run, to developing economies' principal objectives such as employment creation, especially through importation of labour-intensive and luxury commodities.

According to Magee (1975: 218), the main policy questions related to empirical estimates of trade behavior include, the trade balance and welfare effects of tariff cuts, the use of the constant-market-share analysis to evaluate the trends in excess demand for tradable commodities, and most importantly alternative approaches to devaluation (also see, Goldstein and Khan, 1985: 1042). In order to understand the effects of tariff policy, exchange rate, and economic performance changes, structural shifts, and other policy shifts, it is critically important to know or examine the trade elasticities in general or import demand elasticities in particular.

Houthakker and Magee (1969:121) concluded that even if all countries grew the same way and had similar inflation, the trade balances of various countries would behave differently, some experiencing secular improvements and others subject to deterioration because of disparities in import demand elasticities with respect to income. Consequently, analysis of each country's income elasticities of the demand for imports remains a fundamental goal in international trade research. Many authors have been able to make sensible policy suggestions through import demand modeling (see, Kwack (1972), Khan (1974), Magee (1975), Goldstein and Kahn (1985) and others).

3.12 Further Research

As indicated above, research on trade elasticities remains the subject of intense debate. Estimation techniques, levels of aggregation, specification issues and other econometric controversies have not been entirely settled.

However, it should be noted that studies have improved over the past two decades. Criticisms of earlier studies have been taken into account and better methods of estimation have come about. Orcut (1950:126) suggested methods to remove errors and bias in the price elasticities of import demand estimation. These entail better data collection methods and estimation of import demand function at a more disaggregated level. Price and Thornblade (1972: 57) suggested further work to "identify factors, other than income and price, which influence demand". Kreinin (1973: 23) suggested further disaggregation of import demand functions by country and commodity. Khan and Ross (1975: 357) insisted on the separation between long and short-term relationships. Murray and Ginman (1976) raised doubts about the aggregate import demand model and suggested modifications which deal with the 'identification problem' inherent in aggregate import demand models. Single-equation specifications of import demand have also been challenged (Thursby and Thursby, 1984).

The structural stability of trade relationships discussed in Magee (1975) and Goldstein and Khan (1985) have recently been addressed by Ceglowski (1997) for the case of Japan. Nearly all areas for future research reflected above have been considered by recent studies on import demand estimation. However, certain suggestions for further research remain unexplored due to lack of adequate data and due to the unquantifiable nature of certain relationships or factors.

Shortcomings in terms of dealing with econometric issues raised above should be noted. A result should be seen as a broad picture of assessed relationships rather than the correct magnitude of an effect. For example, Khan's (1974: 692) suggestion that a country's special features, such as the state of development, characteristics of trade structures and special circumstances during the period of study, have been difficult to tackle. Price and Thornblade's (1972) recommendation that studies should include other factors affecting import demand has not been successfully pursued.

Magee (1975: 234) suggests that estimating trade elasticities should look at other factors such as the linkages between the theory of international trade and finance and practice. That is, distortions in product and factor markets and implications of factor and trade flows should be examined. Furthermore, the interaction between trade, securities, factor, and money markets should also be taken into account.

These suggestions are further elaborated in Goldstein and Khan (1985: 1098) whoe argue that empirical work must be connected to macroeconomic theory, integrate real and financial sectors, address time lags in trade equations, and consider inter-country differences in the estimation process. As said above, recent studies have considered most of the suggestions for future international trade research articulated above. Those relevant to the present study are briefly discussed below.

3.13   Recent Developments

In the past two decades econometric research has accomplished some improvements, largely by taking into account factors that most trade models had left out. The recent studies have made considerable efforts in establishing both theoretically and empirically more acceptable ways in dealing with a wide range of measurement errors and biases inherent is some of the literature reviewed above.

These developments include, *inter alia*, time-series estimation in the presence of the unit root, and the separation of cyclical dynamics and long run equilibrium relationships. This section will briefly discuss some of the recent estimation approaches and other related measurement questions. It also highlights some of the major differences between the literature surveyed above and the current ways of estimating economic relationships, especially import demand elasticities.

3.13.1 Unit Roots in Macro-economic Time-Series

The argument about the presence of the unit root in economic data has been a subject of the past three decades as stimulated by Dickey (1976). This gave impetus to the ongoing debate and search for better estimation techniques.

A large number of studies have emerged since Dickey's paper. Amongst many, Dickey and Fuller (1979), Engle and Granger (1987), Engle and Yoo (1990), and Hendry (1987) stimulated discussions.

Briefly, the main point is that economic time-series have some pattern, such as a trend. This therefore results in the traditional regression estimating 'spurious' relationships. Consequently, the efficacy and reliability of those results is questionable. As alternatives to the traditional estimation methods that do not consider the possibility of the unit root in data, a set of new techniques has been developed to deal with non-stationary data and also estimating both short term and long term economic relationships.

The familiar technique firstly conducts the unit root tests for all variables entering the estimated model and then, after identifying the univariate characteristics of data, proceeds to estimating relationships both in the short and the long-run. This is the Engle and Granger (1987) estimation technique, combined with Dickey-Fuller unit root tests.[26] The recent methods of time-series estimation use co-intergration and error-correction mechanisms, as shown by the Engle and Granger (1987) representation theorem.

In the context of trade elasticities, Maquez (1994), Muscatelli et al (1994, 1995), Reinhart (1995) and Senhadji (1997) have done interesting work using recent time-series techniques. Maquez (1994) estimates the import elasticities for the United States using a simultaneous model combined with the Rotterdam model and Full Information Maximum Likelihood (FIML).

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[26] The Engle and Granger two step approach uses the Dickey-Fuller (DF) or Augmented Dickey-Fuller (ADF) unit root test. In the process of time-series analysis, various statistical tests are performed to ascertain the univariate features of the series. ADF unit root tests are conducted for all variables entering the model and the initial long-term equation is estimated. The unit root test is then performed on the residuals from the first equation. If the residuals pass the test they are then used in the short-run equation as an error-correction mechanism. Otherwise, re-specification of an equation for a correct functional form resumes and the similar procedure followed. For more detail see Engle and Granger (1987).

In fact, Maquez (1994) argues that estimation of elasticities has relied on a number of unreal assumptions. In relaxing those assumptions, Maquez found that the traditional OLS method of estimation gives poor estimates compared to FIML. Applying a simultaneous model explaining US import volumes and prices, Maquez (1994: 471) relaxes the assumptions that "trade elasticities are autonomous parameters, that both price and trade effects and simultaneity biases are absent, and that expenditures on domestic and foreign goods can be studied independently of each other".

According to Maquez (1994), these assumptions undermine effectiveness in "addressing questions relevant to economic interactions among nations". Muscatelli et al (1994, 1995) study the quantitative issues pertaining to export expansion in the Newly Industrialised Economies (NIEs) and other developing nations. They use various recent techniques explained above to evaluate the impact of export expansion on the various aspects of NIEs.

Reinhart (1995) evaluates the impact of devaluation in developing countries' trade relations. Using recent time-series methods, Reinhart (1995) studies a sample of 12 developing countries. The main conclusion from this paper is that the import demand is generally inelastic, and that the stable economic relationship assumed by traditional models does not exist. This was earlier verified by Magee (1975), Goldstein and Khan (1985) where income-trade relationships proved unstable. Ceglowski (1997) has recently validated this argument examining the Japanese economy. Lastly, Senhadji (1997) is the fairly recent paper that estimates the import demand elasticities with respect to income and prices using recent techniques. Senhadji (1997) studies 66 countries including South Africa, using both OLS and Fully Modified (FM) estimators within the framework of Monte-Carlo methods. Like in Reinhart (1995), OLS estimates performed rather poorly compared to FM estimators. Senhadji (1997) concludes that import demand is more elastic to income than to prices.

3.14   The Synthesis

Although only a few studies have been done on import demand in South Africa, the line of thought and methodological considerations yield common features between South African empirical literature and the rest of the world. Comparisons between a few studies such as Houthakker and Magee(1969), Khan and Ross (1975) and Erasmus(1978) and Kahn (1987) suggest an extensive overlap in both theory and practice in trade elasticities.[27]

However, there are, presently, no extensive published studies, for South Africa, of trade elasticities that utilize recent time-series techniques as done by the studies reviewed in this section. The theoretical and methodological background alluded to above holds in many respects for statistical estimates of trade elasticities or propensities. The selection of variables, tests of significance, model specification follow nearly the same path. Consequently, practical and methodological considerations enunciated or rather encompassed in the preceding discussion are largely similar.

3.15   Concluding Remarks

This chapter has provided an extensive review of general literature on trade elasticities and more specifically on the demand for imports. The main points that emerge entail the nature of econometric models, theoretical and methodological background, and econometric issues in trade modeling.

An assessment of the validity of these models and applicability of results in policy formulation was noted as to be beyond the scope of the present chapter. These issues shall be addressed properly in the seventh chapter of policy implications.

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[27] This point is further substantiated by reference that South African studies make to other studies in model selection and specification. (see references from Erasmus, 1978 and Kahn, 1987).

However, like above, these issues are discussed as they incidentally prevail in particular sections. The descriptive analysis of the South African import demand presented in chapter two and the empirical model pursued in chapter six further give some light to the relevance of these studies for policy marking.

Chapter 4

Description of South African Studies:
Literature Review

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ıblished or accessible studies conducted in South Africa on the

sponsiveness or elasticities with respect to income and relative

ıde the pioneering paper by Woods (1958), and later Erasmus

;7), and more recently Lawrence and van der Westhuizen (1990,

ies evaluate the magnitude of the possible effects of the level of

and relative prices on import demand, in some cases adopting

r to international studies discussed in the previous chapter.

nethods used in these studies somehow differ, although policy

videnced by results are similar to some particular extent[28]. These

on various hypotheses and assumptions discussed in later sections.

pt methods used by prominent international trade studies such as

Vlagee (1969), Khan and Ross (1975), Magee (1975), Goldstein and

hli (1978) and many others.

ıts a sample of selected results from studies described in this chapter. The
ıroach are shown by the nature of quantitative estimation and choice of variables.
npared with results in appendix I and results of the empirical import demand
l in chapter six.

Woods' (1958) study is an exception to this since, understandably, it does not make reference to these studies. However, in many respects Woods (1958) uses a descriptive approach that is compatible with the economic theory of international trade relationships, which is largely similar to other studies including the ones mentioned above.

Estimation techniques used in Woods (1958) are somehow outdated. However, economic policy ideas encapsulated in that paper remain useful and help in tracking the economic history of trade relationships and foreign trade policy of the South African economy. Woods' paper is arguably the stepping-stone in trade relationships estimation in South Africa.

As discussed in the previous chapter, the reason for studying trade elasticities and import demand in particular is, amongst other things, because of their importance in foreign trade theory and, most importantly, in policy making (Thursby and Thusrby, 1984 :120). Consequently, studies reviewed in this chapter generally contend that import demand estimation has particular relevance given the importance of the trade sector and policy changes or shocks for the well-being of the South African economy.[29] According to Lawrence et al (1990: 318) the size of export supply and import demand elasticities is an important determinant "of the effects of exogenous shocks and policy changes on a country's industrial structure and the level of welfare".

This review or description of the methods and results of the studies of trade elasticities and/or import demand in particular will narrowly focus on describing the South African studies mentioned above, although reference to other studies is made where necessary. The review describes, chronologically, the scope and purpose for the study, the variables, methods used and tests of significance (if any), measurement issues, and policy conclusions drawn from literature.

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[29] Kahn (1987), and Lawrence et al (1990) contend that import demand elasticities are of fundamental importance in South Africa in relation to the effects of international sanctions and/or trade embargoes applied against South Africa. There are other reasons as argued in Bell and Cattaneo (1997) which imply that if the foreign exchange scarcity constrains the growth of the

It should be noted that the basic statistical data underlying estimation in these studies may not be entirely accurate, adequate, or appropriate. As discussed previously, estimation techniques have continuously been subjected to scrutiny and debate. As argued in Houthakker and Magee (1969: 121), Mutti (1977:73) results should be interpreted carefully because of some problems associated with different estimation methods. The main aim of the present chapter is to describe, rather than to provide a critical evaluation, although critical comments are made in a few instances.

4.2   Research Methods and Data

As mentioned above, studies reviewed in the present chapter use different methods to measure import demand elasticities or trade elasticities in general. Woods (1958), unlike others, uses mainly quantitative techniques to estimate a two-variable regression model of trade and income. Woods (1958: 136) studies the relationship between aggregate income and foreign trade in the period 1910 to 1954. Basically, Woods (1958) evaluates the relationship between the money value of visible imports and exports and the money value of South Africa's aggregate income, because of data constraints.

