An econometric analysis of the import demand for meat in Saudi Arabia

Thesis Submitted for the Degree of

Doctor of Philosophy at

Kingston University

by

Mohammed. S. Alomair

Supervisor: Professor. Subrata Ghatak

Department of Economics

Kingston University

September 2003

Dedication

To the sunshine of my life:

My Parents.

Acknowledgements

I would like to express my thanks to my supervisor, Professor Subrata Ghatak, for his generous assistance, guidance and encouragement; I greatly appreciate his constructive criticism and invaluable suggestions throughout my study.

My thanks must go to my co-supervisor Mr Vincent Daly Head School of Economics, for his help, encouragement and generosity.

Many thanks and deep appreciations are also extended to the member of staff of the University of Kingston including Mrs Ann Holloway Research Administrator for all assistance, Kingston Library staff and The Economics Department staff.

I also extend my thanks to Professor John Presley, Department of Economics, Loughborough University and Professor Anita Ghatak, Department of Economics, Greenwich University for their help and encouragement.

I also wish to thank the Ambassador of the Kingdom of Saudi Arabia in the United Kingdom, His Royal Highness Prince Turki AL-Faisal for his help and encouragement to all Saudi students.

I also thank all my friends and my classmates for their help and encouragement, in particular to Mr Rafiq Chandio and Ms Louisa Fernandez.

My gratitude goes to all those who have talked and corresponded with me on this project, in particular to my advisors at the Saudi Arabian Cultural Bureau in, Mr Tareq, the members of the Saudi Economic Association, Mr Abdullah AL-Gassim chief of Price and Index Division from Ministry of Planning, the Minister's Office Dr. Saad Esa from Ministry of Agriculture and Water, Ministry of Interior, the Ministry of Finance and National Economy, Saudi Arabian Monetary Agency, King Fahd Security College.

Last but not least, I am greatly indebted to my wife Amel for her support, encouragement and sacrifices during the hard times I have encountered while undertaking this work. I also extend my thanks to my brothers and sisters in particular to Mr. Abdullah, Mr. Abdulrahman, Mr. Abdulaziz, and Mr. Abdulmajed, for their help and encouragement.

Finally, I wish to thank Mrs Shirley Briggs and Mrs Jacky Godfrey for their help and excellent co-operation in drafting the final revision of this thesis.

Abstract

Demand for meat in Saudi Arabia increased dramatically during the last two decades which led the government to promote economic development and increased self-sufficiency in meat commodities.

This study represents a dynamic specification of the Almost Ideal Demand System (AIDS) based on recent developments on cointegration techniques and error correction models, based on meat and fish consumption data in Saudi Arabia over the period 1981 to 2000.

The results show that there is evidence of long-run relationship between expenditure on meat with commodity prices and total meat expenditure. Also, the results for all budget shares elasticities indicate that the demand of poultry and fish, in both the short and long-run are price inelastic. While the demand for beef and lamb in the short-run was price inelastic, in the long-run these were found to have unit elasticity. The magnitude of short and long run cross-price elasticities indicates that lamb is a substitute for all meat items. Beef is a substitute for fish only. Poultry is a substitute for lamb and beef, while fish is a substitute for lamb only. In addition, poultry is a complement for fish, while fish is a complement for beef and poultry, beef is a complement for lamb and poultry. The short and long run expenditure elasticities indicate that beef, lamb and poultry were found to have a short run elasticity of less than one. In the long run beef, lamb and poultry, exhibited similar behaviour with regard to expenditure changes, indicating that these three meat items can be considered as necessities. On the other hand, fish is found in the short run and the long run to behave as a luxury good.

TABLE OF CONTENTS

List of Tables

List of Figures

Abbreviations

ADF: Augmented Dickey Fuller.

AIDS: Almost Ideal Demand System.

AIC: Akaike Information Criterion.

CPI: Consumer Price Index.

DSP: Differenced Stationary Process.

ECM: Error Correction Modelling.

ECT: Error Correction Term.

EG: Engle-Granger.

EGM: Engle-Granger Modelling.

GDP: Gross Domestic Product.

GRT: Granger Representation Theorem.

K.S.A: Kingdom of Saudi Arabia.

ML: Maximum Likelihood.

LA: Linear Approximation.

LES: Linear Approximation System.

OLS: Ordinary Least Squares.

PP: Phillips and Perron.

SBC: Schwarz Bayesian Criterion.

SR: Saudi Riyal.

URH: Unit Root Hypothesis.

VAR: Vector Auto Regressive.

VECM: Vector Error Correction Model.

Chapter One: Introduction

Kingdom of Saudi Arabia (KSA) is an open economy, which allows free trade and capital mobility. For continuous economic development and industrialization, KSA government imports from many countries. As with manufactured goods, many food products are imported too. A significant proportion of these imports are financed by the oil revenues, which represent the main source of national income. Crude oil and related products account for more that 90% of Saudi Arabia's exports, with the remainder taking the form of re-export products and a negligible percentage of agricultural products.

Saudi Arabia has a large foreign sector as measured by the export and import ratio to its Gross Domestic Product (GDP). During the period 1970-2000, KSA had a significant growth in the overall magnitude of trade. The total value of commodity exports increased from SR 10.9 billion in 1970 to SR 290.5 billion in 2000. During the same period, the total value of imports (cif) increased from SR 3.2 billion in 1970 to SR 113.2 billion in 2000. The average annual growth rate of exports and imports reached 5.6 and 10.5 percent between 1970 and 2000 respectively. This sharp increase in the value of imports may be partially attributed to inflationary trends. However, a large portion of the increase in the total value of imports could have been due to the development process that the country was undergoing (Ministry of Finance and National Economy, 2000).

These figures are indicative of the extent to which KSA depends on exports and imports in developing its economy and fulfilling the basic requirements of its population. This is also evidence of the degree of its reliance on international markets. This, in turn, brings to light the increasing influence of the economic fluctuations of the industrialized countries on the KSA key sectors of the economy since approximately 63 percent of KSA imports are provided by the industrialized world, i.e., the European Union, the USA and Japan (SAMA, 1999).

There was a major change in the composition of imports during 1970-2000. for example, the major import category shows that one of the most significant import is foodstuff; by 2000, foodstuffs represented 31.6 percent of the total. There has been a more noticeable change in the structure of imports over the longer term; in 1970, for example, foodstuffs accounted for only 15.8 percent of total imports (Ministry of Finance and National Economy, 2000).

Over the past two decades, many countries have exported to the Saudi market. However, France and Brazil's share of the Saudi market for meat has been very large over the past decade. The imported quantity recorded in 1981 was 570.000 tons with a total value of SR 1.9 billion, while in 2000 it reached 854.000 tons with a total value of SR 2.6 billion. Most meat imports of live animals into KSA are because of the requirements of Islamic slaughter practices (SAMA, 1995). Of course the quality of meat imported varied considerably. There are major fluctuations in some types of import from year to year; this is particularly evident in relation to imports of food stuff. On the other hand, oil revenues, which constitute the main source of the national income of KSA, have decreased during 1990-1998. Therefore, measures to decrease total imports, including food products, have become part of economic policy makers in KSA. However, this cannot be achieved without thorough knowledge of the structure and composition of food imports and a better understanding of the factors affecting demand.

There are several social and economic factors causing this rapid increase in consumption of basic food commodities, including population growth, up from six million in 1970 to about twenty two million in 2000. Because of high wages and a significant increase in the number of development projects launched by the government, there are many guest workers drawn from all over the world in the KSA. The census (Statistical Year Book 2000) shows the number of guest workers to number about 4 million from different countries In addition, the number of religious pilgrims who come to the Holy City (Makkah) for a period ranging from one to two months per year has increased to over one million annually. Obviously, the level of consumption and personal preferences and tastes are varied among these groups.

Not only has the total population increased, but the structure and pattern of consumption has been changing among the Saudi population. The nation of Saudi Arabia is becoming more urbanized and cosmopolitan. The level of education has been raised very sharply because of free education scholarships given to Saudi students for training abroad. Also, many students are securing a higher education inside the country. This higher level of education has increased literacy levels and improved health standards. Improved medical care has reduced the infant mortality rate and extended the life expectancy of the average Saudi citizen. These factors, along with increased average real earning have improved standards of living and have changed significantly the structure and pattern of consumption.

Residents have increasingly adopted technology for storing frozen foodstuffs, thus keeping foods for longer periods of time, yet maintaining nutritional value. This has caused consumption patterns to change and to increase. Even though Saudi people are careful with their diets, they are ready to eat fast foods. This has lead to the expansion of the restaurant industry with a resulting impact on consumption.

Consumer subsidies also have had an impact on food demand. The total consumer subsidy was estimated to be about SR 24822 billion from 1980-1995 (SAMA, 1995). Because water, electricity and gasoline are also heavily subsidized by the Saudi government, this has led to an indirect impact on food prices.

The increase in real per capita income (1970-1985), combined with other factors has put more pressure on production and imports (Ministry of Finance and National Economy, 1970- 2000).

1.2 Oil Revenue and Trade Adjustments in KSA:

Saudi Arabia is considered to be a one product economy, heavily dependent upon oil. After the oil embargo in 1973, the Saudi government encouraged development of other sectors (especially the private sector) and thus began diversifying the economy. The strategies of the current Saudi development plan are to decrease dependence on the oil sector and increase reliance on other economic forces such as private investment, personal and corporate taxation and the development of bond markets. A stable domestic economy is essential for the success of such strategies. The fact that KSA relies heavily on export of crude oil for foreign exchange earnings has made her vulnerable to the world events outside her control. The sharp decline in oil production since 1982 and sudden decline in oil prices in 1986, for example, resulted in the oil revenues by the late 1980s to be a quarter of what they were in the early 1980s (Wilson and Presley, 1991). Consequently, in the 1998/99 budget, oil and non-oil revenues contributed 56 and 44 percent respectively of government receipts compared to 90 and 10 percent in the 1969/70 budget; this indicates that Saudi Arabia has taken steps to diversify its economy (Ministry of Finance and National Economy, 1970- 2000). The Saudi government's policy goals include a high level of self-sufficiency in foodstuffs and stable prices of the basic food commodities. Government provides subsides to both producers and consumers. Producer subsidies include commodity price supports; free land grants; a 45 percent subsidy on major farm implements; a 50 percent subsidy on fertilizer, seed and imported farm machinery; and interest free production loans. Direct consumer subsidies in 1984 were estimated at 20 percent on milk, 25 percent on cooking oil, 15 percent on sugar, and 70 percent on bread (Ministry of Agricultural and Water, 1999). Since the start of diversification, the agricultural sector has been one of the fastest growing. An estimated 40 billion dollars has been spent on agricultural infrastructure and subsidized farm inputs during the last decade. As a result of this large subsidy, the annual average growth rate of the agricultural sector increased from 5.2 percent in the 1970s to 8.7

percent in the 1999 period (Ministry of Agricultural and Water, 1999).

Saudi Arabia has achieved self-sufficiency in production of wheat, eggs and dates. In fact, supply currently exceeds the domestic demand for these commodities. In addition to the agricultural sector, these policies have been success in expanding production in broilers, dairy products, vegetables and fruit. For example the domestic product of dairy products and broilers has reached about 40 percent of domestic demand. Self-sufficiency in wheat was achieved in 1984 in response to the government's procurement price of SR 3862.5 per metric ton. Farmers increased their production from 85,435 metric tons in 1980 to 1.3 million metric tons in 1996. Having achieved self-sufficiency in wheat, the government reduced the subsidy to SR 2141.25 a metric ton for the 1985 crop year. The larger, more efficient farmers can still make a profit from wheat production at the lower subsidy (Ministry of Agricultural and Water, 1999).

Even though agricultural output has increased because of heavy subsidies the area under cultivation expanded from 150,000 acres in 1974 to about 2.8million acre in 1996. KSA still imports about 70 percent of its agricultural commodities from international markets. This is estimated to be one of the world's highest per capita import levels (SAMA 1998).

1.3 Scope of the Study:

The pace of economic development has been a major determinant of the volume and composition of the KSA imports. During the first three development plan periods, the share of food items increased from 15.8 percent of total imports in 1970 to 16.3 percent in 1974 and then further increased to 19.9 percent in 1984. During the fourth plan, the share of food items increased to 20.3 percent in 1990. However, with the start of the execution of the fifth plan, the share of food items improved to 26.3 percent in 1995. In 2000, the share of food items rose to 31.6 percent of total imports (Ministry of Finance and National Economy, 1970-2000).

During the last decade, the expenditure for basic food commodities has increased dramatically in KSA. The expenditure percentage on food was ranged from 30-32 percent for a family. Meat group come into the first group on the food expenditure sheet at approximately 25 percent, then the fresh fruit group at 13 percent (Ministry of Agricultural and Water, 1970-2000).

Consumption expenditure in KSA showed that lamb, poultry and fish account for 30, 45 and 13.60 percent of total meat expenditure respectively; these are the highest shares among the meat commodity groups, because lamb, poultry and fish are the meat that are traditionally consumed in KSA.

Per capita consumption of meat increased from roughly 32 to 84 kilograms between 1981 and 2000. Per capita consumption of poultry increased from 10 kg to 32 kg. Fish consumption has also increased, especially in the last decade with per capita consumption of fish increasing from 0.6 kg in 1981 to 13 kg in 2000. Lamb consumption has increased from 11 kg in 1981 to 28 kg in 2000

Based on this evidence, the question of self-sufficiency in the meat industry in Saudi Arabia should be analyzed in depth. The current consumption patterns should be identified, taking into account trends in individual demand and in domestic production, as well as imports. Such analysis requires reliable estimates of demand parameters for meat in Saudi Arabia. Tracing the effects of income and price changes on meat demand must also be carried out. Disaggregated parameters help in understanding the linkage to the international sector, as well as to domestic production, thus facilitating the design of appropriate policies for influencing domestic production, consumption and international trade. Investigation of the consumption functions will explain the trends in meat consumption and provide answers to future expectations about the continuance of this trend, given that real income will continue to fluctuate.

The lack of research regarding the Saudi meat market calls for the need of a full investigation into meat import demand in Saudi Arabia. To the best of our knowledge, there has been no study that has comprehensively investigated meat import demand in KSA. Therefore, it is difficult to explain the nature of the market, compared it to other meat markets, or recommend any kind of policy regarding production, consumption and trade. The analysis of the demand for meat in KSA will provide solid indications of future consumption and lend a basis for the design of future policies. Such analyses may lead to the formulation of new policies that will integrate the Saudi meat market into international markets.

Despite the importance of demand parameters, there has been no attempt to estimate a complete elasticity estimate for Saudi Arabia's meat import demand.

It is important to identify the structure of the foodstuff imports and the main factors affecting the demand on these commodities. In the light of these facts, this study intends to attempt to reach possible solutions to these problems and, at the same time, provide economic indicators that could be useful in launching the strategies needed to handle the growing demand for meat products, as well developing local production of this foodstuff with the aim of reaching self-sufficiency in this field.

1.4 Major Objectives of the study:

This research aims to analyze meat import demand in Saudi Arabia and the main variables that affect such demand. This will help to predict the important factors that affect meat imported and to provide development strategies that can achieve food security in this type of commodity. In this study, Saudi meat import demand models will be discussed in relation to import of five types of meat: beef, camel, lamb, poultry and fish. The effects of expenditure on meat depend on several factors. These include the price of the commodity, the price of substitute and total meat expenditure. The change in demand for a particular meat import also depends on these microeconomic factors.

We ask three major questions which are as follows: What is the effect of a change in prices on the volume of Saudi meat imports? What is the effect of a change in the prices of other types of meats on the volume of Saudi meat imports? What is the effect of a change in the total meat expenditure on the volume of Saudi meat imports?

To answer these questions, a dynamic specification of the Almost Ideal Demand System (AIDS) will be used, based on recent developments in cointegration techniques and error correction models. Based on the time series properties of the data, and as long as cointegration between the dependent and linear combination of independent variables is ensured, an Error Correction Model ECM for AIDS can be established and econometrically estimated with cointegration procedure. Saudi meat import demand will be estimated and the relationships between the expenditure share on meat commodities and prices in the short- and long-run will be analyzed.

Hence, the major objectives of our study are as follow:

1. To review patterns and trends in the trade in Saudi Arabia.
2. To conduct a descriptive and analytical study of the structure of food imports, focusing mainly on the composition and importance of meat. This investigation is made both in terms of value and quantity, as well as the development and implementation of import policies.
3. To determine some major factors which affect meat imports both from a theoretical and empirical perceptive in terms of the demand function of meat imports.
4. To find precisely the relationship between prices and expenditure on meat commodities by estimating the relevant elasticities.

1.5 The Layout of the Thesis:

This study is to investigate meat import demand in the Saudi Arabia through applied econometric analysis. Its central theme is that the disaggregate analysis provides a better understanding of import demand performance and policy formulations. This will improve the statistical reliability of the empirical analysis and will provide economics insight that allows policy makers to formulate and implement suitable economic policies

The subsequent chapters are organized as follows:

Chapter 2 is a review the economic development and progress in Saudi Arabian economy from 1970 to 2000 to identify the nature of the economic characteristics of Saudi Arabia and help planners to overcome the difficulties they often face in the Kingdom of Saudi Arabia.

Chapter 3 provides a comprehensive theoretical and empirical review of the relevant studies. It explains theoretically and empirically import demand in several countries with diverse characteristics.

In Chapter 4 discusses some aspects of the theory and application of demand analysis. It is divided into two parts. The first part reviews the consumer demand theory and the specification of the meat consumption demand model. The second part discusses the Almost Ideal Demand System (AIDS).

Chapter 5 introduces cointegration approaches in terms of specification, estimation and testing. It also illustrates the techniques involved in the context of the relationship between non-stationary time series data. Three issues are involved with the specification of the model: 1) unit root test; 2 cointegration; 3) error correction.

Chapter 6 presents a brief discussion of Saudi meat consumption. It is divided into two parts. First the major factors affecting Saudi meat consumption. Second the structure of Saudi meat consumption including per capita meat consumption and expenditure.