The study ignores price changes as, according to him, price changes affect both trade and income in the same way. According to Woods (1958: 137) trends and changes between the 'real ratio' and 'money ratio' remained the same even during the boom in import prices for the entire period of analysis. However, there may be problems with this approach in that when one examines changes in variables in current prices, the result will reflect price changes than real changes. It is also doubtful whether the direction and magnitude of price changes are the same for all variables, in this case income and trade. For this reason, it may be preferable or at least advantageous to use deflated series in this type of work.

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economy, the import demand study is of crucial importance.

Woods (1958) uses the Net Geographical Income (NGI) as a measure of aggregate income. This measure according to Woods (1958: 136) is similar to Gross National Product (GNP) and it was the only reliable measure of income available. He had observed that NGI was greater than GNP and the results for 1946 to 1954 were the same using NGI and GNP alternatively. This method is presumably correct in that NGI in real terms excludes exports such that the volume of imports and exports, respectively, respond to domestic demand activity, holding other factors constant.

Woods (1958) made no allowance for the import content of South African exports because of the lack of sufficient statistical information. Woods (1958: 141) approach focuses on imports and exports as percentages of NGI (at factor cost), for the 1911/12 to 1954 period and percentage shares of the "major private sectors of the economy in the union's aggregate income, for the 1911/12 to 1953/54 period".

Precise values of the shares of the sectors of the economy in aggregate income, as estimated on many occasions, could be subject to limitations. A result could be either low or high, increasing or decreasing values, depending on whether the numerator or denominator changes or not. For example, imports as a percentage of aggregate income may rise not because of high import penetration but because of diminishing aggregate income relative to the volume of imports. Consequently, it is imperative to also assess the variations for each factor to determine its precise trend.

In addition, Woods (1958) estimates the magnitudes of the relationship between imports, exports and income using a two-variable correlation analysis[30]. According to Magee (1975) and others, as discussed in the previous chapter, there are problems with this approach.

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[30] Woods (1958 : 139) concludes that 'imports and the geographical income are highly and positively correlated in the long run' as shown by "the Pearsonian coefficient". This coefficient stands at

For instance, it does not capture other effects emanating from other factors not included in an equation and it largely depends on the classical assumptions such as absence of auto-correlation, homoskedasticity, and others that do not necessarily hold in reality. Therefore, the validity and reliability of results obtained through this method are questionable.

The major sectors that Woods (1958) studies are Agriculture, Fishing and Mining, Manufacturing and Wholesale and Retail Trade. Data used are taken from the Official Year Book, the Annual Statement of Trade and Shipping, the South African Reserve Bank Quarterly Bulletin, and Annual Reports of the Transvaal and Orange Free State Chamber of mines (various issues).

Scheepers (1969) estimates the magnitude of the effects of import substitution on the volume and structure of South Africa's imports for the period 1926/27 to 1963/64. In fact, this study does not categorically belong to the studies of import demand elasticities. However, there are some reasons to believe that it forms an integral part of the work on import demand. The results and policy issues that Scheepers (1969) addresses have enormous relevance for the current study, especially the interpretation of results of an empirical model estimated in the dissertation and for policy conclusions. Scheepers (1969: 258) based his analysis on the view that, amongst other things, "import substitution had made quite a remarkable contribution towards successfully launching a process of industrialization in South Africa".

This paper is largely conceptual in the discussion of the evolution of import substituting industrialization. Scheepers (1969) uses a model based on Chenery (1960). Like Woods (1958), Scheepers (1969: 264), in addition to the model, evaluates imports as a percentage of Gross Domestic Product (GDP) and the relative share of imports, classified according to the end use, for the period 1926/27 to 1963/64 in constant 1956/57 prices.

0.957, a probable error of 0.009, for the period 1911/12 and 1918-54.

Data sources are not clearly shown. Scheepers (1969) states that data used were taken from his Ph.D dissertation and Du Plessis (1965). Criticisms depicted above about studies using traditional methods also apply in Scheepers (1969).

Erasmus (1978) based the analysis of "Elasticities and Lag Structures in South African Imports" on the basic micro economic demand theory. That is, the demand for any commodity is a function of real income, in the case of final commodities, or production in the case of intermediate or primary products, and relative prices. In fact, this is the basic postulate that many studies on this subject have based their model specification and estimation (refer to studies reviewed in chapter three).

Like other studies, Erasmus (1978) hypothesized a linear relationship in the model. The model estimated includes dummies for policy changes and/or crude oil shock in 1974 and also explores the number of lags included in the model. However, as discussed in the previous chapter, the question of the number of lags to be included, which variables to lag and the nature of a lag structure have not been settled. In short, real gross domestic expenditure, relative prices and a dummy are included in the model as determinants of imports. It is an aggregate quarterly model for the period 1965.1 to 1976.4. Data sources are stipulated in the unpublished M.Com dissertation by Erasmus (1977). This study is open to relatively few criticisms as it accounts for time-lags and adjustments and takes into cognizance structural shifts of the 1970s. However, it still lacks a number of important dynamics that feature in recent studies, such as disaggregation, and the distinction between cyclical and secular trends.

Kahn (1987) mentions a large number of points relevant to the present study. Kahn (1987: 238), like Thursby and Thursby (1984), begins by noting the importance of import demand elasticities and the overwhelming resurgence of trade elasticities studies.

Kahn (1987) provides us with the estimates of import demand and import penetration elasticities for four different economic sectors. These are Manufacturing, Agriculture (ISIC categories), Chemicals and Machinery and Transport equipment (SITC categories). Khan (1987: 238) acknowledges the constraint on the level of disaggregation due to appropriate data shortage. The estimation method is the same as for many other international trade studies. For instance deciding on the lag structure, Kahn (1987) follows a technique set out in Goldstein and Khan (1985: 106).

Basically, Kahn (1987) uses the multi-variable regression system to estimate import demand and import penetration ratio equations. Kahn (1987: 244) estimates the Almon Lag equations for the period 1974 - 1986 for all the economic sectors named above.

Data were derived from the Central Statistical Service Quarterly Bulletin, the SARB Quarterly Bulletin of Statistics and the Foreign Trade Statistics of the Commission for Customs and Exercise (various issues). The study may be subjected to some of the criticisms mentioned above for other studies, especially pertaining to reliability of the data[31]. Fairly recently, Lawrence and van der Westhuizen (1990, 1994) have estimated trade elasticities for the South African economy, firstly at an aggregate level and eventually on disaggregated levels. They also begin by acknowledging the widespread research on trade elasticities and the importance of export supply and import demand elasticities for policy analysis.

Both papers set forth an empirical model using the GNP function approach and the Generalized McFadden function to quantify export supply and import demand elasticities for South Africa.

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[31] The Central Statistics Service (now termed Statistics South Africa) data bank has been critisized in terms of reliability. For a fairly recent study of CSS statistics refer to Klasen and Woolard (Unpublished paper).

The GNP function framework, as argued in Kohli (1978:175), captures the industrial structure's influence of the economy on exports and imports. Lawrence and van der Westhuizen (1994) disaggregate exports into four component groups and imports into three component groups. Aggregator functions are specified and estimated using a two-stage estimation process in order to obtain price elasticities for imports and exports.

This method is based on a number of important assumptions such as that the economy is made up of profit maximizing firms operating under conditions of perfect competition, factors are assumed to be mobile across firms, and exports are treated as output and imports as inputs.

Most importantly, Lawrence et al (1990: 320) assume that South Africa is a price-taker in international markets- small country assumption. Data used are time-series from the National Accounts for the period 1974 to 1987. Errors and biases, discussed in chapter three, are likely to be prevalent in a model estimated with a few observations. It is also difficult to separate short-term from long-term elasticities when faced with a very short-term time-series.

The model includes the quantity of aggregate exports, less the quantity of aggregate imports, less the quantity of labour, and the quantity of domestic sales as the main variables. These assumptions combined with estimation techniques used lend considerable limitation to the general applicability of the model and usefulness of results for policy purposes, especially if these assumptions do not hold for an economy under investigation.

4.3   Estimation Results

Woods (1958: 130) concludes that the average propensity to import shows a "fairly high degree of positive correlation with the trade cycle" for the entire period of analysis, except during the World War II when the imports as a percentage of NGI "dropped quite substantially". Although interrupted during WW II, the trend depicts a greater degree of "cyclical sensitivity" of imports than income. Woods (1958) turns to economic theory and the country's dependence on imports to explain the positive correlation of 95 per cent between imports and income as shown by the Pearsonian coefficient of 0.957 during 1911/12 and 1918-54 periods. The coefficient of variation for imports was higher than for income, 0.890 and 0.763 respectively. This suggests that imports are more sensitive to cyclical variations than income.

The rising tendency of the average propensity to import, according to Woods (1958: 141), was due to "industrialization (process) in South Africa" because the secondary industry is import-surplus. There are other reasons such as the fact that imports tend to contract to the extent that products of the new industries replace goods which were previously imported, and also the income effects of industrialization. The examination of the percentage shares of major sectors to South Africa's income shows that in spite of import controls and devaluation, prosperity of the economy and the "war-time backlog" of demand contributed to high propensity to import.

There is also evidence of the lag between income and imports, of approximately six months. However, equations, both with a lag and no lag, yield similar results. Exports show an even higher degree of positive correlation to income than imports. Woods (1958) does not discuss possible reasons for this result. Almost 98 per cent correlation exists between exports and income. Exports, however, were found to be less sensitive to trade cycles than imports. It is important to note that the export ratio averaged 31.4 per cent whilst import ratio was 28.1 per cent which means that under one third of income was earned from exports and one quarter spent on imports. And there was no evidence for a lag in the case of exports and income.

There are some important results shown in Scheepers' (1969: 270) paper. Firstly at a conceptual level, he concludes that the different schools are somewhat getting closer "together in an approach which links theory and practice in better harmony".

Secondly at an empirical level, imports as a percentage of GDP have declined during the period of analysis combined with changes in the composition of goods. That is, imports of consumption goods declined markedly whilst capital and intermediate capital goods imports showed a continued increasing tendency. This substantiates arguments discussed in the last chapter that South Africa has remained import intensive, especially on intermediate capital goods.

The import substitution performed "exceptionally well to keep the level of imports within the means supplied by the export sector", especially in the context of relatively high import demand elasticities (Scheepers, 1969: 271). Lastly, comparisons of the 1926/27-1956/57 and the 1956/57 - 1963/64 import substitution process reveals that the latter period's import substitution was of small size.

In the regression comprised of imports, income as GDE (1970 prices) and relative prices, the ratio of GDP deflator to the import deflator, Erasmus (1978) found that imports are positively correlated to income whilst the price elasticity result was mixed. Scatter diagrams also indicate that there is a change in the trend, for the period 1974- 1976. Erasmus (1978) attributes this structural shift to, amongst other factors, a change in defense expenditure and includes a dummy in the model to capture this effect.

Kahn (1987) argues that regression results confirm that relative prices and GDE are significant explanatory variables of the behavior of both import demand and the import penetration ratio. In this study relative prices are computed as the domestic price less unit value imports or domestic price index divided by price of imports index.

Results obtained by Kahn (1987) are compatible with *a priori* theoretical expectations. For example, according to the results, the import demand relative to price elaticities for manufacturing are between 1.15 and 1.41 depending on the model used (see results, appendix II). Lawrence et al (1990, 1994) found that import demand response is "generally inelastic". The own-price demand elasticity of imports is -0.671 where as an increase in the price of the other input, labour, decreases import demand by 0.147 per cent.

These findings have some important policy implications which, together with the previous chapter's policy conclusions and the empirical model policy suggestions, prevail in the concluding remarks. This chapter has discussed the methods of estimation, results and possible shortfalls of the studies done on the South African import demand.

This exercise has given a broad picture of the historical trends and behavior of trade relationships as proclaimed by studies. This chapter, together with chapter three, makes a contribution to a tentative direction to be followed on estimating the import demand elasticities in chapter 6, especially with regards to minimizing measurement errors and biases.

Chapter 5

Co-integration, Error-correction and Non-Stationary Data:

A Theoretical Overview

5.1   Introduction

According to Banerjee et al (1993:1), time-series econometrics is particularly concerned with the "estimation of relationships among groups of variables, each of which are observed at a number of consecutive points in time". In a time-series context, observations are connected in all kinds of ways compared to the classical linear regression that is based on a number of assumptions including the central assumption that observations are independently sampled. Unit root tests have indicated that the classical assumptions, such as that the mean and variance of variables are well defined and independent of time do not hold in practice and as a result maintaining these assumptions and others would lead to misleading inferences.

In short, ignoring the presence of unit roots would "at best ignore important information about the underlying (economic and statistical) processes generating the data, and at worst leads to non-sensical or spurious results" (Harris, 1995:1). Spurious regressions simply refer to a model showing statistically significant relationships that do not exist but which develop from contemporaneous correlation emanating from the trend and other misleading factors. That is, for instance, in a model encompassing two completely unrelated variables one could find that the regression results depict very significant correlation that may simply be due to a fact that the series are trending the same direction.

It is therefore because of the fact that economic series may contain a unit root that a co-integration approach is preferred against normal classical linear regression techniques based on certain assumptions which impede appropriate estimation and further provide misleading information about models estimated.

Most studies reviewed in chapters 3 and 4 have used the traditional Ordinary Least Squares (OLS) method. The present work applies the co-integration approach because it takes into account some of the factors that the earlier techniques did not consider. This chapter highlights the background of and the mechanics of time-series methods so as to accommodate even readers with less econometric background. The importance of this chapter stems from the fact that the major part of this study uses time-series econometrics. The discussion is based largely on Banerjee et al (1993), Rao (1994), Engle and Granger (1987), Engle and Yoo (1990), Griffiths et al (1993), Harris (1995), Hendry (1995), and others, including lecture notes.

5.2   Stationarity and Unit Roots

The concept of stationarity is associated with equilibrium in the data. That is, as expressed above, the data does not contain a particular systematic behavior which is non-normal. Given a standard autoregressive process, AR(1):

$$y_t = \delta + \varphi y_{t-1} + \varepsilon_t \tag{5.1}$$

where ε is white noise with mean zero and a constant v^2, the series y_t can be shown to be stationary if and only if $|\varphi| < 1$. There are, however, some complicated AR processes which make the task of proving whether the series contain a unit root difficult. For instance, taking the AR(p) below:

$$y_t = \delta + \varphi y_{t-1} + \varphi_2 y_{t-2} + \varphi_p y_{t-p} + \varepsilon_t \tag{5.2}$$

where, as in 5.1, ε is white noise such that $\varepsilon_t \sim NID(0, v^2)$, it may not be easy to tell whether y_t is stationary or not. Therefore, in order to check for stationarity in this process(equation 5.2) we need to introduce the lag operator (L), which is simply a notational device, defined by the operation of taking a one-period lag, i.e.

$$Ly_t = y_{t-1} \tag{5.3}$$

In which case, $L^2 y_t = LLy_t = Ly_{t-1} = y_{t-2}$ and so $L^p y_t = y_{t-p}$

The AR(p) expressed in equation 5.2 can be re-written with the lag operator notation as (where y_t is the data):

$$(1 - \varphi_1 L - \varphi_2 L^2 - \dots - \varphi_p L^p) y_t = \delta + \varepsilon_t \qquad (5.4)$$

It should be noted that the term in front of y_t is a polynomial in a lag operator. If L is substituted by z, the series will be stationary if every solution of z in the equation 5.4 equal zero. That is:

$$(1 - \varphi_1 z - \varphi_1 z^2 - \dots - \varphi_p z^p) = 0 \qquad (5.5)$$

such that the absolute value of z is less than one. In contrary, if in an AR(1) process the absolute value φ equals 1 and if the absolute value of z equals one, then the series is nonstatiorary, meaning that the series has a unit root.

There are other complicated processes such as the moving average (MA) processes. These processes are beyond the scope of this study as there is no application of them in the estimation. In brief, the MA (1) process can be expressed as:

$$y_t = \delta + \varepsilon_t + \theta_1 \varepsilon_{t-1} \qquad (5.6)$$

where $\varepsilon_t \sim NID(0, v^2)$. The general MA (p) process can be written as:

$$y_t = \delta + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \dots + \theta_q \varepsilon_{t-q} \qquad (5.7)$$

where $\varepsilon_t \sim NID(0, v^2)$ and $\mu = \delta$ and $\sigma^2 = (1 + \theta_1^2 + \theta_2^2 + \dots \theta_q^2) v^2$. In this process, unlike the AR process, autocorrelations will die out after q periods. The combination of AR and MA processes gives the ARMA process such as:

$$y_t = \delta + \varphi y_{t-1} + \varphi_2 y_{t-2} + \dots + \varphi_p y_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \dots + \theta_q \varepsilon_{t-q} \qquad (5.8)$$

This can also be expressed in a lag operator notation as done in the case of AR process above, equation 5.4 :

$$(1-\varphi_1 L-\varphi_2 L^2 -....-\varphi_p L^p)y_t = \delta + (1+\theta_1 L+\theta_2 L^2+.....+\theta_q L^q)\varepsilon_t \qquad (5.9)$$

It should be noted that the series is stationary if and only if the AR component of equation 5.9 is stationary. That is, if the polynomial on the left-hand side of y_t in equation 5.9 does not contain a unit root.

The presence or absence of a unit root depends on the value of an intercept. Given the data generating process (DGP), first order autoregressive process, similar to equation 5.1, it can be shown that y_t is stationary if $|p| < 1$ in the equation below:

$$y_t = p y_{t-1} + u_t \qquad (5.10)$$

However, if $|p| \geq 1$ the series is non-stationary. If we re-arrange equation 5.10 and accumulate for different periods beginning with an initial value of y_{t-n} we obtain:

$$y_t = y_{t-1} + u_t$$
$$y_{t-1} = y_{t-2} + u_{t-1}$$
$$\text{Therefore, } y_t = y_{t-2} + u_t + u_{t-1} \qquad (5.11)$$

It is then clear that y_t depends on the critical value of y_{t-n} and depends on the errors accruing during period $t-n+1$ and t. Equation 5.11 also shows that the variance increases infinitely over time. By definition the unit root would mean that the series have different means at different end points. In the opposite, if $|p| < 1$ y_t is stationary.

The next chapter looks into this question. All variables used in the import demand equation for South Africa are tested for stationarity. As expected, all series are stationary in differences.

The next chapter adopts the co-integration approach which examines the orders of integration for each variable. Once this is done, the regression is estimated taking into account the fact that there is long-term co-integrating relationship. This helps in separating the short-term from the long-term import demand elasticities.

5.3   Integration and Co-integration

Rao (1994:3) contends that co-integration tests are used to directly test or falsify the underlying theory that presumes long-run stable, equilibrium relationships between variables. This section discusses the means by which non-stationary series are rendered stationary. There are two major, broad, steps in co-integration analysis, already detailed above. Firstly, the univariate characteristics of the data must be thoroughly examined, that is testing for unit roots. Secondly, examination of multivariate characteristics of the data follows, that is, co-integration properties of the data as explained in Engle and Granger (1987).

The series that are stationary in levels, without differencing, are said to be integrated of order zero, denoted by I(0). By implication, the series can be made stationary through differencing. That is, $|\varphi| > 1$ can be rendered $|\varphi| < 1$. If, for instance, the series becomes stationary after differencing once it is denoted by I (1). By the same token, if two or more series are integrated of the same order it can be said that the series are co-integrated. For instance, if two series are rendered stationary after first differencing it can be said that they are co-integrated, denoted by CI (1,1). The orders of integration of a particular series can be ascertained by applying the Augmented Dickey-Fuller unit root test (Banerjee et al, 1993:157).

Stock and Watson (1987) show that ascertaining the presence or absence of the unit root in the data can be difficult. For example, there may be a stochastic (non-stationary) or a deterministic (stationary) trend in the data generating process that affects the power of the unit root test. The next chapter takes this into account. The data is extensively examined prior to use in the South African import demand model.

5.3.1 Engle-Granger Approach

There are two well-known approaches to dealing with non-stationary variables, these are the Engle-Granger two-step and Johansen technique. There have been various extensions to these approaches in order to take cognizance of certain limitations of these techniques. For instance, Harris (1995:56) discusses the extensions to the standard Engle-Granger two-step approach phrased as Engle-Granger-Yoo three-step procedure which takes into account the limitations of the Engle-Granger two-step approach. The critical limitation of the Engle-Granger approach is that the use of the Augmented Dicker-Fuller unit root tests effectively restricts short run dynamics, such that the reaction of one variable to another is the same both in the short and long-run. In fact, the model acts as if variables were in equilibrium. The other limitation of the Engle-Granger technique is the prevalence of non-standard distributions to the estimators. The third step of the Engle-Yoo procedure, therefore, is to provide correction of the first stage estimation of the long-run parameters of the model, in order to ensure that distributions return to normal distribution.

There are other issues to be considered in this process. Certain prerequisites should be met for the E-Y procedure to apply. For instance, a particular co-integrating vector should exist. However, for the purposes of the current study the E-G two-step approach is used largely because of its widest use in other studies and because of its relative simplicity. In fact, E-G two-step procedure represents a simple test for the presence or otherwise of co-integration, and is often used as a first indication of whether a particular set of variables represent a combination which is consistent with a long-run equilibrium relationship. It also allows use of the super-consistency property of the Ordinary Least Squares to obtain consistent estimates of the co-integrating vector, provided a unique co-integrating vector exists. Lastly, since the E-G approach is combined with the second stage of estimating short-run dynamics by means of the error- correction mechanism which employs the measure of dis-equilibrium obtained from the equilibrium relationship, it also provides information about the speed of adjustment to equilibrium.

Engle and Granger (1987) proposed a two-step estimator for models involving integrated variables. That is, at first step parameters of the co-integrated vector are estimated by running the static regression in the levels of variables.

In the second step, the residuals are incorporated into the dynamic regression run in differences as an error- correction term. This procedure can be accomplished through standard estimation techniques (Banerjee et al, 1993:157). In short, E-G approach rests on the existence of co-integration between variables, and is a technique designed to identify the presence of co-integration between variables where it exists. This is done by means of close examination of the properties of the residuals from the static regression. This is of paramount importance for the current undertaking so as to be able to separate long-term from short-term elasticities of the import demand.

In effect, the E-G approach amounts to testing the residuals in terms of whether is there a unit root or not. The null hypothesis is that there is a unit root which means that variables are not co-integrated or there are no co-integrating relationships. The Engle-Granger approach is illustrated below.

The Engle and Granger two-step procedure, roughly discussed above, can be briefly highlighted. After ascertaining the nature of the data, the long-term regression is estimated as:

$$y_t = \beta x_t + \varepsilon_t \qquad (5.12)$$

As said above, we take residuals from equation 5.12 and conduct a unit root test on them using the ADF unit root test.

If the residuals are stationary then the short-term dynamic model (5.13) is estimated, otherwise re-check data and re-specify the model.

$$y_t = \Upsilon_0 x_t + \Upsilon_1 x_{t-1} + \alpha y_{t-1} + u_t \qquad (5.13)$$

Equation 5.13 can be expressed in the error-correction form as Harris (1995: 53) suggested:

$$\Delta\varepsilon_t = \bar{\Psi}^* \varepsilon_{t-1} + \sum_{i=1}^{p-1} \Psi_i^* \Delta\varepsilon_{t-i} + \mu + \delta t + \omega_t \quad \text{where } \omega_t \sim IID(0, \sigma^2) \qquad (5.14)$$

The error term is obtained from the long-term regression ($y_t = \beta x_t + \varepsilon_t$). In the test one should decide whether to include a deterministic trend or not. This depends on whether a constant and/or a trend term appear in the static long - term equation. That is, deterministic components can be included in either long-term static or short-term dynamic equation, but not to both.

There have also been attempts to deal with problems of more than one co-integrating relationships in an equation. Based on a single equation dynamic model shown above this problem can be resolved by using the vector error-correction model as shown below:

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + \dots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-1} + u_t \qquad (5.15)$$

where $\Gamma_i = -(I - A_1 - A_2 - \dots - A_i)$ and $i = 1, 2, \dots, k-1$ and $\Pi = -(I - A_1 - A_2 - \dots - A_k)$.

The matrix used contains information about the long-run relationships and the speed of adjustment to equilibrium. However, this technique (Johansen approach) is beyond the scope of this study and it is not used in estimation. The next chapter uses basic co-integration techniques that examines the nature of the series, and tests for co-integration using the Augmented Dickey-Fuller (ADF) unit root test.

The ADF tests are used because of their generality and relative simplicity. There are, however, instances where the ADF tests perform poorly. For instance, the presence of structural breaks, seasonal patterns in data, small samples, and the presence of autocorrelated errors can negatively affect the power of the test.

The other critical point concerns the number of lags chosen in the ADF test because too few lags may result in over-rejection of the null hypothesis of non-stationarity when it is correct and too many lags may reduce the power of the test. The estimation undertaken in this work takes this into account. I use the general-to-specific method to choose the lag length. That is, beginning with many lags and testing down.

There are other unit root tests that can be used but they also have significant problems. For example, recent work on the Phillips-Perron tests show that the power of this test is poor.