Chapter 7 presents the empirical results of the study of import demand for meat in Saudi Arabia; six issues are involved with the specification for Saudi meat demand: 1- Statistical Measurements, 2-Pretesting the Variables for Non-stationary, 3- Granger Causality test, 4-Cointegration test, 5-Estimation and Hypothesis Testing of Cointegration Vector and 6- Error Correction Model.

Chapter 8 concludes and makes some policy recommendations.

Chapter Two: The Saudi Arabian Economy

2.0 Introduction:

As a consequence of the huge oil revenues, which accrued to Kingdom of Saudi Arabia (KSA) as a result of drastic increases in oil prices during the 1970's, the KSA government launched ambitious spending programme aimed at building the infrastructure of the economy and to create structural changes in the economy. Economic diversification through a strong agricultural and industrial structure has long been the main macroeconomic objective of KSA. In the pursuit of this goal, the government's short-term strategy has been to direct a large portion of development expenditure towards the creation of social and economic infrastructure. The government's longer-term strategy has been to limit its economic involvement to regulatory and promotional functions while encouraging the participation of the private sector in investing on a profitable basis in economic diversification projects[1]. Specifically, to increase economic efficiency and to promote sustainable economic growth, the Saudi government is committed to the eventual realization of indigenous private ownership of all sectors of the economy except oil extraction.

---

[1] For a general economic background, see Presley and Westaway (1989).

This chapter is organized as follows: Section 2.1 provides a brief historical and demographic background; Section 2.2 describes economic development during six development plans; Section 2.3 explains the behaviour of import trends into Saudi Arabia; Section 2.4 considers agricultural development; Section 2.5 describes general social development. Section 2.6 concludes.

2.1 Location and Climate:

KSA occupies four-fifths of the Arabian Peninsula and is bordered by the Red Sea on the west and by the Arabian Gulf, Qatar, Oman and the United Arab Emirates on the east. To the north, it borders Jordan, Iraq and Kuwait, and to the South, the Republic of Yemen. The total area of KSA is approximately 2.25 million square kilometres (about one-third the size of the United States). Although KSA is surrounded on two sides by sea, aridity is the dominant feature. Moreover, KSA is the largest country on earth without rivers. In fact, the intense heat of the summer months is the best known feature of the Arabian climate. Summer temperature averages usually range between 95° F and 120° F. In winter, temperature range between 32°F and 75°F, but can drop below the freezing point in some areas. Rainfall is scanty and irregular, occurring mostly during the months from October to April. The precipitation varies from about 100 mm in the north to less than 25 mm in the Rub-AL-Khali or the Empty Quarter, while there is more in the mountains on the west, and perhaps as much as 300 mm in the southern part of the coastal range. This total could hardly support plant growth, especially in view of the high evaporation rates observed in the country.

2.1.1 The Population:

According to the 2000 Population Census, there were slightly over twenty two million people in the country, with an annual growth rate of 3 percent. It is very difficult to obtain reliable population statistics of the non-settled Beduins, due to the great changes in their lifestyle many of them turning to agriculture and some to life in the cities. However, it has been estimated that about 1.9 million are non-settled or nomadic. The large migration experienced in KSA from rural area to cities by villagers and nomads is usually the result of a search for better employment opportunities, higher wages, better education and a better standard of living. The urban population has grown very fast due to the large influx of people from the interior, as well as from outside the KSA. There are three urban population centres in KSA: the western region which includes Jeddah and the holy cities of Makkah and Madinah, the central region which includes the capital city of Riyadh and the Qasim area. The eastern region which, includes Dammam and AL ahsa.

2.1.2 Discovery of Oil and Early Problems:

A hundred years ago, the economy of the territories, which were unified in 1932 and proclaimed as the KSA, was in a very rudimentary stage, depending mainly on trade, agriculture, animal husbandry and services to pilgrims, who visited the holy cities of Makkah and Madinah. No economic data are available for the early period for comparison with later developments. However, it is known that the economy lacked physical infrastructure as well as industry and was much poorer than most other economies in the contemporary world.

Oil was discovered in 1938 and the first shipment of oil was made in May, 1939. However, after the outbreak of World War II in 1939, production could not be increased substantially for several years as wartime conditions interfered with the shipments to markets. Nevertheless, explorations were continued during the war period and a refinery with a capacity of 50,000 bpd was built at Ra's Tanurah, which went on stream in September 1945[2]. Government revenue remained low up to the mid-forties because, with the escalation of the war, not only oil revenue but also receipts from pilgrimage fell sharply, bringing the budgetary position under severe strain. The situation, however, improved greatly from 1945 onward as oil production went on rising. As a result, oil revenue, which had amounted to SR 12 million in 1939, rose to SR 39 million in 1946. It went up to SR 213 million in 1950 and to SR 1279 million in 1955. The rise in revenue enabled the government to enlarge its expenditure over the years. However, in 1956-58, oil revenue fell below SR 1125 million, although government expenditure continued to rise, leading to aggravation in fiscal imbalance and increase in government borrowings. The large creation of purchasing power through the budget deficits resulted in a serious balance of payments problems due to an increase in demand for imports, which exceeded the availability of foreign exchange.

---

[2] Saudi Arabian Monetary Agency (SAMA), Annual Report, 1970. Saudi Arabia, Riyadh.

Control on foreign exchange transactions, introduced in July 1957, proved ineffective, and the free market exchange rate of the Riyal fell from the official rate of SR 3.75 to SR 6.25 per U.S. Dollar. As the economy depended heavily on imports, the import restrictions and depreciation of the Riyal resulted in a serious upward pressure on prices and the cost of living[3].

2.1.3 The Stabilization Programme:

The government introduced a stabilization programme in 1958. In its first phase the programme provided for achieving budget surpluses, the retirement of outstanding government debt over a reasonable period, and the reform of the exchange and import control system. A dual exchange rate system was introduced, with the official exchange rate applying to essential consumer goods and capital goods, while for all other purposes foreign exchange was to be obtained from the free market. The stabilization programme proved to be a great success and within two years government domestic debt was nearly eliminated, and gold and foreign exchange reserves increased substantially[4].

The stabilization programme proved to be the cornerstone of the development of the Kingdom's Economy on sound lines.

---

[3] Saudi Arabian Monetary Agency (SAMA) Annual Report 1975. Saudi Arabia, Riyadh.

[4] For more information on the basic features of economy including organisation and use of manpower, financial sector, and the government budget the period up to 1958, the reader is referred to Lipsky (1959).

2.2 Economic Development:

After the successful completion of the stabilization programme, the government gave increasing attention to the economic development of the KSA. An Economic Development Committee was set up at the beginning of August, 1959. A World Bank Mission was invited to prepare a report on the possibilities of economic development. The Mission, after assessing the existing projects, suggested a two year programme with certain basic surveys to be undertaken within the same period on which a more comprehensive and balanced programme for economic development for a longer period could be based. In early July 1960, a High Planning Council was established to deal with the problems of economic development. The government made increasingly large allocations for the development budget. The allocation increased from SR 55 million [4.1 percent of the total expenditure budgeted for fiscal 1959] to SR 2,682 million [about 45.0 percent of the total expenditure] in 1969-70, the year immediately preceding the introduction of medium-term development planning (SAMA, 1970). In addition, during 1960-1970 appropriations increased more rapidly for development than for consumption. For example, allocation for development increased from less than SR 0.06 billion in 1959 to SR 2.655 billion in 1970; for this same period allocation for consumption increased from SR 1.140 billion to SR 3.285 billion[5].

---

[5] See Wilson (1979), and Saudi Arabian Monetary Agency, Annual Report (1975). Saudi Arabia, Riyadh.

2.2.1 The Budget: Government Revenues:

The level of government revenues in the KSA was strongly affected by conditions prevailing in the world oil market during the past years. The buoyant conditions in the world oil market during the first plan (1970-75) and second plan (1975-80) resulted in raising total government revenues, from both oil and other sources, from SR. 7.9 billion in 1970 to SR. 103.3 billion in 1975, and to SR. 348.1 billion in 1980. The average annual growth rate of revenues during the first and second plans, reached 77.6 percent and 16.1 percent respectively (See Figure 2.1), (Ministry of Planning, 1980).

During the third plan period (1980-85), the world oil market witnessed significant changes which adversely affected both the price and quantity of oil produced by the KSA, The sharp decline in oil production since 1982 and sudden decline in oil prices in 1986, for example, resulted in the oil revenues by the late 1980s to be a quarter of what they were in the early 1980s[6], thus resulting in a significant decline in total government revenues. The average annual growth rate of government revenues during this period declined to -4.1 percent, and continued to decline during the fourth plan period (1985-90). The government revenues reached SR. 133.6 billion in 1985, and declined further to SR. 114.6 billion in 1989 mainly due to the decline in oil revenues.

---

[6] For more information see Wilson and Presley, (1991).

Revenues fluctuated during the fifth (1990-95) and sixth (1995-2000) plan periods, and peaked to SR. 205.5 billion in 1997[7]. However, revenues increased in 2000 to SR. 258 billion (see Table 2.1).

Government revenues from oil increased from SR. 7.1 billion in 1970 to SR. 93.4 billion in 1975 and to 319 billion in 1980. Since then the non-oil revenues have been fluctuating, reaching SR. 160 billion in 1997. However, in 2000, they increased further to SR. 214.4 billion, owing to increase in oil prices. Government revenues from non-oil sources have been growing, rising from about SR. 0.8 billion in 1970 to about 45.1 billion in 1985. Since then, non-oil revenues have also been fluctuating and reached SR. 43.6 billion in 2000, mainly due to the drop in investment income and in revenues from some services such as telephone and telex services. In spite of the general decline in total government revenues during that period, revenues from a number of local non-oil sources including custom duties, port services, airport fees and fees levied on the sale and lease of property steadily increased after 1984 (SAMA,1970-2000).

Clearly, changes in oil revenues and government expenditures changed employment, economic growth and the demand for meat in KSA.

---

[7] Ministry of Planning, Third Development Plan 1980-2000.Saudi Arabia, Riyadh.

Table: 2.1: Annual Government Revenues and Expenditures in KSA.

(Million Riyals)

Year	Oil Revenues	Other Revenues	Total Revenues	Total Expenditures	Deficit / Surplus
1970	7122	818	7940	6418	1522
1971	9685	1435	11120	8303	2817
1972	13480	1888	15368	10148	5220
1973	39285	2420	41705	18595	23110
1974	94190	5913	100103	32038	68065
1975	93481	9903	103384	81784	21600
1976	121191	14766	135957	128273	7684
1977	114042	16617	130659	138048	-7389
1978	115078	16427	131505	147971	-16466
1979	189295	21901	211196	188363	22833
1980	319305	28795	348100	236570	111530
1981	328594	39412	368006	284650	83356
1982	186006	60176	246182	244912	1270
1983	145123	61296	206419	230185	-23766
1984	121348	50161	171509	216363	-44854
1985	88425	45140	133565	184004	-50439
1986	42464	34034	76498	137422	-60924
1987	67405	36406	103811	173526	-69715
1988	48400	36200	84600	134850	-50250
1989	75900	38700	114600	149500	-34900
(1990 & 1991)*	246297	70342	316639	457477	-140838
1992	128790	40857	169647	211340	-41693
1993	105976	35469	141445	187890	-46445
1994	95505	33486	128991	163776	-34785
1995	105728	40772	146500	173945	-27445
1996	135982	43103	179085	198117	-19032
1997	159985	45515	205500	221272	-15772
1998	79998	61610	141608	190060	-48452
1999	104447	43007	147454	183841	-36387
2000	214424	43641	258065	235322	22743

Source: Ministry of Planning, Central department of statistics, 1969-2000. Saudi Arabia, Riyadh.

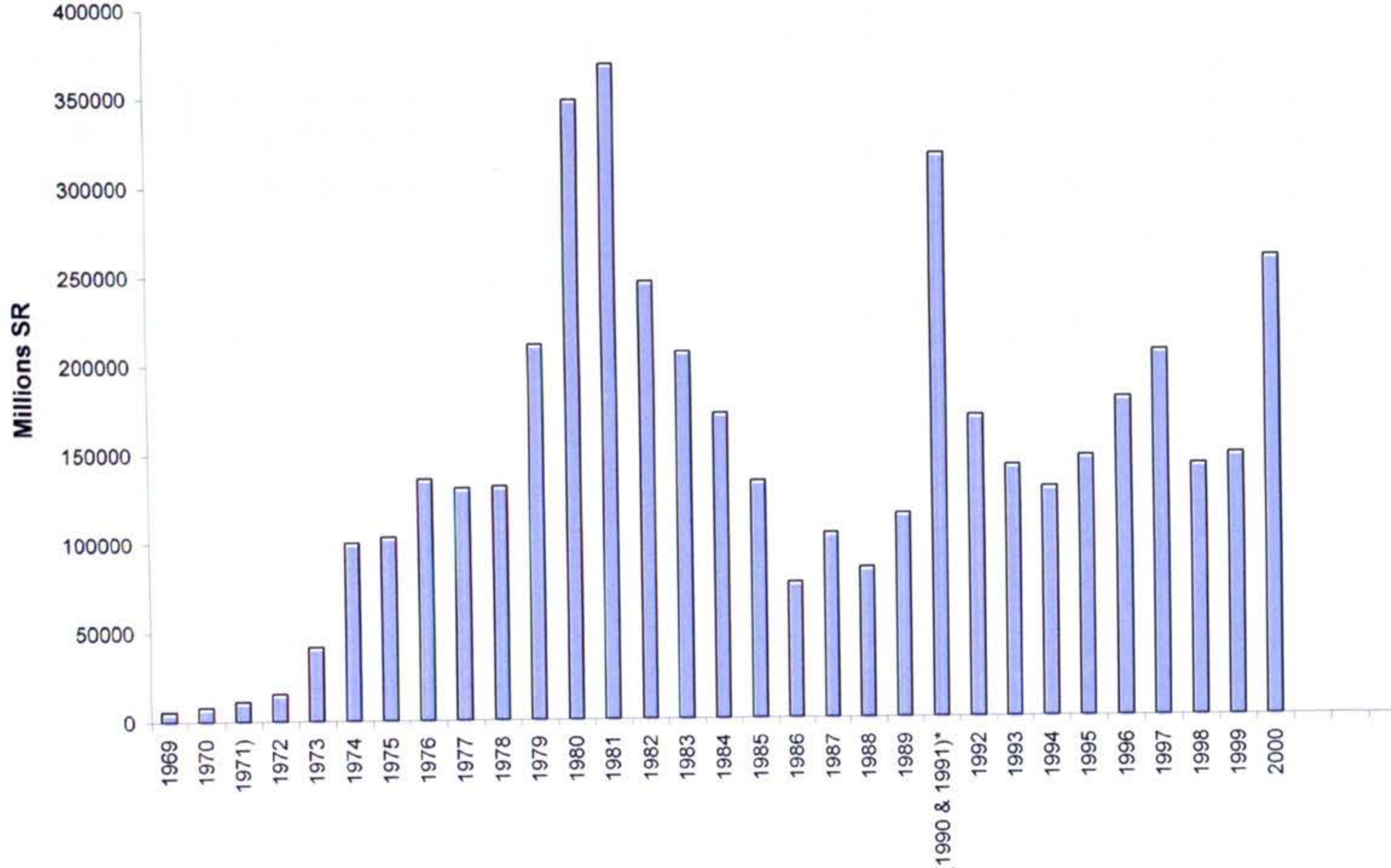


Figure 2.1: Total Government Revenues in Saudi Arabia.

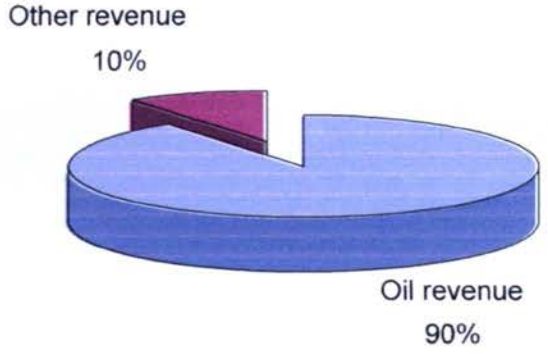
2.2.2: Percentage Distribution of Government Revenues

The contribution of oil revenues to total government revenues increased from 90.3 percent in 1970 to 94.1 percent in 1975 but decreased to 89.6 percent in 1980 and then to 70.8 percent in 1985 (see Figure 2.2). Recent developments in the world oil market, which have adversely affected oil revenues, plus the effects of growth in the non-oil revenues, have, however, changed the relative shares of the oil and non-oil revenues over this period. In 1995, revenues from oil and non-oil sources provided 72.2 percent and 27.8 percent of total government revenues respectively. Thereafter, the share of oil revenues started improving and reached 83.1 percent in 2000, while the share of non-oil revenues reached 16.9 percent (see Table 2.2).

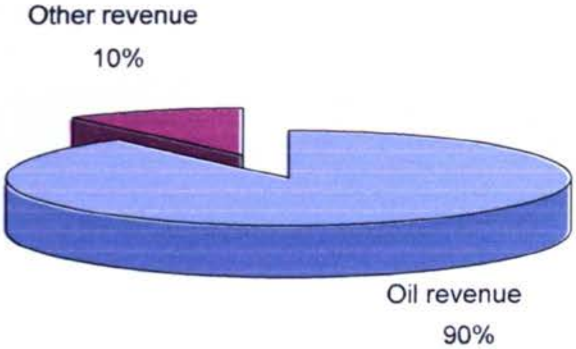
Table 2.2: Percentage Distribution of Government Revenues in KSA

Year	Oil revenue	Other revenue	Total Revenues
1970	90.3	9.7	100
1975	94.1	5.9	100
1980	89.6	10.4	100
1985	70.8	29.2	100
1990	76.4	23.6	100
1995	72.2	27.8	100
2000	83.1	16.9	100

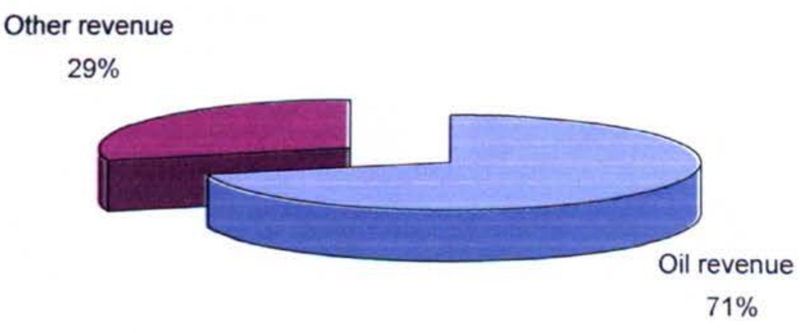
Source: Saudi Arabian Monetary Agency (SAMA), Annual Report, 1970-2000 Riyadh. Saudi Arabia.