5.3.2 The Engle-Yoo Three Step Approach

As discussed above the E-Y three step simply adds to the above mentioned E-G two-step procedure. As noted above there are a few critical limitations of the E-G approach and as a result E-Y's third step provides a correction for one particular problem of non-standard distributions to the estimators. As stated above there are two major requirements for the application of the E-Y approach. That is there must be a unique co-integrating vector that is ascertained in the E-G procedure through close examination of the properties of residuals. Another important prerequisite is that weak exogeneity applies to the explanatory regressors of the short-run ECM.

Briefly the procedure begins with estimating a long-run relationship, such as equation 5.12, directly by means of OLS.

$$y_t = \alpha y_{t-1} + \varepsilon_t \tag{5.16}$$

As explained above in the case of E-G two-step technique, the residuals from the first step provide estimates of disequilibrium which enter the ECM model as the error-correction term, in order to provide an estimate of the speed of adjustment term $(1-\lambda)$ and the estimated residuals, u_t

$$\Delta y_t = \Delta x_t - (1-\lambda)\varepsilon_{t-1} + u_t \tag{5.17}$$

In the third stage, the estimated speed of adjustment term is applied in a third stage regression, in order to obtain an estimate of the error- correction term required in order to adjust the α^1 first round estimate of the long run parameters:

$$u_t = \delta \left[(1-\lambda)x_{t-1}\right] + v_t \qquad (5.18)$$

From δ and its standard deviation, we correct the α^1 first round estimate of the long-run parameters:

$$\alpha^2 = \alpha^1 + \delta \qquad (5.19)$$

The correct standard deviation to apply to α^2 is that obtained from δ.

In conclusion the results obtained using these techniques need to be treated with caution because of some critical limitations cited above in the discussion. One solution suggested by many is to resort to the very recent techniques that have emerged over the past decade which are referred to as the Johansen estimation procedures. These are discussed in Rao (1994) by Holden and Perman. The basic idea of this approach is that it tries to answer some of the questions that the E-G-Y approaches fail to address adequately. These questions include the testing of the hypothesis concerning the α matrix and testing for more than one equilibrium relationships.

In short, Johansen works with the ECM directly and adopts a framework based on the assumption that introducing sufficient lags will allow for a better disturbance term. However as indicated above, E-G two-stage technique will be sufficient for the current study of import demand elasticities.

The procedure will be to estimate a long-term import demand function, get residuals and use residuals in a short-term equation as an error- correction mechanism, provided the ADF unit root test-statistic rejects the null hypothesis of no co-integration through examining residuals.

5.4   Concluding Remarks

As indicated above, time-series estimation involves a number of critical areas that deserve some minimal level of time-series econometrics understanding. The most important aspect of time-series estimation is that one develops a very detailed understanding of the structure of the economy and how the economy responds to shocks and policy changes. This is done through a very detailed check of data and also considering the history of economic events that might have had an influence in the economy.

This chapter has shown how time-series econometric estimation operates. Basic steps to estimating a time-series model have been alluded to and illustratively shown. In short, the traditional estimation methods have not been entirely successful in explaining economic phenomena. The assumptions that drive and guide estimation using classical linear regression methods do not hold in reality. The data generating processes are not as simple as postulated in a traditional approach. It is within this context that recent time-series techniques are adopted in the present study. The next chapter applies these techniques in estimating the import demand function for South Africa. It also highlights some issues that the studies reviewed in chapter 4 neglected.

Chapter 6

Import Demand Elasticities for South Africa:
Data, Estimation and Results

6.1 Introduction

The preceding chapters have discussed various issues of importance relating to estimation procedures and the theory governing those procedures. The current chapter applies the empirical techniques discussed largely in the theory chapter of co-integration, error-correction models, and non-stationary data. In doing so, the present chapter also uses most of the information discussed in the literature chapters, especially with regards to specification issues.

Like studies reviewed in chapters 3 and 4, this chapter derives and estimates an import demand model that assesses the responsiveness of import demand to relative prices and income, for South Africa. Income, economic activity or scale variable, is expressed as gross domestic product less exports or gross domestic expenditure in real prices. Relative price variable is expressed as the ratio of unit value imports to domestic production prices. Theoretically, income is expected to be positively related to import demand whereas relative prices are expected to be negatively related to import demand. That is, when relative prices or the price of imports relative to domestic prices increase the demand for imports declines and when economic activity or aggregate economic demand rises the demand for imports increases, holding other factors constant.

Whilst maintaining the above-mentioned specification, the present chapter, unlike studies reviewed in chapters 3 and 4, examines the import demand function within a framework of recent time-series techniques explained in chapter 5.

As said above, these techniques are used because some empirical work has shown that the data used for modeling many economic relationships often contain a unit root (for instance, see Granger and Newbold, 1974). Consequently, if this is not taken into account the model may give misleading results.

This chapter begins with stating and mathematically deriving the import demand model. The next sections discuss the data used. First, this chapter, besides deriving an import demand model, starts with the discussion of the data sources, the period of analysis and calculations done on the data. Second, it explains the behavior of the data. The unit root test results are shown and explained. The rest of the chapter focuses on the South African specific import demand model, estimation and discussion of results using techniques discussed in preceding chapters. The discussion of results involves comparing elasticities for different sectors and those of other studies.

6.2 An Empirical Model

A simplified version of an import demand function, based on economic theory and the general knowledge of the forces governing foreign trade relationships, specifies the volume of imports as a function of income and prices (as shown below).

$$Q_t = f(P_t, Y_t) \tag{6.1}$$

Where:

Q = Volume of imports demanded,

P = Price of imports relative to the price of domestic goods, and

Y = Income or activity variable.

The procedure followed here, which is presumably consistent with economic theory, is to further assume that the elasticity of supply of imports is infinitely elastic (or at least large). Furthermore, importers are assumed to be always on their demand function, that is $M^d_i = M_i$ (imports demanded equal imports).

The equation presented above is expressed in logarithmic form because of its superior fit and ease of interpretation. In this context, an import demand model can be specified as:

$$log\ M^d_{it} = A_{oi} + A_{1i}\ log\ Y_{it} + A_{2i}\ log\ P_{it} + u_{it} \qquad (6.2)$$

Where:

M^d refers to real imports demanded

Y, refers to real income

P, refers to relative prices

And A_{1i} and A_{2i} are the elasticities with respect to income and prices, respectively.

The errors u_{it} are assumed to be normal and independent, with zero mean and constant variances. If this assumption does not hold, the model estimated can be declared invalid because OLS will give misleading results. For the model estimated in this study, this assumption holds because the LM autocorrelation test rejected the null hypothesis of autocorrelated errors.

As a result OLS is used within a time-series context with various ways to correct for other statistical problems. As noted above, an income elasticity is expected to be positive whilst the price elasticity of import demand should be negative. Table 6.1 shows various models (selected and modified from Thursby and Thursby, 1984) specified for the purposes of identifying an appropriate model, a model that concurs with economic theory and provides significant coefficients.

Table 6.1: Alternative Models of Import Demand

1. $Q_t = f(P_t, Y_t)$	2. $Q_t = f(P_t, Y_t, Q_{t-1})$
3. $Q_t = f(P_{t-1}, Y_t, Q_{t-1})$	4. $Q_t = f(P_t, P_{t-1}, Y_t)$
5. $Q_t = f(P_t, P_{t-1}, Y_t, Q_{t-1})$	6. $Q_t = f(P_t, P_{t-1}, Y_t, Y_{t-1})$
7. $Q_t = f(P_1, P_2, Y_t, Q_{t-1})$	

Source : Thursby and Thursby (1984 : 122)

The above models were tested for the estimation of import demand function for South Africa. The ultimate model depends on many other relevant tests and proven adequacy of the model. The approach used refers to the discussion above and most importantly to chapter five and literature chapters three and four. That is, the manner in which empirical work proceeds depends on the nature of the series and economic history shaping the variables included in regressions. For instance, dummies are used for the specification of certain models so as to correct for structural changes as identified in the description of the behavior of the series. Econometric estimation and diagnostic checking was performed using *PC Give Professional* along the lines of the general-to-specific modeling approach. *E-views* was also used, especially with regards to model validation tests.

6.2.1 The Micro-Foundations for the Import Demand Model[32]

The aggregate import demand of a country can be derived mathematically under the assumptions of an indefinitely living representative consumer, as shown in Senhadji (1997). This formulation is premised from the postulate that the demand for any commodity, capital or consumer, depends on income and relative prices. It is however acknowledged that investments, particularly in the case of capital goods, needs to be addressed. In the present formulation investment is assumed to be encompassed within the economic activity variable. Moreover, this study discusses imports in general and not investment imports in particular. Consequently, the model is confined to microeconomic demand theory. This mathematical formulation of the import demand concentrates on the utility function of the consumer as discussed below.

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[32] This symbolic representation of the import demand model is based on the micro-economic utility maximazation theorem as explained in Senhadji (1997). All studies reviewed use this formulation. For example, Reinhart (1995) in estimating relative price elasticities with respect to import demand for developing countries, small open economies, uses a similar mathematical model. In fact, which ever formulation used, the ultimate regression is same as for all studies of trade elasticities.

Given the expected lifetime utility function of domestic and foreign goods:

$$U_0 = E_0 \sum_{t=0}^{\infty} (1+\delta)^{-t} u(d_t, m_t)$$

U_0 is the expected utility at $t = 0$. δ is the personal discount rate. The greater δ is, the lesser the household value future consumption relative to current consumption. Expected utility of the representative consumer depends solely on the consumption of domestic endowment, d_t, and consumption of imports m_t. The maximization problem becomes:

$$Max_{\{d,m \in [0;\infty]\}} E_0 \sum_{t=0}^{\infty} (1+\delta)^{-t} u(d_t, m_t)$$

subject to the budget constraint $b_{t+1} = (1+r)b_t + (e_t - d_t) - p_t m_t$

for $e_t = (1-\rho)\underline{e} + \rho e_{t-1} + \xi_t, \qquad \xi_t \sim (0, \sigma^2)$

and $\quad \lim_{T \to \infty} (b_{T+1} / \prod_{t=0}^{T} (1+r)^{-1}) = 0$

The budget constraint assures that the domestic holding of foreign bonds at $t+1$ will equal the holding at t including the accumulated interest from t to $t+1$ plus the excess domestic endowment after consumption, $e_t - d_t$, minus the value of import spending, $p_t m_t$. The budget constraint is simply a national account equation, where the financial side of a trade surplus/deficit $b_{t+1} - (1+r)b_t$ must equal the value of the trade surplus/deficit, $(e_t - d_t) - p_t m_t$. The relative price of imports can be depicted as p_d/p_m.

The domestic endowment e is stochastic and follows an AR(1) process with the unconditional mean $\underline{e}$ and variance $\sigma^2/(1-\rho^2)$. ξ_t is a normal distributed innovation parameter. The last condition is the transversality condition. It is necessary to impose the maximization problem so as to rule out the possibility for the consumer to generate an infinite budget deficit (Ponzi game).

This incentive to generate an infinite trade deficit arises from the assumption of an infinite time horizon together with the assumption of perfect international capital markets.

The model further assumes that the exchange rate is perfectly flexible, and that the world's commodity market absorbs the excess domestic production, and also provides the domestic market with demanded import goods.

In this context, the representation holds the assumption of perfect capital markets, where the country can borrow an unlimited amount in the fixed world market interest rate. This, therefore, enables the country to adjust or rather smoothen its inter-temporal preferences. In this regard, the model represents an infinite maximization problem. The representative consumer has an incentive to accumulate an infinite debt. Consequently, it is necessary to impose a budget constraint, transversality condition, which rules out the possibility to generate an infinite budget debt. The transversality condition states that the discount value should, at all times, equal zero or be less than zero.

The instantaneous utility function can be defined as

$u(d_t, m_t) = A_t d_t^{1-\alpha}(1-\alpha)^{-1} + B_t m_t^{1-\beta}(1-\beta)^{-1}$

In which case the representative consumer's utility maximization problem can be calculated in the *Lagrange* optimization form:

$$L = E_0 \sum_{t=0}^{\infty} (1+\delta)^{-t} [A_t d_t^{1-\alpha}(1-\alpha)^{-1} + B_t m_t^{1-\beta}(1-\beta)^{-1}] - \lambda[b_{t+1} - (1+r)b_t - (e_t - d_t) + p_t m_t]$$

$\Downarrow$

$\partial L / \partial d_t = (1+\delta)^{-t} (A_t d_t^{-\alpha}) - \lambda = 0$

$\partial L / \partial m_t = (1+\delta)^{-t} (B_t m_t^{-\beta}) - p_t \lambda = 0$

$\Downarrow$

$A_t d_t^{-\alpha} = B_t m_t^{-\beta} / p_t$

$\Downarrow$

$m_t = p_t^{-1/\beta} A_t^{-1/\beta} B_t^{1/\beta} d_t^{-\alpha/\beta}$

Taking the logarithmic form of the above representation, the equation becomes:

$\ln m_t = -(1/\beta) \ln p_t - (1/\beta) \ln A_t + (1/\beta) \ln B_t + (\alpha/\beta) \ln d_t$

for $B_t = e^{b_0 + \varepsilon_{B,t}}$

and $A_t = e^{a_0 + \varepsilon_{A,t}}$

$$
\begin{aligned}
m_t &= -(1/\beta) \ln p_t - (1/\beta)(a_0 + \varepsilon_{A,t}) + (1/\beta)(b_0 + \varepsilon_{B,t}) + (\alpha/\beta) \ln d_t \\
&= -(1/\beta) \ln p_t + (\alpha/\beta) \ln d_t + (1/\beta)(b_0 - a_0) + (1/\beta)(\varepsilon_{B,t} - \varepsilon_{A,t}) \\
&= -(1/\beta) \ln p_t + (\alpha/\beta) \ln d_t + c_0 + \varepsilon_t
\end{aligned}
$$

Let $d_t = GDP_t - x_t$

$\Downarrow$

$\ln d_t = \ln(GDP_t - x_t)$

Which results to the import demand equation that can be written as:

$$lnm_t = c - (1/\beta)\, lnp_t + (\alpha/\beta)\, ln(GDP_t - x_t) + \varepsilon_t$$

where lnm_t refers to imports of goods and non-factor services, lnp_t as relative prices computed as the ratio of unit value imports to domestic prices, and $ln(GDP_t - x_t)$ as the scale variable, that is real gross domestic product less exports, theoretically similar to real gross domestic expenditure used in the present study. Imports include both capital goods and consumer goods. Investment goods are taken into account in the model because they are highly correlated to real income. The equation would not change even if one were to devise a different model that explicitly take into account investment goods imports. All studies of trade elasticities, import or export elasticities, use a simple model which entails real income and relative prices as the main explanatory variables.

The import demand function derived above postulates that economic activity positively correlates to import demand where as relative prices, in the form of unit value imports divided by domestic prices, negatively correlate to import demand. The current estimation uses a similar specification with economic activity variable specified as real gross domestic expenditure or real gross domestic product less exports and relative prices as ratio of import prices to domestic prices.

The derivation of the import demand model as illustrated above relies on the number of assumptions, also mentioned above, which may not hold in the real trade situation. Although the use of the model falls short of a true representation of the real world, it is sufficient for the current study as it gives background to the models estimated and it is compatible with theory. For instance, the model largely depends on the two-commodity, two-country assumption which becomes very critical when estimating regressions for certain sectors. Above this, there may be other influential factors not taken into cognizance that would significantly affect the demand for imports.

Perhaps the high significance of the residuals in the dynamic equation and the relatively low R-squared are evidence to the importance of other factors not included in the regression. However, different diagnostic tests, such as specification and stability tests, suggest that the specification is correct, at least for the majority of models. It should also be noted that estimation of elasticities has been subjected to many criticisms because of the reliance of the exercise on certain assumptions[33].

6.3   Data Sources and The Period of Estimation

6.3.1   Aggregate Import Demand Data

The aggregate data for production prices and unit values of imports and imports (free on board -f.o.b.) were taken from the International Monetary Fund's International Financial Statistics (IFS).

The total economy gross domestic expenditure series, the gross domestic product and the exports were taken from various issues of the South African Reserve Bank Quarterly Bulletin. The early objective of the study was to go as far back in time as possible. However, this objective has been constrained by the limited published economic series, especially on a quarterly basis. As a result, the data only goes back to 1960(1). The same series could not be found prior to 1960, especially not in the same format.

The same applies with regard to up-dating the series to the present. These data could not be found after 1996(4). However, 1960(1) to 1996(4) still amounts to enough observations. There were possibilities of using other related series as proxies, but this seemed to affect the consistency of the series. For instance, the import prices published in the South African Reserve Bank Quarterly Bulletin would have been used instead of unit value imports in order to up-date the series to the latest quarter of 1998.

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[33] Amongst others, see Maquez's (1994) detailed discussion of the problems with estimating elasticities. Maquez (1994:471) questions assumptions that 'trade elasticities are autonomous parameters, that both cross-price effects and simultaneity biases are absent, and that expenditures on domestic and foreign goods can be studied independent of each other'.

However, import prices in the Bulletin were a little understated compared to unit value imports published in the IFS. In fact, comparing similar years, say 1990 to 1996, import prices in the Bulletin were fairly low relative to unit value imports in the IFS yearbooks.

These data were therefore transformed to fit the purposes of the study. Firstly, a similar base period had to be fixed. All the series, except imports (fob), were rebased to 1990 prices. 1990 was chosen as the base period for the sake of convenience and this was done because 1990 was viewed as the latest year that many series were based on. During the process of data gathering and processing many series were identified to be based on 1990 prices as well.

This therefore meant that other series which were based to previous years, such as unit values based on1970, 1975, 1980 and 1985 had to be rebased to 1990 prices by splicing the indices as discussed in Mohr et al (1988: 20-21). In addition to that, imports (f.o.b.) and gross domestic expenditure data were given in current prices.

These were converted to real terms through deflating the series by respective price indices, gross domestic expenditure deflated by domestic production prices and imports deflated by unit value imports. The gross domestic product and aggregate exports were given in 1990 prices from the bulletin. Thus, the base year is 1990 for all series used in estimating import demand functions.

6.3.2 Selected Sectors Import Demand Data

There were a few problems with getting sectoral import data, especially in a format similar to the aggregate import demand function data discussed above. These data were not available prior to 1986 and were not available for all economic sectors even after 1986[34]. As a result, the selection of the sectors for the study was constrained by data.

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[34] Kahn (1987) acknowledges the similar problems with data in estimating the import demand functions and import penetration ratios for South Africa.

For many sectors data begins in 1988 and it is monthly. This therefore meant that, for those sectors selected or which had data, the series had to start in the first quarter of 1988 for the sake of consistency and comparability. These data were published by the Central Statistical Service, Pretoria. The trade statistics release P 6161 encompassed data on the quantity of imports, import volumes, unit value imports, the price statistics release P 0142.1 publishes the production price index, and the statistical release P3041.2 has the index of physical volume of manufacturing production.

The CSS (or presently Stats SA) does not any longer produce trade statistics P 6161. As a result, the import demand function data for selected sectors, including the main economic sectors but not services, goes only to the fourth quarter of 1996, as in the case of aggregate import demand function data.

Customs and Excise data would have been used to update the series to the latest quarter of 1998 but the classification is far different from the trade data produced by the Central Statistical Service, and there are even further changes currently taking place in ISIC codes which also hamper the up-dating of the series to a more recent quarter. Another potential source would have been the Industrial Development Cooperation (IDC). However, the IDC sectoral trade data includes other SACU countries and is generally given only on an annual basis. This may affect the models in that there are a few observations and that it is not really South African specific trade data. The quarterly import data published in the recent IDC's quarterly publications on trade do not have the corresponding unit values and only begin from 1990 which also leaves the study with a few observations which may result to finite sample bias using time-series techniques. A procedure similar to that described in the case of the aggregate import demand function data section above was followed with regard to transforming the series to a same base period and converting series to constant 1990 prices and also converting current price to constant price data.

The economic activity variable chosen is the physical volume of manufacturing production because there was not any specific activity variable for each sector. The physical volume of manufacturing production did not, however, prove significant as an activity variable for many sectors. As a result, as physical volume of manufacturing production proved to be not effective to capturing the level of economic activity, for many sectors, the gross domestic expenditure was therefore used.

Lastly, the variables named above, such as imports, unit value imports, domestic prices, gross domestic expenditure, gross domestic product less exports and index of manufacturing production, were chosen largely because many studies have used them for the similar estimation objectives.

The logic behind the choice of these variables was simply that they captured the relationships meant for estimation. The variables entering the import demand function, both at the aggregate and disaggregated levels, were transformed to logarithmic and first difference forms. This was done because the study intends to assess the elasticities in terms of by how much does a percentage change in one variable affect the other.

In addition to that, the study uses a time-series approach which begins with thorough assessment of the characteristics of the data, diagnostic tests, estimation, and the validity of the model.

6.4   The Behavior of the Data

6.4.1   Aggregate Series

Most of the data described above seem to have some particular behavior worth noting. This section briefly highlights the main characteristics of the data used for the import demand equations. It is notable that most data follow similar trends and that some data depict some possible structural breaks, especially the ones around the end of 1970s associated with the oil price shocks.

To start with, the total economy import demand equation contains domestic prices (PPI), unit value of imports (UVALUE), real gross domestic expenditure (GDE) or gross domestic product less exports (XGDP), as explanatory variables and the imports (MPORTS) as a dependent variable. The relative prices (RPRICE) are calculated by dividing UVALUE by PPI and real imports are measured as MPORTS deflated by UVALUE. All real variables, including price indices, are based on 1990 prices. All variables were transformed to be in logarithmic form.

In the aggregate level the PPI and UVALUE show a smooth behavior, starting around the same level and growing at a similar pace. These data are relatively stable from 1960.1 to the late 1970s and they then begin to grow a little faster. This is also notable when looking at RPRICE which remains stable from the beginning of the series until the beginning of the 1970s. From the early 1970s to around 1986 the series shows steady increase and by 1990/91 it decreases.

This basically means that the PPI has from 1990 onwards grown faster than UVALUE or UVALUE declined relative to PPI, the falling ratio. The relative rise in MPORTS during this period can be explained by this factor, relatively low UVALUEs relative to PPI. The MPORTS series shows that there has been a structural change or a break between 1973/4 and 1977/8. This is further shown by RMPORTS which depicts huge jumps during the same period. RMPORTS jump from 4.2 million to 6.3 million between 1973 and 1974. It then settles to just about 4.3 millions in 1975 and jumps back again to around 6.2 millions between 1976 and 1977/8. It then settles down to relatively stable levels between 4.2 million and 3.5 million[35].

The only conclusive possible explanation for these spikes is the oil price shocks of the 1970s. Lastly, fluctuations in GDE and/or XGDP have been relatively stable for the entire period of investigation. There are no clear spikes except the small seasonal huddles normal in quarterly data. It can be noted, however, that the growth rate begins to decline in the 1980s compared to previous years.

6.4.2 Disaggregated Series

The are visible similar patterns in sectoral data. Some few general observations can be made. The data depict seasonal patterns, although not quite significant. The structural stability test for seasonal spikes rejected the null of non-normal distribution. There are no clear structural breaks or any form of shocks and policy changes. The econometric packages used take into account outliers that affect regression results.

All import data tend to move in the same direction with similar characteristics, with the volumes of imports fluctuating and increasing less than relative prices. The sectors under consideration include agriculture, mining and quarrying, manufacturing, other manufacturing, chemicals, electrical machinery, iron and steel, machinery, metals, paper, and transport. The variables are similar to the aggregate import demand function. That is, PPI, UVALUE, and RPRICE are respective prices as explained in the case of the total economy. The economic activity variable is either the physical volume of manufacturing production (MPROD) or the GDE as in the aggregate function. The dependent variable remains the MPORTS which at a sectoral level is either the volume of imports (MVOL) or real imports (RMPORTS) calculated by taking MPORTS divided by UVALUE. The trends in all chosen import variables are the same, except that the MVOL and the RMPORTS are deflated by import prices (UVALUE). MVOL was taken as given in the CSS statistical release P 6161 whilst RMPORTS was calculated just like in the case of the total economy.

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[35] Plots not given in the text.

RMPORTS and MVOL are theoretically the same, they are effectively the same depicting exactly similar patterns, although RMPORTS remains below MVOL in real terms, the price index used to deflate this series by CSS could be slightly different from the one used in the current study. The data are converted to logarithmic forms like in the case of the aggregate import demand data, the sectoral data are prefixed by S to signify sectors' data and all data are in constant 1990 prices from 1988.1 to 1996.4.

6.5   Unit Root Test Results

The main aim of this section is to ascertain whether the series are stationary or not, as explained in the previous chapter. The equations estimated in the current study have already been estimated by numerous studies. The choice of the models estimated are as given in the empirical model section, Thursby and Thursby (1984) specification. The estimation begins with the Augmented Dickey-Fuller unit root tests.