1970

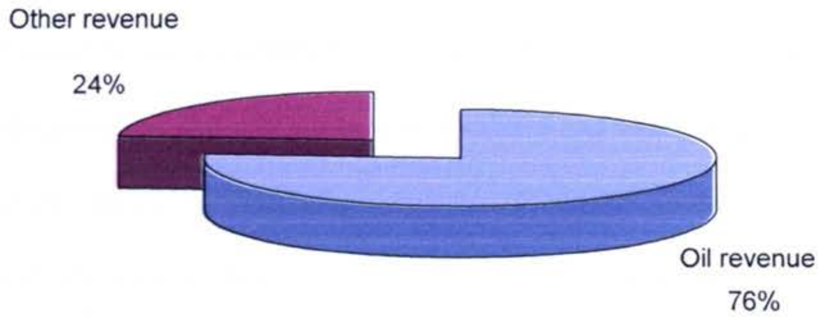


1980

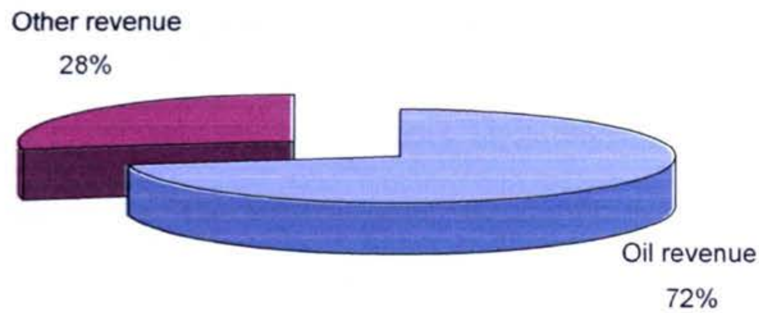


1985

Figure 2.2A: Percentage Distribution of Government Revenues in KSA.



1990



1995

2000

Figure 2.2B: Percentage Distribution of Government Revenues in KSA.

2.2.3 Government Expenditure:

Because of the government's commitment to improve housing, education, health, transportation and communication facilities and to develop the agriculture and industrial sectors, the level of government expenditure increased continuously to accelerate the pace of development in the KSA. Government expenditure rose from SR. 6.4 billion in 1970 to SR. 81.7 billion in 1975, SR 236.6 billion in 1980, and SR. 184.0 billion in 1985 (SAMA, 1985). The average annual growth rates of government expenditure during the first, second and third plans reached 39.4 percent, 42.5 percent and 2.8 percent respectively (see Table 2.3).

During the fourth plan period, the level of government expenditure experienced a steady decline. This trend occurred, not only due to the decline in government revenues but, more importantly, because of the completion of major infrastructure projects, thus diminishing the need for maintaining high levels of development expenditure. KSA has become well equipped in terms of modern infrastructure such as transport and communications, education, health, housing, and agricultural and industrial facilities. Government expenditure in 1989 amounted to SR. 149.5 billion. However, this expenditure fluctuated in subsequent years and reached SR. 235.3 billion in 2000 (SAMA, 2000), (see Figure 2.3).

Table: 2.3: Annual Government Expenditures in KSA.

(Million Riyals)

Year	Total Expenditures
1970	6418
1971	8303
1972	10148
1973	18595
1974	32038
1975	81784
1976	128273
1977	138048
1978	147971
1979	188363
1980	236570
1981	284650
1982	244912
1983	230185
1984	216363
1985	184004
1986	137422
1987	173526
1988	134850
1989	149500
(1990 & 1991)*	457477
1992	211340
1993	187890
1994	163776
1995	173945
1996	198117
1997	221272
1998	190060
1999	183841
2000	235322

Source: Ministry of Planning, Central department of statistics, 1970-2000. Saudi Arabia, Riyadh.

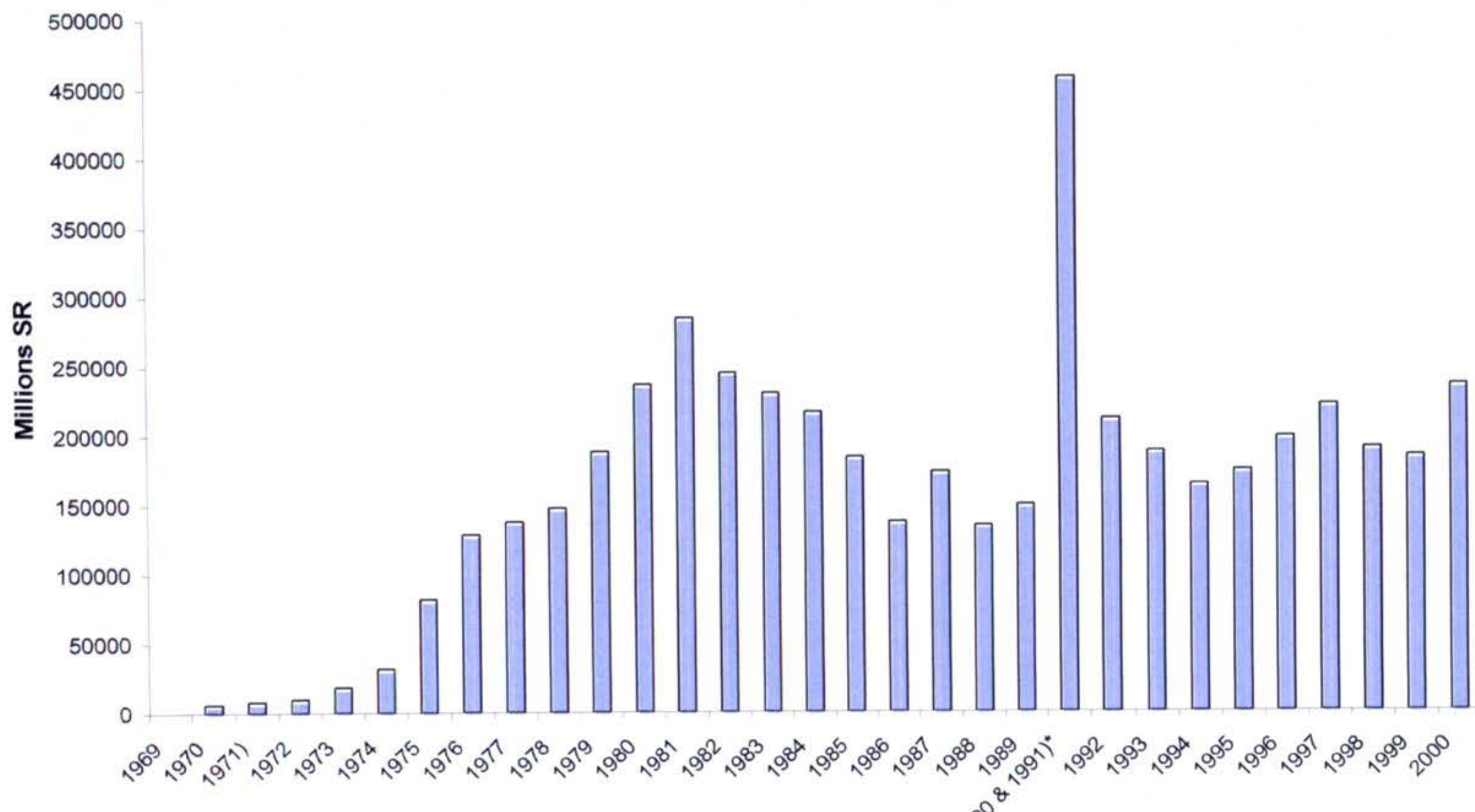


Figure 2.3: Government Expenditures in Saudi Arabia.

2.3 Gross Domestic Product:

At current prices, the value of all goods and services produced by the nation, as measured by the Gross Domestic Product (GDP), rose from SR. 18.59 billion in 1968 to SR. 544 billion in 1980 and then declined to SR. 350.3 billion in 1989, mainly due to the drastic fall in the output of the oil sector. GDP has shown a steady increase since 1996 and reached SR. 697.7 billion in 2000 (see Table 2.4). Real GDP, measured at 1999 constant prices, followed a similar pattern, rising from a level of SR. 129.2 billion in 1969; real GDP reached SR. 512.4 billion in 1980 but fluctuated thereafter. Since 1996, real GDP has risen steadily and reached SR. 623.2 billion in 2000 (SAMA, 1999). The real GDP of the oil sector, measured at constant prices of 1999, grew from SR. 80.4 billion in 1969 to SR. 243.5 billion in 1981 and fell sharply to SR. 92.5 billion in 1985. In 2000, it increased to SR. 212.6 billion. In comparison, the real GDP of the non-oil sectors, measured at constant prices of 1999, increased at an average annual growth rate of 5.6 percent, rising from SR. 48.7 billion in 1969 to SR. 312.1 billion in 1985 and then to SR. 410.5 billion in 2000. The performance of the private sector (including public enterprises) has remained buoyant within the non-oil sector. The private sector's contribution to real GDP, measured at constant prices of 1999, rose from SR. 18.8 billion in 1969 to SR. 223 billion in 1983. However, it declined to SR. 190.8 billion in 1986 but rose gradually thereafter to SR 266.4 billion in 2000 (Ministry of Planning, 1970-2000).

Table 2.4: Gross Domestic Product by Oil and Non oil sectors in K.S.A.

(Million Riyals)

Year	AT CURRENT PRICES					AT CONSTANT 1999 PRICES				
	GDP	Oil Sector	Non-oil Sector			GDP	Oil Sector	Non-oil Sector		
			Private	Govt.	Total			Private	Govt.	Total
1968	18599	8572	6159	3868	10027	121888	76360	17366	28162	45528
1969	19915	8885		4277	11030	129216	80445	18855	29916	48771
1970	22279	10390	7270	4619	11889	145037	95362	18753	30922	49675
1971	30124	17031	8016	5078	13094	173772	117466	22511	33795	56306
1972	37819	22450	9629	5740	15369	215107	146886	30385	37835	68220
1973	53047	33217	12935	6896	19831	271336	183796	43442	44098	87540
1974	159276	126320	24580	8376	32956	347508	205987	88400	53121	141521
1975	163156	104876	46879	11401	58280	365829	171508	130689	63632	194321
1976	224441	137999	70469	15973	86442	412825	211494	135643	65687	201330
1977	259548	146758	90227	22562	112789	441024	225530	142758	72736	215494
1978	270439	130552	109812	30076	139888	437054	205812	157504	73737	231241
1979	373309	203623	132474	37212	169686	480784	235341	172677	72766	245443
1980	544069	341641	155724	46704	202428	512403	245843	187841	78719	266560
1981	619538	380798	181436	57303	238739	537048	243580	209124	84344	293468
1982	520949	254737	199035	67178	266213	476916	167454	222289	87172	309461
1983	441533	163118	206288	72126	278414	437023	122932	223020	91070	314090
1984	416416	140671	200507	75238	275745	423111	112160	214356	96594	310950
1985	372408	104451	188756	79201	267957	404685	92525	208543	103617	312160
1986	318775	72666	167301	78808	246109	425166	131162	190879	103125	294004
1987	317478	78775	160486	78217	238703	408752	116103	190081	102568	292649
1988	322283	76738	163120	82425	245545	437192	140769	193481	102942	296423
1989	350325	98652	167118	84554	251672	439238	136966	196827	105445	302272
1990	430334	158693	175387	96254	271641	476225	170076	197041	109108	306149
1991	484853	179572	186754	118527	305281	520999	207911	200866	112222	313088
1992	501359	199856	197270	104233	301503	542726	214109	208908	119709	328617
1993	485630	170012	205637	109980	315617	542927	207491	212868	122568	335436
1994	494766	169438	213191	112137	325328	547799	207889	215719	124191	339910
1995	526004	187718	218599	119686	338285	549963	206972	217644	125346	342990
1996	581873	226476	230509	124888	355397	567550	211879	228397	127274	355671
1997	608802	228250	241304	139248	380552	582438	208724	238705	135008	373713
1998	536635	152829	245603	138202	383805	598154	215357	244891	137905	382796
1999	593955	198988	255200	139767	394967	593955	198988	255200	139767	394967
2000	697007	289165	264873	142969	407842	623237	212652	266437	144148	410585

Source: Ministry of Planning, Achievements of the Development Plans 1970-2000, Saudi Arabia, Riyadh.

2.3.1 Sectorial Composition of GDP:

The share of the oil sector in the total GDP rose from 56.1 percent in 1969 to 65.3 percent in 1974 but declined to 37 percent in 2000. The rapid growth of the non-oil sectors has resulted in increasing the relative share of these sectors in the total GDP from 41.5 percent in 1969 to 76.1 percent in 1985. Thereafter, it fluctuated and reached 63 percent in 2000 (see Table 2.5). This structural transformation of the economy had first begun to occur during a period when the non-oil sector's GDP was experiencing high rates of growth. During the first and second development plans, the average annual growth rate in the oil sector decreased from 17.9 percent to 2.9 percent while the average annual growth rate in the non-oil sectors increased from 9.5 percent to 15.5 percent respectively (Ministry of Planning, 1999). This structural transformation of the economy is a testimony to the successful achievement of the objectives of successive development plans which have emphasized the need to reduce reliance on the oil sector and achieve economic diversification. With the beginning of the third plan, and after 1980, the prevailing world oil market conditions began to affect adversely the real GDP of the oil sector in the KSA. Accordingly, the GDP of the oil sector, declined from SR. 235.3 billion in 1979 to SR. 92.5 billion in 1985. Consequently, its contribution to GDP decreased from 51.9 percent to 26.7 percent during the same period and continued to fluctuate during the fourth plan until it reached SR. 408.7 billion in 1987. This substantial decline was due to decreases in world oil prices during this period. Nevertheless, the GDP for the oil sector started to increase until it reached SR. 212.6 billion, which is 35.3 percent of the total GDP, in 2000. The non-oil GDP continued to grow perfectly. As a result, the share of the non-oil real GDP in the total economy, at 1999 constant prices, increased from 47.1 percent in 1979 to 72 percent in 1987. However, it declined to 63 percent in 2000 (see Table 2.5). The share of the construction sector in the real non-oil GDP increased during the first two plans. It rose from 8.2 percent in 1969 to 27.1 percent in 1979. However, it fell back to 17.6 percent in 2000. The share of manufacturing activity in the non-oil GDP rose from 4.3 percent in 1969 to 8.2 percent in 2000 (SAMA, 2000). The contribution of the agriculture sector in real GDP steadily increased during all the plan periods, rising from SR 4.4 billion in 1969 to SR. 26.1 billion in 2000. During the third plan the growth rate of the agriculture sector accelerated despite the general decline of total GDP. As a result, the share of the agriculture sector in non-oil GDP rose from 4.8 percent in 1979 to 10.2 percent in 2000. This rapid growth reflects the successful implementation of the government's policies to promote the development of the agriculture sector. The share of transport and communications in non-oil GDP fell from 13.6 percent in 1969 to 10.3 percent in 2000, while that of the trade sector rose from 7.4 percent to 11.3 percent. The share of all other services declined from 57.2 percent in 1969 to 42.3 percent in 2000. The percentage contribution of the constituents of the oil sector also changed during the period 1969 to 2000. The share of crude oil and natural gas, excluding construction associated thereof, in the total GDP of the oil sector which stood at 94.5 percent in 1969, rose to 96.9 percent in 1979 and subsequently declined to 89.6 percent in 1999. The share of oil refining amounted to 5.5 percent in 1969. It declined to 2.9 percent in 1974, but rose again to 10.4 percent in 2000 (Ministry of Planning, 1970-2000).

Table 2.5: Percentage Distribution of Gross Domestic Product by Oil and Non-oil Sectors in K.S.A.

	Oil Sector				Non Oil Sector		
Year	Mining of Crude oil and natural gas	Petroleum refining	Other sectors associated thereof	Total	Private Sector	Government sector	Total
1969	48.1	2.8	5.2	56.1	23.5	18	41.5
1974	59	1.8	4.5	65.3	19	14.4	33.3
1979	48.1	1.6	2.2	51.9	26	21.1	47.1
1984	23.4	1.9	1.4	26.7	43.5	28.5	72
1985	19.4	2.4	0.7	22.5	46.6	29.5	76.1
1986	27.4	2.3	0.6	30.3	42.2	26.4	68.6
1987	24.2	3.1	-0.6	26.8	43.9	28.2	72
1988	27.3	3.3	-0.8	29.8	41.4	26.1	67.5
1989	27	3	-0.8	29.2	41.8	26.8	68.6
1990	30.9	3.5	-1	33.3	39.8	24.9	64.7
1991	34	3.8	-1.6	36.2	36.5	25.5	61.9
1992	35.6	4	-1.9	37.7	36.1	24.2	60.3
1993	34.5	3.9	-1.9	36.5	35.9	25.6	61.5
1994	34.4	3.9	-1.9	36.4	36.1	25.6	61.6
1995	34.4	3.8	-1.9	36.3	36.1	25.4	61.4
1996	34.6	3.8	-1.9	36.5	35.9	25.3	61.2
1997	34.2	3.8	-1.9	36.1	36.6	25.4	61.7
1998	34.4	3.8	-1.9	36.3	36.2	25.3	61.4
1999	33.3	3.9	-1.8	35.3	36.	26.4	62.4
2000	35.3	3.2	-1.5	37	36.5	26.5	63

Source: Ministry of Planning, Achievements of the Development Plans 1970-2000, Saudi Arabia, Riyadh.

2.3.2 The average annual growth rate of real GDP:

Economic planning has become one of the main instruments of achieving a higher growth rate and better standard of living in many countries. Planning can be defined as a conscious effort on the part of any government to follow pattern of economic development in order to promote rapid and fundamental change in the economy and society. Such a concept of planning is fairly broad as it seeks to promote not only a fast growth rate but also significant structural socioeconomic changes via public intervention. However, the degree of state intervention defines the nature of different types of planning (Ghatak, S. 2003).

During the past three decades, six development plans have been implemented enveloped within a comprehensive strategic framework the goals of which are reflected in the set of long-term general objectives of development that have been adopted by the government at the early stages of development planning in 1970. these objectives encompassed: improving the standard of living and the quality of life; diversifying the economic base and reducing dependence on the production and export of crude oil as the main source of income; developing other non-oil exports; maintaining socio-economic stability; developing human resources; supporting the role of the private sector in the national economy; achieving balanced development and completing the development of infrastructure. Table 2.6 summarises the actual average annual and planned rates of growth of overall GDP, oil sector, and major non-oil sectors for these five-year development plans. Following are some indicators that reveal the extent of progress made by the KSA in accomplishing those development objectives:

2.3.2.1 First Development Plan:

According to the Table 2.6, the annual rate of growth in real GDP averaged 13.0 percent which was above the planned rate of 9.8 percent. This was partly due to the growth in oil production by an average annual rate of 14.8 percent which surpassed the target rate of 9.1 percent. The 10.6 percent average annual rate of growth in the non-oil sector was in line with the 10.5 percent target rate. The construction sector grew at an average annual rate of 21.4 percent, far above the planned rate of 10.4 percent. Agricultural, non-oil mining, and manufacturing sector grew, but at rates below the planned rates. For example, the average annual rate of growth in agriculture was 3.6 percent compared to the 4.6 percent target rate. Non oil mining and manufacturing averaged annual rates of 11.8 percent and 10.8 percent compared to, respectively, 23.3 percent and 14.0 percent target rates (Ministry of Planning, 1970-2000).

2.3.2.2 Second Development Plan:

During the second plan period, the 7.0 percent average annual rate of growth in the overall real GDP was less than the 10.2 percent planned rate, due to a lower than expected growth in oil production. For example, oil sector growth averaged an annual rate of 4.6 percent compared to the 9.7 percent target rate. The real non oil GDP, however, grew at the average annual rate of 14.7 percent which was above the planned rate of 13.3 percent. Agriculture, manufacturing, construction, utilities, transport, trade, and finance all exceeded their targets. Non-oil mining and other services also grew but at less than their projected rates (Ministry of

Planning, 1970-2000).

2.3.2.3 Third Development Plan:

The sharp decline in Saudi oil production resulted in a 14.4 percent average annual rate of decline in the oil sector during the third plan period. Consequently, the overall GDP decline by an average annual rate of 1.6 percent compared to the 3.3 percent planned annual rate of increase. The non oil sector, however, scored a 6.2 percent average annual rate of growth due mainly to the continuing infrastructure and industrial projects with relatively few cutbacks in government development expenditures, despite the declining oil revenues. The agricultural sector averaged a rapid growth of 9.5 percent annually, well above the 5.4 percent planned rate (Ministry of Planning, 1970-2000).

2.3.2.4 Fourth Development Plan:

The increase in oil production later in the period, however, resulted in average annual growth rate of 5.1 percent in the oil sector. The overall GDP growing at 1.3 percent annual rate was well below the planned rate of 4.0 percent. In addition, economic diversification was hindered as the non oil sector experienced a low rate of growth due to cutbacks in development projects following the sharp decline in oil revenues during the fourth plan (Ministry of Planning, 1970-2000).

2.3.2.5 Fifth Development Plan:

During the fifth plan period, the overall GDP growth averaged an annual rate of 5.3 percent, exceeding its target rate of 3.2 percent. This occurred because of the higher than expected rate of growth in the oil sector which averaged an annual rate of growth of 8.9 percent, far above the planned rate of 2.7 percent. The average annual rate of growth of 1.9 percent in the non oil sector was lower than the planned rate of 3.6 percent (Ministry of Planning, 1970-2000).

2.3.2.6 Sixth Development Plan:

Under the sixth development plan[8], the average annual rate of growth for overall GDP is projected to be 3.8 percent, with oil and non-oil sectors growing, respectively, at 3.8 percent and 3.9 percent per annum. The non-oil sector growth rate of 3.9 percent combines the non-oil private sector target growth rate of 4.3 percent per annum and the public sector target growth rate of only 2.7 percent per annum. These target rates, of course, reflects the plan's goal for larger non-oil private sector activity and the desire to restrain growth in the public sector (Ministry of Planning, 2001).

[8] For more details see Presley (1996).

Table 2.6 Actual and Target Growth Rate in Oil and Non-oil sector.

	First plan 1970-1974		Second plan 1975-1979		Third plan 1980-1984		Fourth plan 1985-1989		Fifth plan 1990-1994		Sixth plan 1995-2000
	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Oil sector	9.1	14.8	9.7	4.6	1.3	-14.4	5.6	5.1	2.7	8.9	3.8
Non- oil sector	10.5	10.6	13.3	14.7	6.2	6.2	2.9	-1.1	3.6	1.9	3.9
Government	7.0	7.8	12.9	6.5	7.2	7.3	----	1.7	0.8	2.8	2.7
Private	12.0	11.3	13.4	14.1	6.0	6.0	3.5	-1.8	4.6	1.5	4.3
Agriculture	4.6	3.6	4.0	6.9	5.4	9.5	6.0	13.4	7.0	3.1	3.1
Mining	23.3	11.8	15.0	9.5	9.8	7.3	3.0	-0.9	4.0	4.9	9.0
Manufacturing	14.0	10.8	14.0	15.4	18.8	11.7	15.5	0.5	7.0	8.2	4.9
Construction	10.4	21.4	15.0	15.8	-2.5	-2.4	-2.8	-7.7	3.8	1.5	4.0
Utilities	3.4	13.2	15.0	21.9	29.5	21.2	5.0	5.9	6.9	4.5	
Service Sector:											
Transport	12.9	0.7	15.0	19.3	12.9	7.1	5.0	-0.8	3.2	1.6	5.5
Trade	12.8	13.8	15.0	22.7	8.4	8.7	2.5	-1.5	3.0	1.3	2.9
Finance	9.5	17.1	9.5	14.3	7.3	2.5	4.1	-4.6	5.1	1.9	6.2
Others	10.0	6.0	14.0	11.8	3.0	4.4	3.5	2.5	1.7	0.7	4.1
Total GDP	9.8	13.0	10.2	7.0	3.3	-1.6	4.0	1.3	3.2	5.3	3.8

Source: Ministry of Planning, Central Department of Statistics, 1970-2000.Saudi Arabia, Riyadh.

2.4.1 Foreign Sector: Merchandise Trade:

The value of commodity exports (FOB) grew during the first plan period (1970-75) with a high average annual growth rate of 84.4 percent. It increased from SR. 10.9 billion in 1970 to SR. 126.2 billion in 1974. During the same period, the average annual growth rate of imports (CIF) reached 33.5 percent, with an increase of commodity imports from SR. 3.2 billion in 1970 to SR. 10.1 billion in 1974[8] (see Table 2.7).

During the second plan period (1975-80), the average annual growth rate of exports (FOB) declined to 11.1 percent and total exports reached SR. 213.2 billion in 1979. However, the average annual growth rate of imports (CIF) rose to 51.7 percent during the same period, and the total value of imports reached SR. 82.2 billion in 1979. During the third plan period [9](1980-85), exports recorded a negative average annual growth rate of 9.1 percent. In 1984, the value of exports reached SR. 132.3 billion. However, it began to decrease in the early years of the fourth plan (1985-1990) and reached SR 106.3 billion in 1989 (see Figure 2.4). It then increased to SR. 178.6 billion in 1991 showing an increase of about 7.4 percent compared to the previous year. See Table 2.7. In 1992, the value of exports reached SR. 188.3 billion, recording an increase of 5.4 percent over the 1991 level.

---

[8] For more information see Ministry of Planning, Central Department of Statistics, Foreign Trade, 1975

[9] Ministry of Planning, Achievements of the Development Plans, 2000

Table 2.7: Foreign Trade in KSA.

(Million Riyals)

Year	Exports	Percentage Change	Imports	Percentage Change
1970	10,907	14.9	3,197	-5.4
1971	17,303	58.6	3,668	14.7
1972	22,761	31.5	4,708	28.4
1973	33,309	46.3	7,310	55.3
1974	126,223	278.9	10,149	38.8
1975	104,412	-17.3	14,823	46.1
1976	135,154	29.4	30,691	107.0
1977	153,209	13.4	51,662	68.3
1978	138,242	-9.8	69,180	33.9
1979	213,183	54.2	82,223	18.9
1980	362,885	70.2	100,350	22.0
1981	405,481	11.7	119,298	18.9
1982	271,090	-33.1	139,335	16.8
1983	158,444	-41.6	135,417	-2.8
1984	132,299	-16.5	118,737	-12.3
1985	99,536	-24.8	85,564	-27.9
1986	74,377	-25.3	70,780	-17.3
1987	86,880	16.8	75,313	6.4
1988	91,288	5.1	81,582	8.3
1989	106,294	16.4	79,219	-2.9
1990	166,339	56.5	90,282	14.0
1991	178,624	7.4	108,934	20.7
1992	188,325	5.4	124,606	14.4
1993	158,770	-15.7	105,616	-15.2
1994	159,590	0.5	87,449	-17.2
1995	187,403	17.4	105,187	20.3
1996	227,428	21.4	103,980	-1.1
1997	227,443	0.0	107,643	3.5
1998	145,388	-36.1	112,397	4.4
1999	190,084	30.7	104,980	-6.6
2000	290,553	52.9	113,240	7.9

Source: Ministry of Finance and National Economy, Central Department of Statistics, 1970-2000.
Ministry of Planning, Central Department of Statistics, 1970-2000.Saudi Arabia, Riyadh.

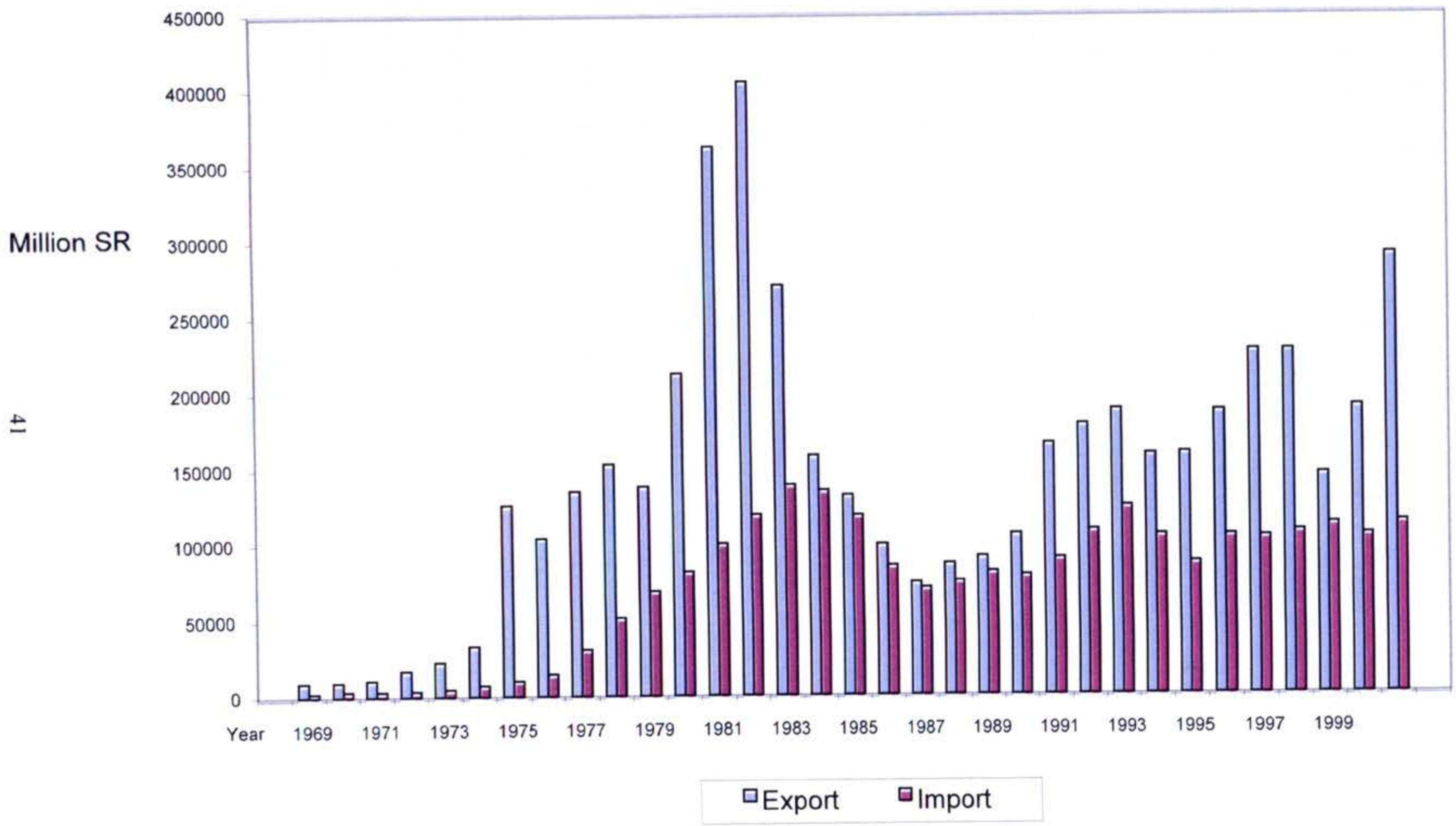


Figure 2.4: Merchandise Trade in K.S.A.

However, in 2000, the value of exports amounted to about SR. 290.5 billion. The value of imports during the third plan period recorded a positive average annual growth rate of 7.8 percent and SR 14.8 billion, and by 1982 they had reached a peak of SR 139.3 billion; import values fell as low as SR 71billion in 1986 only to recover to reach over SR 124 billion during 1992. By 1993 import values fell yet again to SR 105 billion and 1994 fell even further to SR 87 billion. Since then, however, import values have increased again, reaching SR 105 billion in 1995 and peaking at SR 112 billion in 1998 with positive annual growth rates of over 3percent per annum in 1997 and 1998. In 1999, visible import values fell back again to SR 104 billion, a decline of 6.6percent (Ministry of Planning, 2000).

2.4.2 Percentage Distribution of Merchandise Exports:

Crude oil exports constitute the most important component of the KSA's total merchandise exports. The share of crude oil in total exports increased from 83.2 percent approximately in 1970 to nearly 94 percent in 1979. Since then it has steadily declined to 67.2 percent in 1998. Petroleum products represent the second major export item. In 1998, petroleum products constituted 17.1 percent of total merchandise exports. Exports of other commodities, such as animals and animal products, chemicals, and agricultural products, constituted less than one percent of total exports until 1979. Since then the share of other commodities in total exports has risen gradually to 15.7 percent in 1998 (see Table 2.8).

Table 2.8: Percentage Distribution of Merchandise Exports by Main Sections.

Year	Crude Petroleum	Petroleum Products	Other	Total
1969	83.2	16.5	0.3	100
1974	94.3	5.5	0.2	100
1979	93.9	5.2	0.9	100
1984	86.6	10	3.4	100
1985	76	18.4	5.6	100
1986	73	17	10.1	100
1987	63.5	24.5	12	100
1988	60.3	22.6	17.1	100
1989	66.4	18.4	15.1	100
1990	74.1	16.2	9.7	100
1991	78.3	13.2	8.6	100
1992	78.8	13.8	7.5	100
1993	75.5	15.6	8.9	100
1994	73.4	16.1	10.5	100
1995	71	16.1	13	100
1996	71.8	17.6	10.6	100
1997	71.7	16.2	12.2	100
1998	67.2	17.1	15.7	100
1999	82.5	10.3	7.2	100
2000	83.1	11.1	5.8	100

Source: Ministry of Planning, Annual Report, 1970-1998, Saudi Arabia, Riyadh.

2.4.3 Exports from Saudi Arabia:

Naturally, despite the major industrial growth taking place in the KSA, exports are still dominated by crude and refined oil; together such oil exports rose to SR 168.7 billion in 1999, representing 88.8 percent of total exports of SR 190.1 billion. Given further increases in oil prices in 2000, with export prices averaging $27/barrel and with export volume increases as well, oil export values should exceed SR 220 billion (The Saudi British Bank, 2001). The direction of exports reflects the sources of imports; in 1999, the USA imported over SR 37 billion worth of Saudi products, followed by Japan at SR 28.5 billion. The top ten countries importing from KSA accounted for SRI 35 billion or 71 percent of the total Saudi exports in 1999. Asian countries accounted for SR 8 1.1 billion of Saudi exports, or almost 43 percent of the total, with North America taking SR 38.5 billion and Western Europe SR 31.7 billion in 1999 (see Table 2.9), (Ministry of Planning, 1999).

The decline in net oil revenue in 1980 and the emergence of deficit in balance of payments in K.S.A. (as illustrated in Table 2.7), forced the government to engage in import substitution, particularly in the poultry industry.

Table 2.9: Top Ten Exports Destinations (SR Millions)

Country	Value of Exports
USA	37,185
Japan	28,496
South Korea	20,429
Singapore	11,107
India	8,175
Holland	7,845
France	7,469
Bahrain	5,560
United Arab Emirates	4,710
Italy	4,428
Total ten countries	135,404
Other countries	54,680
Total	190,084

Source: Ministry of Planning, Central Department of Statistics, 1999 Saudi Arabia, Riyadh.

2.5. Economic Development and Import Trends:

Explaining the behaviour of imports into KSA requires an understanding of the links between the development process and government spending. Since the oil price rise in the early 1970s, KSA has pursued a development policy which, amongst other things, aims to:

1. Transform an essentially agricultural economy into a developed industrial economy while still keeping a prudent level of self sufficiency in agriculture.
2. Build a strong physical and social infrastructure (roads, airports, hospitals, schools etc.).
3. Create in the long term a highly skilled and productive domestic workforce through an emphasis on education, training and health provision but, in the short to medium term, allow the use of expatriate labour to overcome the skills shortage.
4. Create less dependence upon the oil sector and oil revenues by generating more self sufficiency and a broader export potential based on the comparative advantage afforded by cheap energy resources.
5. Focus in the early years, on capital intensive products in order to overcome the relative labour shortage at the time; now Saudi labour is in abundant supply and it is necessary to create jobs for Saudi nationals.