Table 6.2: ADF Unit Root Tests (Aggregate Import Demand Variables)

Level Variables	n.obs.	k	ADF-stat	First differences Variables	n.obs.	k	ADF-stat
LPPI	143	4	-2.82	DLPPI	143	3	-2.51..
LUVALUE	143	4	-2.38	DLUVALUE	143	3	-4.54**
LMPORTS	143	4	-2.88	DLMPORTS	143	3	-7.97**
LGDE, XGDP	143	4	-2.18	DLGDE	143	3	-4.99**
LRPRICE	143	4	-2.04	DLRPRICE	143	3	-6.18**
LRMPORTS	143	4	-2.49	DLRMPORTS	143	3	-7.85**

Cv 5% : -3.442   cv 1% : -4.025   cv5% : -2.882 cv1% : -3.477

The table above shows the results of the Augmented Dickey-Fuller unit root tests that were conducted using the general-to-specific approach. That is, initially a number of 8 lags were assigned to each variable in order to 'test-down' and ascertain the number of lags (k) to be included in a formal ADF unit root test. The variables as explained above interchangeably enter the total import demand regression which maintains that the demand for imports is a function of relative prices and real income. The number of lags were identified along the lines of 'testing-down'. The first lag length significant at at least 5% level was taken to be the lag length to be assigned in a variable when the formal individual variable unit root test was conducted. As it is apparent above, the lag length for the variables in levels was found to be four and for first differences the lag length was ascertained at three.

As expected in macro-economic series analysis, all variables entering the aggregate import demand function proved to contain a unit root in levels and not in first differences, except for domestic prices. The critical values are shown above at 5% and 1% both for variables in levels and variables in first differences.

The critical values show that all variables, except LPPI, are integrated of order one, denoted as I(1). The significance levels of the ADF-statistic is signified by * at a 5% level and ** at a 1% level. This basically means that the null hypothesis that there is a unit root is rejected at a 1% significance level for all variables in first differences, except LPPI which becomes stationary when differenced twice. This therefore will shape the manner in which the regressions will be specified. Below is the ADF unit root test results for economic sectors. A similar conclusion can be drawn. All variables are clearly I(1) although at different levels of significance. The same line of analysis can be followed, just like in the aggregate import demand model.

Table 6.3: ADF Unit Root Tests (Disaggregated Import Demand Variables)

Levels Variables	n.obs.	k	ADF- stat	First differences Variables	n.obs	K	ADF- stat
LSMPORTS	32	3	-2.78	LSMPORTS	32	2	-3.72**
LSMVOL	32	3	-2.04	LSMVOL	32	2	-3.72**
LSUVALUE	32	3	0.03	LSUVALUE	32	2	-4.44**
LSPPI	32	3	-2.63	LSPPI	32	2	-3.33*.
LMPROD	32	3	-1.8	LMPROD	32	2	-6.34**
LSGDE	32	3	-0.49	LSGDE	32	2	-5.51**
LSRMPORTS	32	3	-2.24	LSRMPORTS	32	2	-3.66**
LSRPRICE	32	3	-0.26	LSRPRICE	32	2	-4.67**

cv 5% : -3.551   cv 1% : -4.26   cv 5% : -2.956   cv 1% : -3.65

Using the similar approach as in the case of aggregate import demand variables, the lag length is 3 for variables in levels and it is 2 for variables in first differences. It should be noted that not all these variables will be used for the estimation, they are tested for the unit root in order to widen the choice of variables to be included in the models. The table above holds for all sectors selected for the estimation. As in the case of aggregate import demand variables the number of observations and the lag length are shown as *n.obs* and *k*, respectively.

ADF-stat refers to the result of the test which proves whether to accept the null of a unit root or not. The critical values are shown as *cv5%* and *cv 1%, respectively.* The next step is to estimate the long-term static regression in levels, save residuals and test for a unit root in residuals. If the ADF-unit root statistic rejects the null of a unit root the residuals will be incorporated to the short-term dynamic regression as an error-correction term. There are many other tasks associated with this approach and these will be undertaken in due course. It has been observed that there were sharp spikes in the 1970s and that needs to be corrected for, in this case by the use of dummies. It has also been observed that the sectoral data depict seasonal patterns and some structural breaks for certain periods. It has also been proven that the data analyzed above contain a unit root in levels and are stationary in differences. All these facts and others are given a lot more attention in the estimation and the analysis of results. The major concern for this study is to separate long-term from short-term elasticities and also by all possible means avoid spurious regression problem.

6.6   Regression Results

6.6.1   The Total Economy Import Demand Regressions

Following the Engle-Granger two-stage technique within a general-to-specific framework, the long-run equilibrium import demand elasticities reveal a normal result which is very much in line with economic theory governing demand relationships. In short, out of many different regressions estimated the dominant result is that import demand as a dependent variable is significantly positively related to economic activity. And relative prices, import prices divided by domestic prices, are less significantly negatively related to import demand. As said above, the demand for imports in South Africa could be influenced by economic activity and other factors, which may not be quantifiable or factors whose direct impact can not easily be identified. The import price variable is more significant than domestic price variable, even when the domestic price variable is differenced twice. Long-term elasticities for import demand with respect to relative prices and income provide better results than short-term regressions as depicted by moderate R-squared and low t-values of the short-term results.

The signs of relationships are correct as envisaged in theory. However, the long-term regression depicts unreliable results because of non-stationary data. With reference to the Engle-Granger approach there is a co-integrating relationship present between variables of the import demand regressions. The ADF unit root tests on residuals, as explained above, reject the null hypothesis of no co-integration. As a result, the E-G approach fits-in well in the estimation and analysis. The static long-term regression specified as:

$$lnm_t = c - (1/\beta) \, lnp_t + (\alpha/\beta) \, ln(GDE_t) + \varepsilon_t \qquad (6.3)$$

shows that real imports lnm_t is negatively related to relative prices lnp_t and positively related to real gross domestic expenditure $ln(GDE_t)$. Taking this specification, real imports variable is regressed to domestic prices (LPPI), unit value imports (LUVALUE), and real gross domestic expenditure (LGDE) which gives the following result:

```
            Modeling LRMPORTS by OLS³⁶
            The present sample is:  1960 (1) to 1996 (4)

Variable       Coefficient    Std.Error   t-value   t-prob   PartRý
Constant          -18.142        2.2661    -8.006   0.0000   0.3080
LPPI               1.2372      0.557039     2.221   0.0279   0.0331
LUVALUE           -1.6795      0.554888    -3.027   0.0029   0.0598
LGDE               2.2552      0.227733     9.903   0.0000   0.4051

Rý = 0.4587954  F(3, 144) = 40.691 [0.0000]  å = 0.5612841  DW = 0.5022
RSS = 45.36573952 for 4 variables and 148 observations
```

This regression confirms the findings briefly discussed above. As shown by t-values, the variables are relatively significant with domestic prices significant at a 5% level and gross domestic expenditure at a 1% level. The signs, as indicated above, are in line with demand theory.

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[36] This regression and others are used as examples. The main regression for the aggregate import demand function will entail real imports as a dependent variable and relative price and real gross domestic expenditure or real gross domestic product less real exports, as explanatory variables.

Substituting LGDE by LXGDP the results relatively improve. In certain cases LGDE is more significant than LXGDP and the opposite applies in other cases. Below is an example of a model which uses LXGDP as an activity variable.

```
Modeling LRMPORTS by OLS
The present sample is:  1960 (1) to 1996 (4)

Variable     Coefficient   Std.Error   t-value  t-prob  PartRý
Constant       -10.579       1.4699     -7.197   0.0000  0.2646
LPPI             1.6114      0.550058    2.929   0.0039  0.0562
LUVALUE         -1.9870      0.551318   -3.604   0.0004  0.0827
LXGDP            1.5928      0.157127   10.137   0.0000  0.4164

Rý = 0.4690869  F(3, 144) = 42.41 [0.0000]  å = 0.5559219  DW = 0.5466
RSS = 44.50307382 for 4 variables and 148 observations
```

Other regressions also give similar results. For instance, when prices are estimated as relative prices, that is import prices divided by domestic prices, the sign and the level of significance is relatively the same as in the above regression.

```
Modeling LRMPORTS by OLS[37]
The present sample is:  1960 (1) to 1996 (4)

Variable     Coefficient   Std.Error   t-value  t-prob  PartRý
Constant       -6.7635       1.4804     -4.569   0.0000  0.1258
LGDE            1.0693       0.137416    7.782   0.0000  0.2946
LRPRICE        -1.5616       0.621602   -2.512   0.0131  0.0417

Rý = 0.3153081  F(2, 145) = 33.387 [0.0000]  å = 0.6291393  DW = 0.3912
RSS = 57.39336654 for 3 variables and 148 observations
```

The result remains relatively unchanged except that the R-squared and the Durbin-Watson statistics decline. When the above-shown regressions are further modified to include a lag of a dependent variable, the model looks even much better. There is an economic meaning to this. However, the dynamics can not be introduced in a long-term static spurious regression. The basic aim of estimating this regression is to get residuals. This long-run static regression confirms the micro-economic theory represented above

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[37] This is the main regression that this study analyzes because all variables are I(1). The ADF test on residuals of this regression are reported below and further included in a dynamic regression.

and the result is largely similar to that of other import demand studies[38]. The residuals taken from the above-shown regression reveal that there is a co-integrating relationship in the regression. The ADF unit root test, shown below, shows that the residuals are stationary at a 1% significance level which means that the null hypothesis of a unit root or no co-integration is rejected.

```
            Unit root tests for R1
            The present sample is:  1961 (3) to 1996 (4)

Augmented Dickey-Fuller test for R1; DR1 on
Variable        Coefficient     Std.Error   t-value
R1_1             -0.195586       0.0673974   -2.902
DR1_1            -0.145640       0.0894450   -1.628
DR1_2             0.0458457      0.0887427    0.517
DR1_3            -0.00688971     0.0878254   -0.078
DR1_4            -0.224784       0.0829517   -2.710

â = 0.3651536  DW = 1.93  DW(R1) = 0.51355  ADF(R1) = -2.902**
Critical values used in ADF test: 5%=-1.942 1%=-2.58
```

Other tests confirm this as well. The plots of residuals and parameter stability tests show that residuals (R1) are stationary. In E-G approach the residuals are therefore incorporated into the short-term differenced regression and should be negative and significant, as shown below:

```
            Modeling DLRMPORT by OLS
            The present sample is:  1960 (3) to 1996 (4)

Variable      Coefficient    Std.Error   t-value   t-prob   PartRŷ
Constant      -0.00678465     0.0308123   -0.220    0.8260   0.0003
DLGDE          1.6372         0.541193     3.025    0.0030   0.0605
R1(-1)        -0.254793       0.0549897   -4.633    0.0000   0.1313
DLRPRICE      -1.0019         0.692367    -1.447    0.1501   0.0145

Rŷ = 0.2068674  F(3, 142) = 12.346 [0.0000]  â = 0.3684851  DW = 2.19
RSS = 19.2809399 for 4 variables and 146 observations
```

---

[38] Refer to studies reviewed in chapters three and four. This is discussed in section 6.7.

The regressions shown above are the best selected from a number of different specifications similar to Thursby and Thursby (1984). The basic result is that prices or relative prices are not statistically significant in influencing the import demand or the propensity to import for the South African economy is not significantly influenced by prices, at least in the short-term.

The economic activity, depicted by gross domestic expenditure or gross domestic product less exports, has a significant influence to the demand for imports both in the short and the long-run[39]. The summary of diagnostic tests shows that the regressions are not well specified. Differencing and transforming data to logarithmic form solves some statistical problems that appeared in the static levels regression. Other variables were also tried. For example dummies were introduced for certain periods such as 1973 - 1978 and 1985 - 86 in order to correct for structural breaks associated with oil price shocks, sanctions and other external factors.

However, these dummies proved to be statistically not significant and did not add any value to the models. Lastly although the overall significance of the long-term regression is low, as interpreted by low r-squared and possible autocorrelation shown by a low D-W, all variables are significant. LPPI and UVALUE are significant at a 5% level and LGDE or LXGDP at a 1% level. In the short-term regression the overall significance of the model is quite low but variables are significant, except LPPI.

---

[39] The chosen variables, income and prices, do not really show a significant influence to import demand which signifies that there may be other factors which influence import demand other than income and prices. One interesting hypothesis in the co-movement analysis of aggregate demand is that exports have a significant influence in imports. This is relatively apparent for the period starting in 1994. The export promotion policies might be a driving factor on increased imports. The regression of imports to expenditure on GDP less exports shows no direct correlation which is realized when plotting schedules of imports and exports alone. This is the hypothesis worth exploring but it is not the focus of the present study.

6.6.2 Disaggregated Import Demand Regressions

The results of the short-term ealsticities of imports with respect to income and prices are very much similar to the aggregate import demand model results. The approach and the technique are the same as in the long-term elasticities. A static long-term regression was estimated for each sector and then residuals saved and unit root tests done on residuals. The general observation is that all regressions had a long-run co-integration relationship. Prior to sector by sector analysis, there are a few observations need mentioning. Like in the aggregate import demand case, residuals were stationary and significant for some sectors at a 1% and for others at a 5% level.