These policy objectives have been consistently followed over the past 30 years, with government spending on the mechanism for emphasising these development priorities. As a consequence, import trends have reflected these priorities; the 1970s saw a focus on the import of both capital and consumer goods, but because of the drive for infrastructure development, capital goods imports were particularly important. More recently, prompted by a relative decline in the importance of government spending, there has been a climate which has further encouraged the import substitution required in the second phase of the development process. It is important not to over-emphasise the links between trends in government spending and imports into Saudi Arabia; certainly the strength of the relationship between government spending and imports is weakening as the private sector develops in KSA and as government spending becomes a much smaller proportion of total spending in the KSA. However, the correlation that exists between government spending and imports, with apparently an increase (or decrease) in import values lagging behind an increase (or decrease) in government spending by 6-12 months. This does not imply that the public sector undertakes most of the imports. Indeed, in 1981, when the value of imports to KSA peaked in value terms, the public sector was responsible for only 12 percent of imports. However, government spending does create business for the private sector which, in turn, has had to resort to imports (SAMA, 1999). In 1975, imports stood at SR 14.8 billion, and by 1982 they had reached a peak of SR 139.3 billion; import values fell as low as SR 71billion in 1986 only to recover to reach over SR 124 billion during 1992. By 1993 import values fell yet again to SR 105 billion and 1994 fell even further to SR 87 billion. Since then, however, import values have increased again, reaching SR 105 billion in 1995 and peaking at SR 112 billion in 1998 with positive annual growth rates of over 3percent per annum in 1997 and 1998. In 1999, visible import values fell back again to SR 104 billion, a decline of 6.6percent. However, with higher government oil revenues, a slight rise in government spending and debt repayment, more spending power may be promoted which could increase imports in 2001. The evidence, for example, by the second quarter of 2000 seems to support this with imports increasing by 2.6 percent to SR 30 billion compared to the second quarter of 1999. But the increase is not spread over all types of imports; for example, imports of machinery and equipment fell by SR 0.5 billion to SR 6.73 billion whilst food imports rose by SR 0.5 billion to SR5.4 billion (Ministry of Finance and National Economy, 1970-1988). There are clearly a number of factors influencing import trends: government spending is just one factor and this is growing less important over time. Secondly, the push for import substitutes and local products, sometimes via joint ventures, is also beginning to have a strong influence on import values. Thirdly, the changing nature of the development process, with less emphasis on large infrastructure projects is now affecting the type of imports, together with the structure of the age distribution of the Saudi and non-Saudi population[10] (affecting, for example, the composition of foodstuff imports).

---

[10] The Saudi British Bank, Trade and Saudi Arabia, 2001, Saudi Arabia, Riyadh.

2.5.1 Percentage Distribution of Merchandise Imports:

The pace of economic development has been a major determinant of the volume and composition of the KSA imports. During the first three development plan periods, the pace of development accelerated the share of imports related to project development, like transport equipment, machinery, mechanical and electrical equipment, base metals and construction materials. These rose from 42.6 percent of total imports in 1970, to 59.1 percent in 1979 and then declined to 52.3 percent in 1984. During this period, the share of food items increased from 15.8 percent of total imports in 1970 to 16.3 percent in 1974 and then further increased to 19.9 percent in 1984 (Ministry of Finance and National Economy, 1970-1988).

During the fourth plan, as the pace of development decelerated, the share of development related imports also declined. In 1990, imports of these items constituted just 47.5 percent of total imports. Also, the share of food items increased to 20.3 percent in the same year. However, with the start of the execution of the fifth plan's development projects, the share of the development related imports increased to 48.2 percent while the share of food items improved to 26.3 percent in 1995. In 2000, the share of development related imports maintained increased to 52.2 percent, while the share of food items rose to 31.6 percent (Ministry of Finance and National Economy, 1990-2000).

2.5.2 The Composition and Volatility of Imports:

The Composition and Volatility of Imports between 1995 and 1999 by major import category shows that the most significant imports are electrical equipment, foodstuffs and transport equipment (cars, spare parts, etc); by 1999, electrical equipment constituted 24 percent of total visible imports, with foodstuffs representing 19.2 percent of the total. There has been a more noticeable change in the structure of imports over the longer term; in 1981, for example, foodstuffs accounted for only 11 percent of total imports, while electrical and transport equipment combined represented around 40 percent of imports compared with only 27.8 percent by 1999. However, making this kind of comparison can be very problematical. There are major fluctuations in some types of import from year to year; this is particularly evident in relation to imports of capital goods (see Table 2.10, Ministry of Planning, 1999).

Table 2.10: Product-wise Imports into Saudi Arabia: 1995-1999.

	1995	1999	% Change
Foodstuffs	17,171	18,072	+5.2
Textiles and clothes	7,913	6,494	-17.9
Chemical / mineral products	9,551	10,768	+12.7
Wood and wood products	1,592	1,259	-20.9
Jewellery	4,237	5,113	+20.6
Base metals and metal articles	10,857	8,808	-18.9
Electrical machines	23,020	25,187	+9.4
Transport equipment	15,171	15,201	0.0
Others	15,674	14,078	-10.2
Total	105,187	104,980	-0.2

Source: Ministry of Planning, Central Department of Statistics, 1995-1999. Saudi Arabia, Riyadh

2.5.3 Sources of Imports:

KSA is dependent upon relatively few countries for the vast majority of its import requirements. Historically, the leading exporter to the KSA has been the USA; it has exported more than twice as much as any other country to KSA over the last three years. However, its importance as an exporter to the KSA has diminished with its share of the KSA's imports falling from 22 percent in 1997 to 19 percent in 1999, accounting for a drop in import values of over SR 3 billion during this period. Japan and the UK have occupied second and third ranking for import sources though again, in the case of the UK, exports to the KSA have fallen over the last three years from over SR 11.2 billion in 1997 to SR 8.4 billion by 1999 (Ministry of Finance and National Economy, 1970-1999).

The top six exporters to the KSA account for over 50 percent of total exports at some SR 54.4 billion in 1999; the next ten countries account for SR 24.7 billion or 23 percent of the KSA's imports. Taken together, the top sixteen exporters to the KSA were responsible for 77 percent of the total visible imports in 1999, with the rest of the world accounting for only 23 percent. Clearly, Saudi Arabia's trade relations at present are very country specific by international standards. However, the latest Saudi Arabian Monetary Agency (SAMA) Report (2000) indicates that imports from the top six industrialised countries fell by 10.3 percent in 1999, offsetting a rise of 4.8 percent in the preceding year (see Table 2.11).

Table 2.11: Saudi Imports by Region: 1984, 1995 and 1999.

(SR Millions).

Region	1984		1995		1999	
	Value	% Total	Value	% Total	Value	% Total
GCC	1,539	1.2	2,822	2.7	4,082	3.9
Other Arab League	2,152	1.8	3,255	3.1	4,186	4.0
Islamic (Not Arab)	3,015	2.5	5,512	5.2	4,634	4.4
East Europe	1,077	0.9	1,519	1.5	1,293	1.2
Oceania & Australia	2,404	2.0	1,110	1.1	2,564	2.4
South America	1,722	1.5	2,447	2.3	2,876	2.7
Africa	281	0.2	566	0.5	1,739	1.7
North America	21,432	18.0	23,81	22.6	21,20	20.2
Asia	35,642	30.0	21,43	20.4	23,27	22.2
Western Europe	49,117	41.4	42,33	40.3	38,94	37.1
Other	356	0.3	298	0.3	183	0.2
Total	118,73	100 %	105,1	100%	104,9	100%

Source: Ministry of Planning, Central Department of Statistics, 1999 Saudi Arabia, Riyadh

2.6 Agricultural Development:

The agricultural sector is one of the major sectors in the KSA which enjoys the paramount attention of the government .The agricultural sector has received the attention and support of the government of the KSA within the framework of the comprehensive development strategy adopted by the government since the outset of its socio-economic development planning in 1970. This sector has become one of the largest non petroleum production sectors in the KSA based on sound scientific bases and the advantages derived from the experiences of the leading countries in the field of agriculture. The KSA has succeeded in realizing comprehensive agricultural development, surmounting all obstacles and difficulties in spite of the scarcity of natural resources and the inconvenient climatic conditions. The substantial agricultural achievements realized by the KSA have gained the admiration and appreciation of many regional and international organizations and bodies involved in the development of agriculture and food security.

2.6.1The Agricultural Credit:

The KSA agricultural bank was founded in 1962 to provide credit for the agricultural sector. With 13 main branches and 57 offices expanding all over the KSA, the objectives of the bank's credit policy aim to encourage farmers to invest in agriculture and assist them in applying modern means of agriculture to improve the quality and quantity of their products. The bank offers farmers long, medium and short-term interest free loans to enable them to finance their agricultural projects and farms in the fields of livestock and plant production, and manufacturing. The amount of loans the bank has extended to farmers since its foundation and up to the end of the year 1999 reached SR 28,125 billion (Ministry of Finance and National Economy, 1970-1999).

2.6.2 Agricultural Subsidies and Price Supports:

The KSA's policy towards agricultural subsidies and price supports has two main aspects: Subsidies are provided for prices of agricultural inputs, the objectives being to minimize the financial burdens of farmers and encourage them to apply modern agricultural methods, to use agricultural machinery and to adopt modern technology in all the agricultural operations. The supports and subsidies provide agricultural equipment and machinery with prices ranging from 30-50 percent below their usual cost. Subsidies are also provided for livestock and forage and air transportation is free for milk producing cattle. The total support and subsidies provided by the agricultural bank for the sector exceeded SR 800 million by the end of the fiscal year 2000. Support is also provided for agricultural products, the objective being to encourage the plantation and expansion of production of certain crops of strategic and nutritional importance. These supports are divided into two categories:

The first takes the form of incentives and encouragement support paid in cash by the Ministry of Agriculture and Water to farmers based on the quantities of production achieved on the following crops: rice, corn, pearl millet, palm seedlings and dates. The total supports and subsidies provided by the Ministry for the agricultural sector reached SR 900 million by the end of the fiscal year 2000.

The second is in the form of purchasing the produce from farmers at encouraging prices. This policy is applicable for wheat, barley and dates that are locally produced. The government founded an organization of grain silos and flour mills and authorized it to purchase, store and manufacture farmers' crops in order to maintain the KSA's strategic stocks of grain and grain by products. Following the same course, the government founded a dates factory to encourage the purchase of good quality dates from farmers at the incentive price of SR 3 per kg. The objective was to provide support to date production because of its economic importance in the KSA (Ministry of Agriculture and Water, 1970-1999).

2.6.3 The Nature of Agriculture and Food in the KSA:

The cultivated area in the KSA rose from 150 thousand hectares in 1975 to 1.6 million hectares in 1995 as a result of the continuous support and encouragement provided by the government to the private sector to invest in the agriculture sector and to adopt cutting edge technology in agricultural fields. The KSA succeeded in achieving self-sufficiency and also exported many agricultural products such as wheat, dates, eggs and fresh milk. On other agriculture products, the KSA attained a high percentage of self-efficiency the KSA improved substantially and the annual food consumed by the individual rose to 683 kg with a daily input of 3528 calories, conforming to on individual's consumption in advanced countries. The agricultural sector, through the application of the said policies, was enabled to achieve a rapid growth rate that exceeded all expectations. The annual growth rate between the years 1969 and 1993 (with reference to prices in 1984) rose to 8.7 percent as a result of the increase in the total value of the local production of the agricultural sector being raised from SR 4,312 billion in 1969 to SR 23,62 billion in 1993. Moreover, the contribution of the agricultural sector as the total value of local production of the non-petroleum sectors rose from 4.4 percent to 9.4 percent in the same period. The benefits of this agricultural development in the KSA, other than the above mentioned, are observed in the social and economic aspects that resulted in the stability of the nomadic inhabitants, the development of the rural areas, and the healthcare and education in these places respectively (Ministry of Agricultural and Water, 1994). In the current stage, the KSA is directing its agricultural policy to concentrate on the diversification of agricultural production, investments in food and industrialization, manufacturing agricultural equipment and machinery that suit the environments and climatic conditions of the KSA, and manufacturing the inputs of this agricultural production such as fertilizers and improved seeds.

The main agricultural products in the KSA and their self-sufficiency rates up to 1999 are as follows:

Cereal: The total area used for cereal production was the largest among all other crop areas, this represented 67 percent of the total area 1994, and reached 1.1 million hectares with a production of 4.7 million tons in the same year. Wheat production accounts for the majority of cereal production. The quantity of wheat produced in the year 1999 was estimated at 2.45 million tons which surpassed the self-sufficiency level and maintained a strategic stock pile that supported the food security of citizens and residents of the KSA. Barley production came second to wheat in terms of the quantities produced, with a quantity of 2 million tons. The production of sorghum amounted to 207 thousand tons.

Vegetables: The total area used for vegetable production in the year 1995 was 160 thousand hectares with a production of about 2.7 million tons of fresh vegetables. The vegetables produced were tomatoes with a production of 489 thousand tons; water melon, with a production of 450 thousand tons, potatoes (406 thousand tons); cucumber (142 thousand tons); and melon (133 thousand tons). A considerable rate of self-sufficiency was achieved in 1999[14].

Currently, there is a concentration on developing the practice of using greenhouses in order to save large quantities of water and to work to eliminate the phenomenon of the seasonal production of vegetable.

Fruits: The area used for fruit tree plantations in 1999 totalled 130 thousands hectares with a production estimated at 1 million tons, achieving 66 percent rate of self-sufficiency of fruit in the KSA.

Dates ranked at the top of the list in the production of fruit with 14 million palm trees in the KSA producing more than 589 thousand tons of dates annually. Other quantities of fruit production totalled 463 thousand tons. It is worth mentioning that the irrigation of fruit trees, which represent the source of most of the fruit

[14] For more information see Ministry of Agricultural and Water, Agriculture Statistical Year Book, 1999.

production in the KSA, was traditional and consumed a great deal of water. This matter persuaded companies and the modern specialists in agricultural fields to use the drip irrigation system; this has substantially assisted in minimizing the water requirements of fruit tree.

Forage: The private sector, being aware of the importance of green forage for domestic animals such as camels, cattle, sheep and goats established plantations of forage by using central irrigation processes. The area used for forage plantation amounted 305 thousand hectares in 1999 with a production estimated at 3 million tons (Ministry of Agricultural and Water, 1999).

Meat: The KSA's red meat production is estimated to reach 481 thousands tons annually, equivalent to 26 percent of the rate of self-sufficiency in meat in the year 1995, however, it should be considered that the KSA requires approximately 2 million head of sheep annually to be slaughtered during the Hajj period in Makkah. In broilers, the rate of self sufficiency was 38 percent in the same year and production is estimated to reach 272 thousand tons with the expectation of an increase, subject to large projects under construction and a large potential for investment in poultry due to the availability of the working capital. In the fisheries, the production reached 54 thousand tons in 1999. This was generated from the coastlines of the Red Sea and the Gulf with 3.5 thousand tons being produced from local fish farms.

Eggs: The KSA achieved self-sufficiency in the production of eggs several years ago, in spite of the increasing numbers of inhabitants, and managed to export to some neighbouring countries. The local production of eggs was estimated to reach 2500 million in 1999. The KSA succeeded in the origination of all aspects pertaining to poultry production due to the production of layers which reaching 378 million broiler chicks and 10 million-egg in1999 (Ministry of Agricultural and Water, 1999).

Milk and Dairy products: The production of milk amounted to 600 thousand ton in 1999 in the KSA, 411 thousand of which was produced by specialized commercial agricultural firms that present milk to markets in the forms of fresh and pasteurized milk, yogurt, long-term milk, buttermilk and others. The KSA achieved self-sufficiency in milk production several years ago.

2.7 Planned Economic Development of other sectors:

The potential demand for products is directly related to the level of economic development, which also affects the quantity and quality of demand on goods. The KSA has embarked on a massive development programme with the long term goals of diversifying the economy by:

1. Continuing balanced economic growth by developing the country's resources;
2. Reducing dependence on the production of crude oil as the primary source of national income;
3. Developing human resources through education and training and the rise in health standards;
4. Completing the basic infrastructure which is required for the attainment of

these goals.

These long term goals will be achieved while, at the same time, the religious values of Islam will be maintained by fostering and propagating the Sharia (Islamic law). During the past three decades, six development plans have been implemented, enveloped within a comprehensive strategic framework the goals of which are reflected in the set of long-term general objectives of development that have been adopted by the government at the early stages of development planning in 1970. These objectives encompassed: improving the standard of living and the quality of life; diversifying the economic base and reducing dependence on the production and export of crude oil as the main source of income; developing other non-oil exports; maintaining socio-economic stability; developing human resources; supporting the role of the private sector in the national economy; achieving balanced development; and completing the development of infrastructure. We now discuss some indicators that reveal the extent of the progress made by the KSA in accomplishing these development objectives.

2.7.1 Improving the Standard of Living and the Quality of Life:

The per capita income or per capita GDP of Saudi citizens has increased from SR 3750 in 1969 to SR 24.3 thousand in 1999. Life expectancy at birth in 1998 averaged 71.4 years compared to 54 years in 1969, reflecting improvements in the standard of living and easy access to high quality health services. Private consumption of goods and services at constant prices of 1994 has risen at an average annual rate of 7.68 percent during the period 1969 to 1999 (SAMA, 1999). The number of physicians in the KSA has risen from 1172 in 1969 to 31502 in 1999, while the number of hospital beds has increased from 9039 to 45729 during the same period. Soft loans provided by the Real Estate Development Fund (REDF), with a total value of SR 124 billion since the establishment of the fund in 1974 up to 1999 has made high quality housing available to about 573,000 Saudi families. Total payments made by the social security system amounted to more than SR.3 billion in 1999 compared with SR. 39.4 million in 1969, while payments made to people in need of temporary assistance reached about SR 399 million in the same year. These social systems, together with government subsidies for the production of foodstuffs, have provided protection for affected groups during periods of rapid socio-economic transition[15]. Clearly the changes in the trends of major macroeconomic variables affected the pattern of import demand in K.S.A.

<u>2.7.2 Diversifying the Economic Base:</u>

The average annual growth rate of real GDP over the past six plans (1969-1999) reached 3.2 percent at constant prices of 1989. The percentage contribution of non-oil sectors in real GDP increased from about 42 percent by the end of 1969 to about 62 percent by the end of the sixth plan. The Non-oil GDP increased more than five-fold during the said period that is, by an average annual growth rate of 5.6 percent, (SAMA, 1999).

---

[15] For more information see Achievements of the Development Plans, 2000, Ministry of Planning, Saudi Arabia, Riyadh.

The average annual growth rate of the value added of manufacturing industries reached 8 percent over the past thirty years. The volume of agricultural production increased about six-fold in terms of value added from the beginning of the first plan to the end of the sixth plan, a development which confirms the KSA's serious endeavour to reach an appropriate level of domestic production of foodstuffs.

2.7.3 Development of Human Resources:

The KSA's successive development plans have given greater attention to the development of human resources through the continuous support of primary, intermediate, secondary and higher education, as well as technical education, vocational training and pre-service and in-service training. The result has been a significant increase in the employment of Saudis and a steady upgrading of skill levels and occupational achievements in the national labour force. The following indicators reflect the major achievements in the field of human resources development: Eight universities, 35 girls' colleges, 12 technological colleges, as well as 68 technical institutes and vocational training centres, have been established. The total number of schools at all stages increased from 3283 in 1970 to about 22770 in 1999. Furthermore, the enrolments in all educational institutions increased from 547000 in 1969 to about 4.8 million in 1999, that is, at an average annual growth rate of 7.4 percent.

2.7.4 Consolidating the Role of the Private Sector:

The private sector's production increased by an average annual real growth rate of 5.8 percent during the period 1969 to 1999, surpassing the average annual growth rate of real GDP which reached 3.2 percent during the same period. The private sector's contribution to total GDP and to non-oil GDP, measured at constant prices of 1989, amounted to 36.2 and 58.9 percent respectively in 1999. Annual private investments rose from SR. 1 billion in 1970 to about SR. 64.2 billion in 1999, thus bringing the contribution of the private sector total fixed capital formation to 64.6 percent at current prices (Ministry of Planning, 1970-2000).

2.7.5 Development of Infrastructure:

The lengths of the paved road network increased from 8000 km in 1969 to about 45500 km in 1999. The KSA enjoys a high standard of road networks, connecting all cities and most of the villages. This road network provides a sound base for the balanced growth of economic activities in all regions of the KSA. The KSA has now 25 modern airports, including three international airports, capable of accommodating the most advanced types of aircraft. These airports ensure swift connection between all main cities. Electricity generating capacity increased from 344 MW in 1969 to 20647 MW in 1999, at an average annual growth rate of 15 percent. The capacity of the desalination plants capacity increased from 21.500 cubic metres per day in 1969 to about 2.4 million cubic metres per day in 1999, at an average annual growth rate of over 17 percent (Ministry of Planning, 2000).

2.8 Conclusion:

In this chapter, we discuss the performance of the Saudi economy between 1970 and 2000; the Saudi economy experienced economic development in two different stages. In the first stage (1970-1985), which represented the oil-boom years, all the major economic indicators, such as the components of non-oil GDP and total gross domestic expenditure, experienced remarkable growth. In the second stage these indicators resisted low growth rate, due to the registered decreases in government expenditure resulting from a decline in oil revenue and the completion of major development projects. Finally, in this chapter the economic and agricultural developments during the six Saudi development plans (1970-2000) have been highlight, shedding some light on the major import trend between 1970 and 2000 in Saudi Arabia.

Chapter Three: Literature Review

Modeling Import Demand

3.0 Introduction:

This chapter reviews several selective empirical studies, which explain theoretically and empirically the behaviour of the import demand in different countries. It is hoped that this analysis will be helpful in constructing an appropriate empirical model of the demand for meat in Saudi Arabia.

Since there are very few empirical studies on import demand for meat, and none specifically on Saudi Arabia, the literature on international areas and agricultural goods will be reviewed here. This chapter is divided into three main sections. The first section reviews the demand models for developed and developing countries while the second section describes demand modeling for Saudi Arabia and Arab Countries. The third section reviews the Almost Ideal Demand System (AIDS) for meat for different countries.

3.1 Import Demand Modeling:

Since 1960s the import demand function in developed countries has been subjected to extensive theoretical and empirical research in an attempt to formalize the relationship between import and factors that can affect import. This section presents a review of the literature on the import demand in developed and developing countries. Most previous empirical studies of import demand functions have focused on developed economies (Houthakker and Magee, 1969; Capie, 1974; Khan, 1975; Akhtar, 1981; Arize, 1987; Timothy et al, 1991; Babalola, 1995; Park, 1996; Sawyer and Sprinkle, 1996; Sinha, 1997).In addition to the studies mentioned above, there are also some studies which are related to Saudi Arabia and Arab countries: (Al-Jwaili et al.,1983; Osman, 1987; Al- Mallah and Al-Gazaz, 1987;Al-Ghamdi, 1990; Abo Mouti, 1993;) .

Many models have been proposed as alternatives for estimating demand equations using consumer theory. Deaton and Muellbauer (1980) introduced a new system of demand equations, which they call the Almost Ideal Demand System (AIDS) (see, e.g: Eales and Unnevehr, 1988; Hayes et al, 1990; Sung, 1996; Karagiannis and Velentzas, 1997; Ghatak, 1998; Abigail and Richard, 1999; Awudu et al 1999; Mustapha et al, 1999; Karagiannis and Velentzas, 2000; Akbay and Ismet, 2001; Maradoi et al 2002).

3.2 The Demand Models for Developed and Developing Countries:

Houthakker and Magee (1969) attempted to estimate prices and income demand elasticities both for imports and exports mostly for developed countries. The ordinary least-squares method is used in this research with an annual observation. The following import equation is used:

$$\log M_{it} = \alpha_{0i} + \alpha_{1i} \log Y_{it} + \alpha_{2i} \log(PM_{it} / WPI_{it}) + U_t \qquad (3.2.1)$$

where M_{it} is the i^{th} country's imports during t in fixed price. Y_{it} is an index of the country's GNP; PM_{it} is a price index of imports into the i^{th} country; *WIP* is the country's wholesale price index and U_{it} is an error term. The terms α_{1i} *and* α_{2i} are the elasticities with respect to income and prices respectively. The results of estimation suggest that income elasticities have appropriate magnitudes and proper signs, but the inferences with respect to prices are ambiguous, with many insignificant estimates and a few incorrect signs.

An investigation into the demand for meat in England and Wales was carried out by Capie (1974). The aim of the demand analysis was to estimate parameters, such as own-price elasticities, using multiple regression analysis on time series data for the period 1920-1938. The demand for a perishable agricultural commodity is different from that of an industrial product, the direction of causation being reversed, with the current price being influenced by the clearing of the market.

The equation for testing was:

$$Px_t = \alpha_1 + \beta_1 Qx_t + \beta_2 Zx_t + \beta_3 Y_t \qquad (3.2.2)$$

where Px_t is the price of meat in the current period; Qx_t is the quantity of meat x in the current period; Zx_t is the quantity of meat z in the current period and Y_t is income in the current period. The conclusions of his analysis showed that, in general, price elasticities for imported meat were higher than those for home produced meats, a result which lends support to the argument that imports were of a lower quality than the domestic item. It further suggests that a price raising policy would not have derived great benefit from a supply restriction of such a product.

Khan (1975a) provided estimates of import and export demand functions for 15 countries selected from among those characterised as "developing." He assumed that the import functions for two cases (equilibrium and disequilibrium) are a function of real income and relative prices for equilibrium and, in addition, as a function of lagged imports in the case of disequilibrium. He illustrated these relationships mathematically by a double-log form. In the log-linear form:

$$\log M_{it} = a_0 + a_1 \log\left(\frac{PM_i}{PD_i}\right)_t + a_2 \log Y_{it} + U_t \qquad (3.2.3)$$

where M_i is the import quantity of a country$_i$, PM_i is the unit value of imports of a country$_i$, PD_i is the domestic price level of a country $_i$, Y_i is the real gross national product of a country $_i$, e_t is an error term, and superscript d refers to demand.

The log-linear form (in a partial adjustment model) is:

$$\log M_{it} = \gamma a_0 + \gamma a_1 \log(\frac{PM_t}{PD_t})_t + \gamma a_2 \log Y_{it} + (1-\gamma)\log M_{it-1} + \gamma U_t \qquad (3.2.4)$$

where γ is the coefficient of adjustment, and $\gamma\, a_1$ *and* $\gamma\, a_2$ are the price and income elasticities, respectively. He argued that if either of these assumptions, i.e., the quality of actual and desired imports and the infinite supply price elasticity, is not satisfied, an estimation of the coefficients would be biased and inconsistent. Accordingly, he adopts the disequilibrium approach to clarify behaviour out of equilibrium because of the relaxation of either of these assumptions and the presence of any quantitative constraints. The results of the estimation reveal that relative prices influence trade flows in developing countries. In the case of imports, he specified that "with the exception of Colombia and Pakistan, where the estimated price elasticity is fairly small, all estimated price elasticities that are significantly different from zero are greater than unity. This does not confirm the commonly expressed view that developing countries have a price-inelastic demand for import goods.

Akhtar (1981) provides estimates of demand functions for non-oil commodity imports of Canada, France, Germany, Japan, the United Kingdom and the United States. The empirical analysis used quarterly time series data and covered the period 1967-78 for the United States, 1968-78 for Japan and the United Kingdom, 1969-78 for Canada, and 1971-78 for France and Germany. The choice of the time period reflects the availability of consistent time series data for the main variables.

All estimating equations are based on the following general import demand function:

$$Z = f\,[Y, (P_z / P_w), (I_p / IP_x)] \tag{3.2.5}$$

where Z is non-oil import volume; Y is real Gross National Product (GNP); P_z is non-oil import price (unit value); P_w is wholesale price; I_p is industrial production; and IP_x is trend industrial production based on the average historical growth. The result shows that the long-run income elasticity estimates range from around 1.5 for Canada and Japan to above 2.5 for the United Kingdom and the United States. The estimated long-run price elasticities are between -0.5 and -0.7 for Canada, Japan and Germany but considerably larger (in absolute values) for the United Kingdom and the United States. The adjustment lags seem rather short for Canada, France and Germany but quite long elsewhere.

A study on the elasticities and structural stability of import demand function for Nigeria was carried out by Arize (1987). The period of study was between 1960 and 1977 and empirical results showed that the instability was largely due to instability in the coefficients of the intercept as well as the real income. The import demand equation is as follows:

$$M_t = f\,(Y_t\,, P_{mt}\,, P_{dt}\,) \tag{3.2.6}$$

where M_t is import demand in real terms; Y_t is real income; P_{mt} is price of imported goods and P_{dt} is the domestic price level t. The homogeneity assumption associated with the price ratio variable in the models was found to be appropriate for the Nigerian data. The signs, magnitude and significance of the relevant elasticities were as expected (positive: greater than one and statistically significant for the income variable and negative: less than one and statistically insignificant). The adjustment between the desired import demand and actual import demand is not instantaneous; instead 52 percent of this gap is eliminated yearly.

Timothy et al (1991) undertook a comparison of the demand for imports and exports in Japan and the United States. This study attempted to explain Japan's trade flows using recent data and standard economic models, and compared the estimates of U.S. and Japanese trade elasticities. The model specifications allowed a comparison to be made of the absolute size of the elasticities of income, as well as foreign prices, domestic prices and exchange rates between the two countries.

The demand for imports is expressed in the equation as:

$$Q_m = f\,(Y_d\,, P_{fm}\,, E_{rm}\,, P_d\,) \tag{3.2.7}$$

where Q_m is the quantity imported by the relevant country; Y_d is domestic income; P_{fm} is the weighted average of the foreign wholesale price indexes, with weights based on total imports; E_{rm} is the weighted average exchange rate defined as foreign currency per unit of domestic currency with weights based on total imports; and P_d is the domestic wholesale price index of the importing country. The results showed that both Japanese and U.S. trade confirm previous research conclusions that the two countries have noticeably dissimilar income and price elasticities. In addition, there are pronounced differences in the speed of adjustment of trade-flows to changes in their determinants in the two countries. Accordingly, because the two countries differ substantially in the magnitude and timing of changes in trade-flows caused by changes in income and relative prices, this is potentially a source of friction in bilateral trade relations. While Japan's trade elasticity estimates are quite different from those of the United States, they are similar to those of several other industrialized countries; also, the results are consistent with the hypothesis that if Japan is under-importing this may be due to competitive problems in product distribution and/or differences in consumer preferences. The results, however, do not indicate that Japan overall is a closed market.

In a study on Nigeria, Babalola (1995) examines the price and income elasticities of import demand. Both aggregative and disaggregate import demand functions are specified and estimated for the Nigerian economy.

The demand for imports is expressed in the equation as:

$$LOG\ MI_t = \beta_0 + \beta_1 \log RGDP_t + \beta_2 \log\left(\frac{PM}{PD}\right) + \beta_3 \log FXR_{t-1} + \beta_4 \log M_{t-1} + U_t \quad (3.2.8)$$

The single equation form specifies import demand (Md) as a function of real income ($RGDP_t$); relative price of imported to domestic goods ($\frac{PM}{PD}$); foreign exchange reserve lagged one period (FXR_{t-1}); and real imports lagged one period(M_{t-1}). The specified equation was estimated using ordinary least squares. The result reveals that price and income are significant determinants of import demand, though the response of import demand to these variables is inelastic. Furthermore, capital goods imports are more responsive to price changes than consumer goods imports.

In an analysis of food commodities, Park (1996) used the Nationwide Food Consumption Survey for twelve food commodity groups during the period 1987-88 according to household poverty status. Parameter estimates were used to obtain subsistence expenditures, own-price elasticities, expenditure elasticities, and income elasticities. Own-price elasticities were similar between the income groups for most commodities. However, income elasticities were consistently higher for the lower-income group. The use of average estimates of price and income elasticities for the population as a whole for the projection of individual commodity demands is not likely to be successful if notable changes are evident in income distribution. The results indicate that if the emphasis of policy analysis is centred on the poverty status of households then analysts should employ demand parameter estimates using observations indigenous to this income group, and not average estimates for the population as a whole. This analysis could be enhanced through a further partitioning of income groups, the use of adult equivalency scales in lieu of household size, or the use of particular socio-demographic varieties.

Sawyer and Sprinkle (1997) examined the demand for imports and exports in Japan. More specifically, the survey reviewed the literature in this area published since 1976. The estimation of the demand for imports usually relates changes in the quantity of imports to changes in income and relative prices. The following equation is used:

$$M = f\ [Y, (P_m / P_d)] \qquad (3.2.9)$$

where Y is usually expressed as real GDP; P_m is an import unit value index; and P_d is the domestic wholesale price index. The results show several things about demand for imports and exports in Japan. The income elasticity of aggregate import demand is approximately 1.9. The price elasticity, based on a price ratio, is approximately -0.64. While this seems to be inelastic, the components P_m, P_d and the exchange rate are -0.69, 0.87, and 0.70, respectively. Thus, Japanese imports are somewhat price inelastic but are far from being totally insensitive to changes in relative prices and/or exchange rates. For exports, the analogous estimates are for income 1.60 and -1.27 for relative prices.

A study by Sinha (1997) on the determinants of import demand in Thailand, estimated the aggregate import demand equation for Thailand using annual data for the period 1953-90. This study looks at a number of interesting issues which are of importance for policy purposes. Given the persistent balance of payments deficit faced by Thailand, it is important to know the sensitivity of aggregate import demand to import price, domestic price and real GDP.

The main forms have been used in the study.

$$\ln M_t = \beta_1 + \beta_2 \ln Pm_t + \beta_3 \ln Pd_t + \beta_4 \ln Y_t + \beta_5 \ln M_{t-1} + \varepsilon_t \qquad (3.2.10)$$

where M_t is import in time t ; Pm_t is import price in time t ; Pd_t is domestic price in time t and Y_t is real gross domestic product in time t . The result shows that in both the short and long run own price elasticity is higher than cross price elasticity. This means that import demand is more sensitive to changes in the price of imported goods than to the price of domestic goods.

3.3 Demand Modeling for Saudi Arabia and Arab Countries:

Reviewing previous studies conducted on demand in Saudi Arabia and Arab countries would be helpful in evaluating analytical style and the most significant results; it would also assist in laying out the analytical and methodological bases for the study.

Al-Jwaili (1983) undertook a study on external trade in both Egypt and the Sudan, covering the economic integration of the two countries. The study aimed to assess the main factors affecting, in order to study the influence of the external trade sector on achieving economic integration between Egypt and Sudan, and assess the income elasticity of demand on gross imports and gross export function. The study concluded that income elasticity of demand for imported products in Egypt was 1.445 and the income elasticity of demand for imported products was 1.025 in the Sudan. This means that demand for imported products in the Sudan was less elastic than in Egypt. The study stressed the importance of coordinating the strategies for external trade in both Egypt and the Sudan in order to achieve the aim for economic integration between these two countries.

Osman (1987) estimated the demand for wheat in Saudi Arabia using six different single equation models: linear, logarithmic, semi-logarithmic, exponential, price exponential and hyperbola. The dependent variable was the per capita consumption of wheat, the independent variables were the price of wheat, the price of rice (rice being a substitute), and the per capita income.

Time series data, from 1965 to 1984, were used in this study.