Long-term results are more significant than short-term results for many sectors. Relative prices, or domestic prices specifically, are less significant than income. There may be reasons for this. For example the hypothesis mentioned in the footnote above can give an explanation to this. Another possible explanation could be that most of the sectors examined, or even the total economy as a whole, are natural-resource based and import-oriented in nature. This would mean that sectors or the economy have to import intermediate commodities and equipment besides the level of prices or income so as to produce for perhaps exports. Another observation is that dynamics do not improve regression results. In many occasions introducing lags in variables and introducing dummies does not change a result.

In fact, the results deteriorate in many instances. Lastly, diagnostic tests show that most of the short-term dynamic regressions are relatively well-specified and do not have autocorrelation, heteroskedasticity and other common statistical problems.

6.6.3 Long-term Results

This section discusses results of eleven sectors estimated. This includes the three main economic sectors and sub-sectors of the manufacturing sector as shown in the table below.

Table 6.4: Disaggregated Import Demand Elasticities for South Africa (Long -Term Results)

Sectors	R-sq	D.W.	C	LGDE	LSPPI	LSUVALUE	LSRPRICE
Agriculture	0.599	1.04	30.071 [2.016]	-3.257 [-2.268]	2.276 [4.809]	-0.583 [-1.189]	
Mining & quarrying	0.297	0.93	-27.611 [-2.820]	2.530 [2.845]			0.313 [0.996]
Manufacturing	0.763	1.03	-21.497 [-7.967]	2.357 [9.807]			-0.364 [-1.549]
Other manufacturing	0.748	1.70	-28.208 [-7.766]	2.626 [7.957]			0.293 [0.150]
Chemicals	0.677	1.61	-25.683 [-7.456]	2.581 [8.206]			-0.301 [-0863]
Electrical Machinery	0.899	1.75	-39.473 [-10.674]	3.669 [10.384]	-0.312 [-1.281]	0.481 [-2.543]	
Machinery	0.561	1.94	-49.893 [-5.876]	4.756 [6.125]			-0.113 [-0.165]
Iron & steel	0.234	0.979	-7.415 [-0.981]	1.026 [1.374]	0.413 [1.284]	-1.014 [-2.283]	
Metals	0.875	1.64	-27.369 [-10.635]	2.708 [11.577]	0.385 [2.577]	-0.638 [-3.392]	
Paper	0.664	2.06	-24.876 [-4.499]	2.380 [4.386]	0.796 [4.065]	-0.777 [-2.871]	
Transport	0.508	1.27	-16.427 [-2.216]	2.055 [2.862]	1.202 [4.856]	-1.707 [-5.613]	

As discussed above, long-term result are good for many sectors, as shown by t-values in parenthesis. The R-squared are generally significant, except for Mining and Quarrying and Iron and Steel sectors.

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These are natural-resource based and export-oriented sectors[40]. As a result, intermediate goods and capital equipment have to be imported, in spite of prices and incomes, so as to sustain production and exporting.

In short, the main economic sectors show that relative prices are not that influential in deciding on imports, the same result as in the total economy import demand model. The similar applies in the case of other selected sectors, except Metals, Paper and paper products, and Transport which reflect quite significant results both in terms of overall significance of the models and in terms of significant coefficients as shown by very significant t-values.

6.6.4 Short-term Results

The observations made above also hold for the sectors' short-term regressions. There are no apparent structural breaks and there are no clear mis-specification, autocorrelation, heteroskedasticity, and other statistical problems.

The diagnostic tests conducted using the *PC Give Professional*, the *E-Views* and *the Number Cruncher Statistical System* Interactive econometric packages reject the null hypothesis of autocorrelation, mis-specification, and others, except for Paper and paper product and Transport sectors which seem to have non-normal distributed errors at a 95% confidence level.

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[40] The separation between natural-resource based and non-natural-resource based sectors was done using the 1995 input-output tables. That is how much inputs and wherefrom do each sector need to sustain production. The sectors that needed anything beyond 30% from agriculture, mining, and other related sectors were taken to be natural-resource based. To determining export-oriented, revealed comparative advantage was used as an indicator. Sectors with positive significant revealed comparative advantage were taken to be export-oriented.

The tests conducted include the Breusch-Godfrey Serial Correlation LM test, Ramsey Reset tests, the White heteroskedasticity test, and recursive estimates on residuals[41]. The final results of regressions estimated are shown in the table 6.5 below.

Table 6.5: Disaggregated Import Demand Elasticities for South Africa
(Short - Term Results)

Sectors	R-sq	D.W.	C	DLGDE	DLSPPI	DLSUVALUE	DLSRPRICE	DLRMPORTS (-1)	DLSRPRICE (-1)	R (-1)
Agriculture	0.426	2.10	0.014 [0.037]	0.489 [0.334]			-0.894 [-2.051]	0.409 [2.427]		-0.586 [-3.522]
Mining & quarrying	0.475	1.88	0.017 [0.472]	2.865 [2.024]				0.073 [-2.541]	0.073 [0.250]	-0.285 [-1.740]
Manufacturing	0.571	2.32	-0.000 [-0.059]	2.671 [5.363]			-0.028 [-0.102]			-0.547 [-3.233]
Other manufacturing	0.738	2.04	-0.006 [0.362]	3.376 [5.310]			-0.495 [-1.499]			-0.876 [-5.014]
Chemicals	0.327	1.98	0.008 [0.493]	0.849 [1.131]					0.978 [2.017]	-0.534 [-2.727]
Electrical Machinery	0.758	1.83	0.008 [0.717]	2.746 [6.152]						-0.614 [-4.229]
Machinery	0.521	2.00	-0.007 [-0.164]	4.859 [2.817]			0.237 [0.281]			-1.002 [-5.314]
Iron & steel	0.682	2.06	-0.057 [-1.824]	-0.801 [-1.370]	2.770 [2.650]	-0.280 [-0.896]		0.652 [5.422]		-0.708 [-6.433]
Metals	0.785	1.86	-0.009 [-0.968]	2.562 [5.887]			-0.829 [-4.421]			-0.882 [-4.621]
Paper	0.613	1.80	0.002 [0.113]	2.982 [4.285]			-0.135 [-0.642]			-1.053 [-6.060]
Transport	0.595	1.95	-0.019 [-0.827]	2.579 [2.902]			-1.290 [-4.083]			-0.676 [-3.901]

[41] Results of various diagnostic tests are not reported because the variables entering the import demand models were ascertained to be non-stationary in levels. As a results diagnostic tests of those variables can be misleading. Results of differenced variables, as expected, do not depict any serious statistical shortfalls.

As shown above, the residuals taken from the static regressions were incorporated into the short-term regressions and they are in line with the theoretical analysis presented in the preceding chapters. According to the Engle-Granger two-stage technique residuals from the static regression are saved and if they are stationary, which means that the null hypothesis of a unit root is rejected, they are then used in the short-term regression as an error-correction term. Theoretically, the sign of the residual has to be negative and it has to be significant as it shows the speed of adjustment to the equilibrium.

The short-term results, as shown above, are less significant than long-term results. The elasticities in the long-term regression are significant as depicted by high R-squared and significant t-statistics. Over all the models are good in terms of diagnostic tests. The activity variable is more significant in many regressions than the relative price variable. Lags in certain variables did not really improve the results. The results presented above are the final relatively better results taking into account all possible specifications and dynamics introduced in models.

6.7   Comparative Analysis of Results

As briefly indicated above, the findings of the current study are quite similar to results found by different authors using the recent time-series approach. The findings of the current study are somehow different from results of studies of the import demand done in South Africa. To mention a few examples, appendix one shows results of international import demand studies and the most notable issue is that studies using recent time-series methods (for example Senhadji, 1997) have results similar to the current study findings. That is, for instance, looking at South Africa, Kenya and Argentina, the propensity to import with regards to income is more significant than that of relative prices. For studies using traditional methods (for example, Houthakker et al, 1969 and Khan, 1974) price elasticities are relatively more significant than those of incomes.

In the case of Khan (1974) Argentina and Turkey have more significant price elasticities of import demand than that of income. Similarly, Houthakker et al (1969) shows results where South Africa has a very significant import demand elasticity with respect to real income. The similar result is found in Kahn (1987), for all sectors studied, either price elasticities are as significant as income elasticities or the propensity to import with regards to prices is higher than that of income.

In this dissertation, the results of capital-intensive sectors are slightly different from the results of labour-intensive sectors. The same applies between sectors which are import-competing and export-oriented. It is also observed that most labour-intensive sectors are non-natural resource-based whilst many capital-intensive sectors are natural resource-based. To start with, many studies of the import demand functions that have used the traditional methods show that relative prices are as significant as income. With reference to studies done in South Africa, all studies show relative prices to be statistically significant in explaining import demand. The same result is discernible in international studies reviewed in chapter three. Earlier work on import demand functions used OLS and not taking into account the time-series properties of the data. Most of these studies depict relative prices as statistically significant in an import demand regression[42]. However, the recent work on import demand gives a different result with respect to relative prices. The relative price variable is less significant than earlier studies showed. Amongst others, Reinhart (1995) and Senhadji (1997) reflect on this development. The current study also gets results similar to recent studies. This therefore questions the view that devaluation policy improves the current account. In fact, it seems that relative prices do not matter that much with regards to imports.

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[42] This discussion refers to earlier studies most of them reviewed in chapters three and four. Appendix I and II table these results. The most prominent studies coming with this result include Kahn (1987).

In terms of sectors, many regressions show that relative prices are less important in explaining import demand. However, for capital-intensive sectors the price elasticity of the import demand is relatively insignificant compared to the price elasticity of the demand for labour-intensive commodities. For example, the average response of relative prices to import demand of capital-intensive commodities is –0.71 with a t-value of -2.36 whilst the response to import demand for labour-intensive goods is almost –3.00 with a t-statistic of -2.07. This can be interpreted to mean that a 10% rise in relative price of capital-intensive goods reduces imports of these goods by only 7% whilst an increase of labour-intensive goods relative price by the same percent reduces imports of labour-intensive goods by almost 30%.

The results also show that economic activity is more responsive to labour-intensive goods than capital-intensive goods. On average, a rise in economic activity by say 10% will increase the demand of labour-intensive commodities by 33% whilst the demand of capital-intensive goods rises by only 14%.

It seems that the natural resource-based sectors' import demand does not necessarily depend on relative prices. This is shown by the overall economy import demand regressions that showed insignificant relative price elasticities. The manufacturing sector as a whole also shows the same result. The main economic sectors combined and averaged show that a 10% rise in relative prices will decrease demand for imports by only 4% whilst an increase in economic activity by the same percent will increase imports by 23%. These results show that a rise or a decrease in prices does not really affect the current account in South Africa. On the other hand, the economic activity matters. This result poses a serious challenge in policy making with regards to the balance of payments. If economic growth raises remarkably, foreign exchange is exhausted and this restricts faster growth that the country needs, especially if other factors remain unchanged.

Chapter 7
Conclusion

7.1   Introduction

The entire analysis, both theoretical and empirical, of the import demand in South Africa has given signal to a myriad of fundamentally crucial aspects of the overall economy. The discussion has been premised to the general question of what really binds the faster growth of the South African economy. However, that has not been the main subject of the dissertation. That question still needs detailed exploration. The findings of the current study tentatively indicate that, given massive import increases, low export performance and significant income elasticities of import demand, sustainable faster and high economic growth rates will be difficult to accomplish.

It is arguably clear that there are macro-economic problems related to the balance of payments constraint, high import intensity, precarious export performance, poor performance of world economies, instability in financial markets and poor performance of the domestic economy. Given all these factors, it is important for policy makers to deal with the foreign exchange question.

The views cited in this chapter on policies are based on both the findings of this study and general literature. This study has narrowly examined import performance and import demand elasticities. It begun with the theoretical symbolic representation of the two-gap model which broadly shows the context of the study in terms of the binding constraint to faster growth of the South African economy. The second chapter extensively described the import performance trends. That chapter also briefly examined the export performance and the relationship between import of capital goods and investments in South Africa. The analysis was extended to cover the direction of trade flows. Chapter three examined the literature on import demand elasticities, while chapter four described the literature on trade elasticities in South Africa.

Chapter five sets the scene for the empirical chapter in that a detailed technical discussion of the theory of co-integration, error-correction and non-stationary series is presented. The empirical chapter, chapter six, explains the characteristics of the data, methods of analysis, limitations and reports results of the empirical models. This chapter goes to a larger detail estimating import demand elasticities and discussing results. This last chapter summarizes findings and raises some relevant policy issues.