The standard formulation can be expressed by the following equation:

$$Q_t = f\,(PW_t, PR_t, Y_t) \tag{3.3.1}$$

where Q_t is per capita consumption of wheat; PW_t is price of wheat; PR_t is the price of rice; and Y_t is per capita income. The empirical results were obtained by using the OLS method and showed that the linear model outperformed the other five models in estimating the demand for wheat in the Kingdom. In the linear model, the income and price elasticity of demand for wheat was estimated to be 0.42 and -0.37 respectively. The cross-price elasticity of wheat (with rice) was estimated to be 0.37, therefore enforcing (through the positive sign) the substitutability relationship between them. Using the linear model, the expected total demand for wheat in the Kingdom in 1989 was estimated to be 1.418 million tons or 107.59 kilograms per capita.

Another study by Al-Mallah and Al-Gazaz (1987) used local demand for dates in the KSA, and the demand on exports of this item to the other Gulf Cooperation Council (GCC) States. The study aimed to analyze local demand for dates. The study concluded that the income elasticity of demand (0.56) is relatively low.

Al-Ghamdi (1990) in his work on a dynamic analysis of the demand for fish in the KSA analysed the demand on fresh and frozen fish, determining the most important factors affecting this demand. Time-series data (1971-

1988) were used in this study. This study estimated the demand for fish in the KSA using six different single equation models: linear, logarithmic, semi log-arithmic, hyperbolic and price exponential.

The standard formulation can be expressed by the following equation:

$$Q_t = \beta_1 \; PF_t + \beta_2 \; PC_t \; + \beta_3 \; PR_t + \beta_4 \; PM_t \; + \beta_5 \; I_t + Q_{t-1} + \varepsilon_t \qquad (3.3.2)$$

where Q_t is the consumption of fish; PF_t is price of fish; PC_t is price of chicken; PM_t is price of red meat; (red meat and chicken being substitutes), PR_t is price of rice (rice being complemented), I_t is per capita income; Q_{t-1} is the consumption of fish in the past year and ε_t is a random disturbance. The empirical results, using the OLS method, showed that the semi-logarithmic model outperformed the other five models in the estimation of the demand for fish in the Kingdom. In the semi-logarithmic model, the short and long run price and income elasticities of the demand for fish were estimated to be -1.06, -2.07 and 0.12, 0.23 respectively. The short and long run cross-price elasticities with red meat and rice were estimated to be 0.44, 0.86 and -0.23, -0.45 respectively. The expected total demand for fish in the Kingdom in 1995 was estimated to be 105470 tons or 6.711 kilograms per capita. The deficit in 1995 was estimated to be 37110 ton.

Food expenditure patterns in the KSA were examined by Abo Mouti (1993). The objective of this study was to discover the changes in total and per-capita food consumption of the most important groups of food in the

KSA. Furthermore, the study aimed to examine some factors which have an effect on total expenditure in general, and food expenditure in particular, on income, location and demographic structure. Cross-section data was used for this study to estimate first the expenditure relative functions and then the expenditure elasticities, using the OLS method. The empirical results showed that the expenditure percentage on food ranged from 30-32 percent for a family in the metropolitan areas, and was 34-55 percent for a family in the urban areas between 1980 and 1985. The meat and poultry group was the first group on the food expenditure sheet which accounted for approximately 25 percent followed by the fresh fruits group 13 percent. The highest expenditure elasticity was 0.596 for the fresh fruits group, while the meat and poultry group was 0.574; the lowest expenditure elasticity in 1985 was for the fresh vegetable group. Moreover, the study found that a family in Abha City showed the highest total expenditure in the meat and poultry group while a family in Makkah City expended the lowest total in the same group.

3.4 The Almost Ideal Demand System (AIDS):

Many models have been proposed as alternatives for estimating demand equations using consumer theory. Deaton and Muellbauer (1980) introduced a new system of demand equations, which they call the Almost Ideal Demand System (AIDS), in which the budget shares of the various commodities are linearly related to the logarithm of real total expenditure and the logarithm of relative prices. This system can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters.

Deaton and Muellbauer (1980) developed the AIDS model and applied it using annual post-war British data from 1954 to 1974 inclusive on eight nondurable groups of consumer expenditures: food, clothing, housing services, fuel, drink and tobacco, transport and communication services, other goods, and other services. The model explains a high proportion of the variance of commodity budget shares.

A dynamic AIDS model has been estimated for meat aggregates and for desegregated meat products in US by Eales and Unnevehr, (1988). Two questions were addressed in this study. First, do consumers allocate expenditure among different types of meats by animal origin or by product type? Second, does the desegregation of meat into products in a meat demand model give insight into the causes of structural changes? Two meat demand systems were estimated using the AIDS model to answer these questions.

The results showed that consumers choose from among meat products rather than from meat aggregates, suggesting that the test for structural change in the meat aggregates may be biased.

Hayes (1990) estimated a model of the Japanese meat demand system using the AIDS. They found that there is evidence of net complimentary between chicken and dairy beef and that fish can be treated as separable in the Japanese meat demand system.

In Korea, Sung (1996) estimated beef import demand and the impact of exchange rate changes using AIDS. This study attempted to estimate the import demand for beef by disaggregating demand according to the country of origin in the Korean beef market and to find relationships between prices and exchange rates. It also attempted to analyze the dynamic impact of exchange rate changes on import prices and domestic prices. The results of the study produced two important findings. First, the maximum likelihood ratio test was used to test whether imported beef and Korean domestic beef were homogenous.

The empirical specification of the import share w_i is

$$w_i = \beta_{ij} + \sum_{j=1}^{n} \beta_{ij} \ln P_j + \beta_{ij} \ln(\frac{E}{P}) \qquad (3.4.2)$$

where P_j, is the import price exported from countries j; E is total expenditure on imports; and P the price index, respectively. The results showed that imported beef products in the Korean beef market may not be considered as homogenous. The imported goods may be considered different goods. Therefore, aggregated beef imported from three countries and domestic beef produced in Korea are homogenous, but the quality of beef imported from different countries may not be the same. This study also found different relationship between exchange rates and prices. First, a cointegration test was used to test whether the law of one price with the price transmission equation holds. In the case of US price in the Korean beef market, the result suggests that the law of one price holds in the long run. However, the dynamic effects played a significant but not an overwhelming role in exchange rate relations. The Korean dollar rate has an effect on the US price but not on the Korean domestic price. The Korean domestic price is almost independent of the US price. The Australian dollar and US dollar rates have a significant effect on the Australian import price while the Korean domestic price is affected by the Australian beef price. The NZ dollar and US dollar rates have a significant effect on the New Zealand beef price and the Korean domestic price.

Karagiannis and Velentzas (1997) explained food consumption patterns in Greek during the period from 1950 to 1993.. This paper decomposes observed changes in Greek food budget-shares into two components: the budget (total expenditure), and the habit formation effect. The analysis is based on a dynamic specification of the AIDS model. This framework is applied to post-war Greek consumption pattern, and also used to explain the impact of Greece's accession to the European Union (EU) on food consumption patterns. In this way, an illustration of potential applications of decomposition analysis to consumer demand is provided. The decomposition analysis shows that there was no single factor to explain the evolution of consumption patterns for all food items. This the effects that explain the evolution of consumption patterns vary across food items.

Ghatak (1998) examined aggregate consumption functions for India with the help of a cointegration analysis under structural changes. This study extends cointegration methodology to include the effect of possible structural changes aggregate consumption behaviour in India during 1919-1986. The only cointegrated relation is found to be a dynamic linear regression of lag order two, with 1944 as the year in which structural change began. The estimated short run Marginal Propensity to Consume (MPC) is greater than the long run MPC. The estimates of the MPC are different from previous estimates for the Indian economy based on conventional econometrics.

Abigail and Richard (1999) estimate the food demand elasticities for Great Britain. The results of the estimation of AIDS for United Kingdom food demand using time series data from the National Food Survey (1972 to 1994). The results concur with expectations as aggregate food demand is both price and income inelastic and individual food categories are mostly price and income inelastic the notable exception being meat specifically pork, beef and chicken.

Mustapha et al (1999) examined demand for food in Malaysia. The data used to estimate AIDS model were obtained from a nationwide survey on household expenditures conducted in 1990. The demand for 19 food categories was estimated using the AIDS model for Malaysia. Five out of 16 food categories had positive own price elasticity of demand, contrary to a priori expectation possibly because of the highly aggregated data. Bread, eggs, oils, spices and sugar were found to be price elastic while all food categories had positive income elasticities indicating that they were all normal and necessity goods. Future prospects on food demand in Malaysia were then speculated based on these elasticities and some policy implications were drawn with regards to food security and food safety in this country.

Awudu et al (1999) examined Household Food Demand Analysis in India. The survey was administered by an Indian market research firm from August 1995 to July 1996. Six commodity expenditure share equations were estimated with AIDS. The results indicate that, for commodity groups (milk and milk products; cereals and pulse; edible oils; meat, fish, and eggs; vegetables and fruits; other foods) demand is elastic only for milk and milk products in both rural and urban area of India. The impact of variables such as region, household size, education level of household head, and seasonality, were generally significant. The findings of the study suggest a number of points that are quite relevant for policy makers, planners, and traders. First, all commodity groups are quite responsive to expenditure changes, with milk and milk products and meat, fish, and eggs showing the largest responses. Second, food demand is quite responsive to price changes. Thus, as prices of the commodities increase, expenditure allocated to them is expected to decline.

Karagiannis and Velentzas (2000) applied an error correction to the AIDS for meat in Greek. This paper presents a dynamic specification of the AIDS based on recent developments in cointegration techniques and the error correction model. Based on Greek meat consumption data over the period 1958-1993, it was found that the proposed formulation performs well on both theoretical and statistical grounds, as the theoretical properties of homogeneity and symmetry are supported by the data. Regardless of the time horizon, beef and chicken may be considered luxuries while mutton-lamb and pork are viewed as necessities. In the short run, beef is found to have price elastic demand, pork an almost unitary elasticity, whereas mutton-lamb, chicken and sausage had inelastic demand; in the long run, beef and pork were found to have a demand elasticity greater than one, whereas mutton-lamb, chicken and sausage still had inelastic demand. All meat items are found to be substitutes for each other except chicken for mutton-lamb and pork for chicken.

Martyn (2001) examined an integrated demand system for food in the United Kingdom, reporting on the use of the Error Correction Model (ECM) to estimate an Almost Ideal Demand System. They employed quarterly data over the period 1963 to 2000. In the spirit of cointegration analysis, the demand system is regarded in this study as a set of long-run equilibrium relationships. In the short-run, changes, combined with adjustment cost and sheer force of habit, may cause consumer expenditure patterns to diverge from their long-run equilibrium values, but consumers will adjust their plans to eliminate these deviations over time, and then the demand system may be characterized as cointegrated. In this paper, as a consequence of these considerations, it was decided to estimate a demand system for seven categories of food.

The ith equation in each AIDS takes the usual form:

$$w_{it} = \alpha_i + \sum_{j=1}^{n-1} \gamma_{ij} \log P_j + \beta_i \left(\frac{X}{P}\right) \quad i = 1,2,\ldots..n \tag{3.4.1}$$

where the budget share for each product is denoted w_i. α_i, γ_{ij} and β_i are parameters (i,j=1,2,......,n); n denotes the number of goods in the particular system that is being estimated, X is the logarithm of the expenditure (at current prices) on all goods in the system; and P is the logarithm of the of the price of the ith product (calculated as the ratio of consumer expenditure on that product at current prices to expenditure at constant 1995 prices). All of the compensated, own prices, conditional elasticities are negative, as predicated by the demand theory. They also suggest, quite plausibly, that the demand for each category of food is inelastic with respect to its own price, given the total expenditure on food. The conditional expenditure elasticities vary over a wide range. Some product categories appear to be elastic with respect to total food expenditure: these include categories bread and other cereals, fruit and vegetables, tea, coffee and other foods. Category meat, bacon and fish seems to be inelastic with respect to total food expenditure, whilst

Category sugar and confectionery has an approximately unit conditional expenditure elasticity. Only Category milk, cheese and eggs are characterized by its expenditure elasticity as a conditional inferior good. These conditional expenditure elasticities are consistent with the trend changes in the conditional budget shares for food.

Food consumption patterns in Turkey were studied by Akbay and Ismet (2001). An objective of this study was to estimate household food consumption patterns by using the AIDS. This study uses Household Consumption Expenditure Survey data in 1994. The results showed that all goods have negative own price elasticities and all of these are statistically significant. Even though expenditure elasticities for bread, vegetable and fruit, non-alcoholic beverages, alcoholic beverages and cigarettes were greater than one, income elasticities were positive and less than one for all products. Demographic variables generally have little effect on the food consumption results of the estimated model. However, Likelihood ratio test statistics suggest that demographic variables have an effect on food consumption, even though the restricted AIDS model gave acceptable results which fitted with the data.

Maradoi et al (2002) provided estimates of meat consumption, expenditure and socio-demographic in Indonesia. The data used in this study were taken from the National Socio-Economic Survey during 1990-1993. Household food expenditure and consumption surveys were employed to estimate the demand for meat in Indonesia. The focus was on the Provinces of

Jakarta and West Java where about one-fourth of the Indonesia population reside. The demand for meat Group 1 (dominated by beef) is income inelastic, whereas that for meat Group 2 (dominated by commercial and native chicken) is income elastic. These two groups comprise nearly 95 percent of all meat purchases. The estimated own price elasticity of the beef group is -0.92, while that for the chicken group is -1.09. The cross price elasticities indicate that, all the meat groups are substitute goods. The results suggest that the current focus of the Indonesian government on strengthening the domestic poultry industry is well placed, as the demand for chicken is likely to respond more quickly to income growth than the demand for beef. Further more, consumers seem more likely to adapt their consumption patterns to chicken price changes than they will for beef price changes.

3.5 Conclusion:

This chapter encompassed a large number of empirical studies. It explained many models of import demand for several countries with diverse characteristics. Some of the hypotheses of these models will be helpful in constructing an appropriate empirical model of the import demand for meat in Saudi Arabia.

We reviewed some empirical works on import demand in developed countries. It throws some light on certain important issues associated with the specification of import demand in these countries. Then, import demands in developing countries were selectively examined. Finally, we reviewed some empirical works on AIDS model. The factors which were believed to have an important influence on import demand in these countries are highlighted. Moreover, the derivation of import demand function and elasticities for each study were also examined. Several major differences in the behaviour of import demand in developed and developing countries can be summarized as follows: First, the income elasticities of demand for imports in developed countries show appropriate magnitudes and signs, but the inferences with respect to prices are ambiguous with many insignificant estimates and a few incorrect signs. Second, the income elasticities for import demand in developing countries are significantly positive for some countries but for others the income elasticities are negative and non-significant suggesting that prices do play an important role in the determination of import demand in developing countries. Third, despite the importance of demand parameters, there has been no attempt to estimate a complete elasticity matrix for meat import demand in Saudi Arabia. It is important to identify the structure of the meat imports and the main factors affecting the demand for these commodities.

Chapter Four: The Demand System:

The Linear Expenditure System (LES) and the Almost Ideal Demand System (AIDS).

4.1 Introduction:

The review of basic consumer demand theory reveals that there are two approaches to demand analysis: directly specified demand models and utility based demand models. The utility based demand model overcomes some of the failures of the directly specified demand model in the sense that it is logically derived by postulating that the consumer behaves as if he/she chooses the consumption bundles to maximize a utility function subject to a budget constraint. In other words, the consumer allocation problem can be formulated in a utility maximization framework (for example, see Deaton and Muellbauer (1980); Philips (1983); and Johnson, Hassan and Green (1984).

This type of formulation allows individual demand to be a function of budget constraint, income and prices. The complete demand system, therefore, depends on income and all commodity prices. However, even after the imposition of restrictions implied by consumer theory (adding-up, homogeneity and symmetry), data limitations often preclude the estimation of the complete set of demand equations that correspond to the choice set of the consumer.

This chapter deals with the derivation and specification of demand models. It is divided into two parts. The first part furnishes the basic theory of consumer demand and how it serves as a basis for evaluating various empirical models and discusses the theoretical basis of expenditure allocation models. The second part discusses the derivation of two static demand systems: the Linear Expenditure System (LES) and the Almost Ideal Demand System (AIDS).

4.2 Economic Theory of Consumer Behaviour:

The modern theory of consumer behavior is based on the concept of utility and indifference curves. The assumptions necessary to analyse consumer behavior can be described briefly as follows.

Each consumer has exact and full knowledge of all information relevant to his consumption decisions, i.e., knowledge of the goods and services available and their technical capacities to satisfy his wants, knowledge of market prices and of his money income. In addition each consumer is assumed to be capable of making comparisons between different commodity bundles and hence preference ordering over all consumption bundles. The consumer is also assumed to have limited money income and can purchase goods and services at fixed prices up to the limit of his income. The consumer derives satisfaction or utility from the commodities he consumes and the services he acquires.

The problem that confronts the consumer is attempting to allocate his limited money income among available goods and services so as to maximize his utility (satisfaction). The consumer utility function can be expressed as

$$U = U(q_i ,............, q_n) \qquad (4.2.1)$$

where U is the total utility and $q_i \geq 0 \, (i = 1, 2, ..., n)$ is the quantity of the ith commodity consumed by the individual consumer. The prices of q_i , ..., q_n are respectively P_1, ..., P_n. These prices are assumed fixed and known. Consumer income is denoted as Y. this implies that the consumer budget or income constraint can be expressed as follows:

$$P_i q_i, ..., P_n q_n = Y. \tag{4.2.2}$$

The consumer must decide on how much of each of the commodities to consume in order to maximize his total utility subject to his budget constraint (Theil and Clements, 1987).

The standard utility maximization problem faced by a consumer is stated as:

$$\max u = f(q_1, ..., q_n) \quad subject \;\; to \sum_i P_i \; q_i = Y \tag{4.2.3}$$

where $P_i q_i$ is the price of the ith commodity and Y is denoted as the consumer's total expenditure called "income". Equation (4.2.3) is the linear budget constraint, which indicates that the consumer takes the prices of all goods as given. Moreover, it is clear that Y is the total expenditure on the n goods considered.

This maximization, under plausible conditions of the utility function, yields the system:

$$q^* = M(P,Y), i = 1,.....,n \quad and \; \lambda_* = \lambda \, (P,Y) \tag{4.2.4}$$

where q* is an n-element vector of optimal quantities that describes how the consumer will behave when confronted with alternative sets of processes and particular incomes. This set of equations is known as the Marshallian demand functions; λ is the Lagrangian multiplier interpreted as the marginal utility of income.