As presented by Bliss (1989), Eaton (1989), Bacha (1990) and others, the foreign exchange scarcity is perceived to be an effective binding obstacle to faster growth of developing nations. Discussions by Bell (1993, 1995) allude to the importance of foreign exchange. Bell (1993, 1995), like Kahn (1987), only note the foreign exchange constraint but do not systematically analyze its dynamics. To some extent, the NEM (1993), ISP (1995) and GEAR (1996) attempt to address this question as well. Effectively speaking, the balance of payments issue is widely recognized in South Africa but large attention is focused on export-oriented industrialization, tariff reductions, and extensive trade liberalization as remedy to the problem.[43]

7.2   Policy Considerations

The present study shows that a balanced approach should explore both the export and import sides of the trade account. The analysis of import performance and import demand elasticities highlights the role of imports in different ways. These include awareness about the foreign exchange constraint, implications of swift trade liberalization, and implications of changes in import of capital goods for the current account of the balance of payments.

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[43] There is vast literature on this subject beginning from the recommendations by the Reynders' Commission in 1972. Even the current economic thinking, as reflected in many writings, assign, implicitly or explicitly, import liberalization as remedy policy.

As argued by Rodrik (1992), Bell (1993) and others, trade liberalization may possibly have negative repercussions to the economy. In the South African case, trade liberalization would probably have adverse macro-economic effects in the short and medium-term, especially for employment. Comprehensive tariff reductions should await stable economic environment and should correspond (be compatible) with domestic economic priorities.

Emphasis on trade liberalization follows a wrong premise that the South African economy has been relatively closed[44] and therefore opening trade shall promote growth. This is a possibility, however it does not exactly follow that open economies have high growth rates and appropriate employment levels.[45] Undoubtedly, the significance of exports is undeniable. However, export performance, though necessary, is not a sufficient condition, especially in the presence of slow world demand and high import-intensity of the domestic economy. As Bell (1993) argued, calls for immediate, drastic, comprehensive import liberalization must be resisted. Perhaps policy emphasis should dwell on domestic 'economic restructuring'. However, there is the other side of the argument. Proponents of trade liberalization have stressed the benefits of trade openness. It should, therefore, be necessary to acknowledge different arguments concerning foreign trade issues. This dissertation has not gone into specifics of the arguments but what transpires is that there are many factors involved and that high economic activity increases the demand for imports which may in turn constrain the faster growth of an economy, at least in the case of South Africa.

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[44]Results of studies of Woods (1958) and Scheepers (1969) show that South African foreign trade has been active as early as the 1920s. Also, Kahn (1987) depicts high import penetration to South Africa since 1960s.

[45] The recent experience of 'Asian tigers' supports this point. The economy depends on many factors and the experience of developing nations show that the current account plays a fundamental role in an economy. Also refer to Michaely et al (1991) and Krugman (1987, 1995).

7.3 Summary of Findings

There are some important findings that emanate from this study. The study argues for the need of a focus on the balance of payments question. The theoretical model of the foreign exchange constraint and the literature reviewed in the first chapter point to that direction. The analysis, mainly descriptive, shows that the South African imports are high. The study also tentatively confirms the import-investment nexus. It also transpired that South African exports have not performed well. In short, the demand for imports is more responsive to income than to relative prices.

In the theoretical sections, it comes out that there remain some uncertainties with regards to proper methods used in modeling economic series. However, recent developments have provided invaluable inputs to modeling series properly. This study has shed some light on two fundamental topics. It has made use of the technical contributions in terms of the time-series techniques. And most importantly, it has highlighted very important points regarding South Africa's trade behavior and import demand.

It can be tentatively concluded that there is a high probability that South Africa's economic growth is constrained by the shortage of foreign exchange, at least during the period under investigation. The analysis shows that South Africa has a high import demand elasticity with respect to economic activity. That, combined with the findings of chapter two, implies that every time the economy grows fast, imports rise faster thereby eroding insufficient foreign exchange. In turn, through a multiplier of effects that results to low gross domestic product. As argued above, if this is the case, the pace with which trade liberalization proceeds can bear negative effects to the economy. It is important to note this point, especially because chapter two indicates that large portion of South Africa's imports are labour-intensive manufacturing. This very same manufacturing sector has been identified as providing large amount of employment.

In conclusion, the study has not exhausted all relevant issues. As said in the introduction, the study was intended to focus on import demand elasticities and not trade or macro-economic issues in general. However, the discussion has occasionally alluded to other related issues. It can, possibly, be recommended that further research should be conducted in this area. First and foremost, there needs to be a substantial examination of the foreign exchange question. Perhaps one possibility would be to extend the analysis. That is to examine import demand and export supply elasticities and connect them to the balance of payments research. This would generate some more understanding of the dynamics of the foreign exchange, especially the question of solving this problem. In addition, results of chapter two suggest that further research should be conducted using data exploited in that chapter.

For instance, some of the data can be used, once enough data observations are available, to calculate trade elasticities in terms of specific countries and/or group of countries, trading blocks, and commodity groups. The same data can also be utilized to calculate South Africa's trade balance in the manner that will increase our understanding of South Africa's real foreign trade position with countries and group of countries. In this way, studies can establish the main international markets for South Africa and the products with which South Africa has a comparative advantage or products South Africa could sell to those markets. Also, the relationship between imports and investments needs further investigation, particularly the mechanisms by which this relationship affects the current account of the balance of payments.

Chapter three also raises some important research needs. Most importantly, empirical studies on foreign trade should begin to explore other methods of analysis. For instance, import demand studies should examine not only relative prices and income when dealing with the determinants of the import demand. Studies should begin, amongst other things, to ensure synergy between the empirical work and macroeconomic theory, integrate the real and financial sectors, and take into account inter-country differences.

Lastly, in the mean time, the government needs to mobilize resources towards researching the constraints to faster growth of the South African economy. One other possibility, in the short-term, is to have a clear policy on appropriate intervention. There needs to be a policy on how to conserve scarce foreign exchange. The government can embark on a policy that discourages importation of products that are available in the South African market.

Another possibility is to find a means by which foreign exchange can be increased. That is, for example, the government or policy makers can embark on a policy that generates foreign exchange, perhaps through exports. A dilemma here is that there is no guarantee that exports will rise adequately enough to raise sufficient foreign exchange.

APPENDIX I[46]

SELECTED RESULTS OF STUDIES REVIEWED IN CHAPTER 3
(Values in brackets denote t-statistics)

Time-series Estimation of Structural Import Demand Equations
Senhadji, 1997

Table 1: Import demand equations.

	m(-1)	p	gdpx	AC	ser	R-squared
South Africa	0.50	-0.53	0.33	0.19	0.10	0.87
	[3.96]	[-3.43]	[3.39]	[1.10]		
Kenya	0.47	-0.77	0.55	-0.33	0.12	0.75
	[3.38]	[-3.61]	[3.69]	[-1.54]		
Mexico	0.69	-0.37	0.44	0.55	0.16	0.94
	[5.22]	[-2.18]	[2.37]	[4.50]		
Argentina	0.42	-0.64	0.80	0.19	0.16	0.80
	[3.50]	[-5.00]	[4.57]	[1.01]		

Income and Price Elasticities in World Trade
Houthakker and Magee, 1969

Table 2: Import Elasticities 1951-1966.

	C	Income	Price	R-squared	D.W.
South Africa	-0.21	1.13	1.04	0.796	1.42
	[-0.09]	[5.42]	[1.60]	[0.0954]	[13.0]

Income and Price effects in Foreign Trade
Goldstein and Khan, 1985

Table 3: Long-run price elasticities of demand for total imports.

Country	Houthakker-Magee (1969)	Adams et al. (1969)	Taplin (1973)	Goldenstein-Khan (1980)	Beenstock Minford (1976)	Samuelson (1973)
Germany	-0.24	-0.85	-0.61	-0.25	-0.74	-0.92
France	....	-0.81	-0.39	n.a.	-1.31	-0.79
USA	-1.03	-1.16	-1.05	-1.12	-1.04	....
UK	-0.21	...	-0.22	...	...	...
Japan	-0.72	...	-0.81	n.a.	-1.21	...

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[46] Results depicted in this appendix are meant to expatiate discussions on the choice of variables, signs, time-lags, and statistical significance of import demand elasticities. This appendix is extensively discussed in chapter six, where parallels between the estimated model, South African studies results (Appendix II), and other studies' results tabled in appendix I are discussed.

Table 4: Long-run price elasticities of demand for total imports.

Country	Gylfason (1978)	Stern et al. (1976)	Armington (1970)	Geraci and Prewo(1980)
Germany	-1.36	-0.88	-1.48	-0.60
France	-0.46	-1.80	-1.53	-0.33
USA	-1.12	-1.66	-1.73	-1.23
UK	...	-0.65	-1.38	-0.79
Japan	...	-0.78	-1.47	-0.72

Devaluation, Relative Prices, and International Trade
Reinhart, 1995

Table 5: Import Demand, 1970-91.

Country	C	pm/p	y	R-squared
Kenya	1.960	-0.650	0.095	0.675
	[0.809]	[0.340]	[0.391]	
Hong Kong	-1.247	-1.280	1.402	0.985
	[0.623]	[0.362]	[0.049]	
Mexico	-3.360	-0.393	0.893	0.884
	[3.128]	[0.143]	[0.388]	

Import and Export Demand in Developing Countries
Khan, 1974

Table 6: Imports

Country	C	Price	Income
Argentina	-1.402	-0.850	0.143
	[1.85]	[1.11]	[0.28]
Ghana	3.596	-1.057	0.238
	[0.08]	[0.12]	[0.03]
Morocco	0.139	-0.981	0.213
	[0.30]	[0.79]	[1.13]
Turkey	-1.793	-2.715	0.554
	[0.86]	[1.32]	[1.15]

APPENDIX II[47]
SELECTED RESULTS OF STUDIES REVIEWED IN CHAPTER 4
(Values in brackets denote t-statistics)

Table 1: *Manufacturing Sector (ISIC) - Almon Lag Equations 1974-1986*

Dependent Variables	Constant	Relatives Prices	GDE	Time	R^2	SE	DW
Import Volumes	-18,80 (-16,4)	1,15 (3,28)	2,16 (11,2)	-0.007 (-2,69)	0.092	0.05	1,85
IPR	-10,75 (-9,54)	1,40 (4,96)	1,02 (5,4)	-0,005 (-2,12)	0,91	0,05	1,78

Source: Kahn (1987: 244)

Table 2: *Manufacturing Sector (ISIC) - Partial Adjustment Model 1974-1986*

Dep. Var.	Const.	Relative Prices	GDE	Dep. Var. (-1)	R^2	SE
Import Volumes	-7,31 (-5,19)	0,55 (5,33)	0,72 (4,90)	0,61 (8,15)	0,90	0,06
IPR	-3,18 (-3,09)	0,44 (4,19)	0,26 (2,60)	0,75 (11,5)	0,89	0,05

Source: Kahn (1987: 245)

Table 3: *Agriculture(ISIC)*

(a) Almon Lag Model

Dep.	Const.	Relative Prices	GDE	Time	DUM	R^2	SE	DW
Import Volumes	-1,33 (-1,09)	0,79 (3,22)	0,19 (1,09)	0,00 (0,07)	0,33 (10,9)	0,9	0,05	1,80

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[47] Description of variables and methods of estimation are discussed in the text.

(b) Partial Adjustment Model

Const.	Relative Prices	GDE	Imp. Vol(-1)	DUM	R²	SE	h	Mean Time
-0,58	0,55	0,097	0,28	0,33	0,9	0,05	0,47	0,4
(-0,55)	(2,89)	(0,618)	(2,41)	(10,9)				
	0,76	0,135						

Source: Kahn (1987: 245)

Table 4: *Chemicals (SITC) and Machinery and Transport Equipment (SITC)*

Dep. Var.	Const.	Relative Prices	GDE	Time	R²	SE	DW
Import Volumes (Chem.)	-7,97 (-2,98)	1,37 (2,61)	0,70 (3,05)	0,01 (3,59)	0,73	0,08	2,13
IPR (Chem.)	-5,85 (-2,04)	1,55 (2,73)	0,37 (1,48)	0,001 (0,25)	0,25	0,09	2,33
Imp. Volume (Mach)	-22,1 (-16,3)	0,14 (1,52)	2,96 (15,2)	-0,02 (-4,98)	0,92	0,06	1,72
IPR (Mach)	-12,85 (-9,50)	0,64 (2,41)	1,63 (8,45)	-0,01 (-3,39)	0,91	0,06	1,73

Source: Kahn (1987: 246)

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