The utility function (4.2.2) expresses utility in terms of quantities consumed and is called the direct utility function. However, an Indirect Utility Function (IUF) can be obtained by inserting the demand equations (4.2.4) in (4.2.2), as follows:

$$u=f[M_1(Y,P_1,......,P_n),......,M_n(Y,P_1,.......,P_n)]=v(Y,P) \tag{4.2.5}$$

where v expresses attainable utility as a function of prices and income and u represents the maximum utility at a given set of prices and particular income. However, it may be used to derive a direct utility function. In particular, if (4.2.2) is minimized with respect to prices and income and is subject to the budget constraint, (4.2.2) is obtained (Varian, 1984). Therefore, the direct and indirect utility functions represent the same preference ordering and a duality relationship exists between these two functions. This property is very attractive in empirical research. These attractions will be valid if the indirect utility functions are continuous, not-increasing and quasi-convex in prices, non-decreasing in income, and homogenous to degree of zero in P and Y (Johanson at el, 1984).

The attraction of the Indirect Utility Function (IUF) is that it enables the derivations of demand functions as follows:

$$q_i = -\frac{\partial v / \partial P_i}{\partial v / \partial Y} \qquad i = 1, \ldots\ldots, n \qquad (4.2.6)$$

The two cases of a relationship with the maximum utility function are not the only cases that can define preferences or be used to explain consumer behaviour (Roy, 1942). Preferences can be defined in terms of a cost function (Theil, 1980) where consumer behaviour is described by minimizing cost or expenditure to achieve a given utility level given a set of prices. As in previous cases, optimal quantity is determined using a cost function. The cost function, C = C (U, P), is a function of utility and prices so the new solution will be in terms of these two variables. The optimization problem can be stated as follows:

$$C\ (U, P) = \overset{\min}{q}\ P'.q \qquad (4.2.7)$$

$$\textit{Subject to}\ U(q_i, \ldots\ldots, q_n) = U^0 \qquad (4.2.8)$$

where P.q denotes $\sum P_i\ q_i = C$. If C is the total budget to be allocated, then C is the least expensive way of reaching a given U and at a given P (Varian, 1984). Therefore C (U, P) = Y.

The application of Shephard's Lemma, taking the partial derivative of the cost function with respect to prices, gives Hicksian or compensated demand functions as follows:

$$\frac{\partial C(P,U)}{\partial P_i} = h_i \ (U,P) = q_i \qquad i = 1,........, n \qquad (4.2.9)$$

Hence, with U^0 held constant, q_i (U,P) is the demand function that describes how a consumer's purchases will change when the consumer is provided with additional compensation (positive or negative) sufficient to keep real income and utility constant when any price changes occur. Recovering the utility function from the cost function can be achieved by inverting the cost function C (U, P) = Y, which leads to an Indirect Utility Function (IUF), u = v (Y, P), (Johanson, 1984). Substituting IUF (4.2.5) into Hicksian's demand function (4.2.9) gives q_i in terms of P and Y, i.e.

$$q_i = h_i \ (U,P) = h_i \ [v(Y,P),P] = M_i (Y,P) \qquad (4.2.10)$$

where $M_i(Y, P)$ is the Marshallian demand function. This feature of the cost function, which Deaton (1986) calls the Shephard-Uzawa duality theorem, given convex preferences, allows the recovery of the utility function. In the same manner, using the indirect utility function, Hicksian demands can be obtained by substituting the cost function C (P, U) = Y from (4.2.7) and (4.2.4), i.e.

$$q_i = M_i (Y,P) = M_i [C(P,U),P] = h_i (U,P) \qquad (4.2.11)$$

Therefore, at the minimum income necessary to achieve the desired level of utility, Marshallian and Hicksian demand functions are equal. Moreover, any demand bundle can be expressed as a solution to the utility maximization problem. The identity stated in (4.2.11) has another important feature in demand theory. Differentiating with respect to P_i and using (4.2.9) gives Slutsky's equation (Varian, 1984) as follows:

$$\frac{\partial M_i(Y,P)}{\partial P_i} = \frac{\partial h_i(v(P,Y),P)}{\partial P_i} - \frac{\partial M_i(Y,P)}{\partial Y}.q_i \qquad (4.2.12)$$

Rearranging terms, gives the Slutsky matrix (S_{ij})

$$S_{ij} = \frac{\partial h_i}{\partial P_j} = \frac{\partial M_i}{\partial Y} q_j + \frac{\partial M_i}{\partial P_j} \qquad (4.2.13)$$

The first term on the right-hand side in (4.2.12) is the substitution effect, or the rate at which the consumer substitutes q_i for other commodities when the price of q_i changes and the consumer moves along a given indifference curve. (Slutsky called this the residual variability of the commodity in question.) Furthermore, Houthakker (1960) divided this term into specific and general substitution effects. The specific effect is the effect of a change in P_j accompanied by an income change on q_i while marginal utility of income remains unchanged. The other effect, which he called the general effect, describes the general competition of all commodities resulting from a one dollar increase in the consumer's budget. The direct or own substitution effect of cross price elasticity is always negative. The second term on the right is the income effect, which reflects the way in which changes in P_j affect the demand for q_i through changes in purchasing power.

Income effect is positive for normal goods and negative for inferior goods. In equation (4.2.12) the term on the left represents the total effect of price changes. The cross-substitution effect e_{ij} $(i \neq j)$ is not known in general. In fact, the sign of e_{ij} indicates whether a good is a complement or a substitute of another good. A positive sign, indicates that goods i and j are substitutes while a negative sign indicates that the goods are complements. Overall then, the Marshallian (ordinary) demand curves are not necessarily downward sloping. While e_{ij} is always negative, the term, $\frac{\partial M_i(Y,P)}{\partial Y}$ may be positive and larger in absolute value than e_{ij} in which case $\frac{\partial M_i(Y,P)}{\partial P_i}$ will be positive.

4.3 Properties of the Demand Functions:

A system of demand equations obtained by utility maximization should possess certain properties required by axiomatic preference theory. These properties are adding-up, symmetry, homogeneity and negativity (Phlips, 1983).

4.3.1 Adding-up:

The adding-up restrictions are derived from the budget constraint. The total value of the quantities demanded must satisfy the budget constraint. Consider the normalized budget constraint obtained by dividing each item by total expenditure which yields the budget share, $W_i = \frac{P_i q_i}{Y}$. It is easy to verify that $\sum_i W_i = 1$ is the sum of the budget shares. The adding-up restrictions can be classified into two components. The first component is called the Engle Aggregation condition and can be obtained by differentiating the budget constraint (4.2.3) with respect to the total expenditure. Thus,

$$\sum P_i \frac{\partial q_i}{\partial Y} = \sum \frac{\partial (P_i q_i)}{\partial Y} = 1 \tag{4.3.1}$$

where the last term is called "marginal propensity to consume good i." However, an income elasticity of demand can be defined as:

$$\eta_i = \frac{\partial q_i}{\partial Y} . \frac{Y}{q_i}$$

Equation (4.3.1) can be expressed as:

$$\sum_i W_i \eta_i = 1 \tag{4.3.2}$$

where η_i represents the income elasticity. This equation implies that the sum of the budget share weighted income elasticities is equal to unity. However, the direct result of (4.3.1) is also called "the marginal budget share", β_i, which also amounts to one. In short, equation (4.3.2) can be re-expressed as

$$\eta_i = \frac{\beta_i}{W_i} \tag{4.3.3}$$

The other component of the adding-up condition is called the Cournot Aggregation condition. If the budget constraint is differentiated with respect to the price of the commodity while all other prices remain the same, the Cournot

Aggregation condition can be derived as follows:

$$P_i \frac{\partial q_i}{\partial P_j} + \ldots\ldots + q_j + \ldots\ldots\ldots + P_n \frac{\partial q_n}{\partial P_j} = 0 \qquad (4.3.4)$$

Expressing equation (4.3.4) in terms of elasticities by multiplying the left side by $\frac{q_i}{P_j}$ and both sides by $\frac{P_j}{Y}$, yields the final expression of Cournot Aggregation condition:

$$\sum_{i \neq j} W_i \, e_{ij} = -W_j \qquad j = 1, \ldots\ldots\ldots, n \qquad (4.3.5)$$

while e_{ij} is the cross price elasticity of the *ith* and *jth* commodities. This equation states that under uncompensated price changes, the sum of own and cross price elasticities for the *ith* commodity weighted by the *ith* budget share is equal to the negative of the budget portion of the *jth* commodity (Deaton and Mullbauer, 1980).

<u>4.3.2 Symmetry (Slutsky Symmetry):</u>

Symmetry of the compensated price responses is a consequence of the existence of consistent preferences. Slutsky Symmetry is defined as

$$S_{ij} = \frac{\partial h_i(U,P)}{\partial P_i}.$$

Mathematically, it can be stated that;

$$\frac{\partial h_i}{\partial P_j}=\frac{\partial^2 C}{\partial P_j\,\partial P_i}=\frac{\partial^2 C}{\partial P_i\,\partial P_j}=\frac{\partial h_j}{\partial P_i} \qquad (4.3.6)$$

The restrictions of Symmetry guarantee that a consumer's choice is consistent and indicates that, the effect of a change in the quantity demanded of commodity *i* i, resulting from a change in the price of the *jth* commodity and holding utility constant, is equivalent to the opposite direction of this change keeping utility constant (Varian, 1984).

4.3.3 Homogeneity:

Demand functions are assumed to be homogenous to the degree of zero in all prices and income. This restriction means that the quantity demanded remains unchanged if all prices and income changes by the same proportion. This condition is sometimes referred to as the absence of money illusion. To obtain this restriction in terms of elasticities, Euler's theorem (Varian, 1984) is applied to the demand equation $q_i = q_i(P,Y)$. The homogeneity of the degree of zero results in:

$$\sum_j P_j \frac{\partial q_i}{\partial P_j} + Y\frac{\partial q_i}{\partial Y} = 0 \qquad i = 1,\ldots\ldots\ldots\ldots, n \qquad (4.3.7)$$

In terms of uncompensated price changes, the restriction states that the sum of own and cross price elasticities and the income elasticity of a commodity is zero. Dividing (4.3.7) by q_i results in the elasticity form:

$$\sum_{j=1}^{n} e_{ij} + \eta_i = 0 \qquad i = 1,\ldots\ldots\ldots, n \qquad (4.3.8)$$

4.3.4 Negativity:

The Negativity restriction deals with the matrix of Slutsky's substitution terms, which must be negative and semi-definite. This implies that the matrix's diagonal terms are non-positive.

$$\frac{\partial h_i(U,P)}{\partial P_i}=\frac{\partial^2 C(U,P)}{\partial P_i^2}\leq 0 \qquad (4.3.9)$$

The notion of the negative semi-definite results from the fact that C is a concave function, and since the left hand side of (4.3.9) is unobservable, the properties of symmetry and negativity can be checked from the right hand side of the equation. The restrictions placed on the demand equation are very important in empirical studies. Ignoring these restrictions may result in failure of the empirical results to be consistent with the theory of consumer behaviour (Deaton and Muellbaur, 1980).

4.4. The Linear Expenditure System (LES):

The most well known approach based on a well-defined functional form for the utility functions is The Linear Expenditure System (LES). This approach was developed by Klein and Rubin (1947) and was extended by Geary (1949) and Stone (1954). In this approach, Klein and Rubin imposed the demand restrictions (adding-up, homogeneity and symmetry) on the expenditure equation as:

$$P_i q_i = P_i \gamma_i + \beta_i (Y - \sum_{j=1}^{n} P_j \gamma_j) \qquad (4.4.1)$$

where $P_i q_i$ is expenditure on a good expressed as a linear function of income Y and all prices P_j. This equation says that the expenditure on the ith commodity is equal to a certain basic amount of consumption γ_i (subsistence quantity) valued at current prices plus a certain proportion β_i (marginal to consume) of total expenditure, less total committed subsistence expenditures. The consumer first allocates a certain amount of the total expenditure for this basic level of consumption, then the remainder of his supernumerary income is allocated to the various commodities in proportions presented by β_i's.

From a theoretical aspect, the LES has the advantage of reducing the number of parameters to be estimated, and along with being a useful approach for estimating price elasticities on data with little price variation. To estimate the whole (n X n) array of price elasticities, only the average budget share, n-1 independent expenditure elasticities, and one single price elasticity is needed. The LES was the first approach that was empirically used in demand system estimation with all general restrictions being satisfied. Stone (1954) developed and applied the LES to British data as a first step to obtain more flexible demand systems.

4.5 The Almost Ideal Demand System (AIDS):

Another demand system, introduced by Deaton and Muellbauer (1980), is the Almost Ideal Demand System (AIDS). This approach was based on the consumer's cost function to bridge the gap from household models to aggregate behaviour. This approach uses the dual formulation of the consumer allocation problem to transform the consumer's problem from one of maximizing utility, given prices and income, to that of minimizing the cost of reaching a given level of utility with the same prices and income.

Deaton and Muellbauer present consumer preferences, allowing perfect aggregation over consumers, in the general form of a price independent generalized logarithmic:

$$\log c\,(u,P) = (1-u)\log\{a\,(P)\} + u\log\{b\,(P)\} \tag{4.4.2}$$

where u is a specified utility level, P is price, and a(P) and b(P) are linear homogenous functions. However, in (4.4.2), the representative expenditure level is independent of prices and depends only on the distribution of income. Then specific functional forms for log a(P) and log b(P) are defined as follows:

$$\log a(P) = \alpha_0 + \sum_k \alpha_k \log P_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log P_k \log P_j \tag{4.4.3}$$

$$\log b(P) = \log a(P) + \beta_0 \Pi_k P_k^{B_k} \tag{4.4.4}$$

where Ps are prices of goods included in the system, α, β *and* γ^* are parameters, so that the resulting cost function is a flexible functional form and the system of demand functions derived from it has desirable properties. In this demand system, consumers' preferences are represented by the following cost or expenditure function:

$$\log C(u,p)=\alpha_0+\sum_k \alpha_k \log P_k+\frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log P_k \log P_j+u\beta_0 \prod_k P_k^{\beta_k} \qquad (4.4.5)$$

where α_i, β_i, *and* γ^*_{ij} are parameters, P_i is price, and u is utility level. The demand functions can be derived directly from equation (4.4.5). It is a fundamental property of the cost function (see Deaton and Muellbaur, 1980) that is the price derivatives are the quantities demanded: $\frac{\partial c(u,p)}{\partial p_i}=q_i$ multiplying both sides by $\frac{p_i}{c(u,p)}$ we find $\frac{\partial \log c(u,p)}{\partial \log p_i}=\frac{p_i q_i}{c(u,p)}=w_i$

where w_i is the budget share of good i. Hence, the logarithmic differentiation of (4.4.4) gives the budget share as a function of prices and utility:

$$W_i=\alpha_i \sum_j \gamma_{ij} \log P_j+\beta_i u \beta_0 \prod p_k^{\beta_k} \qquad (4.4.6)$$

$$where \quad \gamma_{ij}=\frac{1}{2}(\gamma^*_{ij}+\gamma^*_{ji}) \qquad (4.4.7)$$

for a utility-maximizing consumer, total expenditure x is equal to $c(u,p)$ and this equality can be inverted to give u as a function of p and x, the indirect utility function. If this is done for (4.4.5), then substitute the result into (4.4.6) it is found that the budget shares as a function of p and x; these are the AIDS demand functions in budget share form:

$$W_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln (\frac{X}{P}) \qquad (4.4.8)$$

where W_i is the budget share of good i, $\alpha_i, \beta_i, and\ \gamma_{ij}$ are parameters, X is total expenditure, and P is a price index defined as:

$$\log P = \alpha_0 + \sum_k \alpha_k \log P_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj} \log P_k \log P_j \qquad (4.4.9)$$

The theoretical restrictions of adding-up, homogeneity and symmetry, implied by demand theory, are satisfied by the following parametric restrictions (on the AIDS model).

(1) Adding-up restrictions

$$\sum_i \alpha_i = 1 \quad , \sum_i \beta_i = 0 \quad , \sum_i \gamma_{ij} = 0 \quad i = 1, \ldots\ldots\ldots, n \qquad (4.4.10)$$

(2) Homogeneity

$$\sum_j \gamma_{ij} = 0 \qquad (4.4.11)$$

(3) Slutsky symmetry

$$\gamma_{ij} = \gamma_{ji} \qquad (4.4.12)$$

These basic demand restrictions, (4.4.10) to (4.4.12), which are expressed in terms of the model's estimated coefficients, may be imposed or tested, provided that equations (4.4.10), (4.4.11) and (4.4.12) hold, the estimated demand functions add up to the total expenditure (4.4.10), are homogenous to a degree of zero in prices and income taken together (4.4.11), and satisfy Slutsky's symmetry (4.4.12) (Deaton and Muellbauer, 1980).

The AIDS is defined by P = log a(P) in equation (4.4.3), this requires that the system should be estimated by non-linear estimation techniques. Deaton and Muellbauer also propose an alternative measurement by some form of price index, P^* and estimate the system of equation (4.4.8) by using linear techniques. The estimated parameters may then be used to calculate a new approximation to P = log a(P) and the process may be iterated. Deaton and Muellbauer have suggested that when prices are highly correlated, as is the case with annual time series data or consumption, it is unnecessary to iterate. A linear approximation of the estimating equation can be found by using Stone's index, (1954).

$$\log \quad P^* = \sum_k \; W_k \log \quad P_k \qquad (4.4.13)$$

where P = ΘP^*., that is, P is assumed to be approximately proportional to P^*. The advantage of the approximation is that the demand system is linear in the structural parameters. Thus equation (4.4.8) can be expressed as:

$$W_i = \alpha_i^* + \sum_j \; \gamma_{ij} \log \; P_j + \beta_i \log \; (\frac{X}{P^*})$$

$$\textit{and} \quad \alpha_i^* = \alpha_i - \beta_i \log \; \Theta \qquad (4.4.14)$$

Deaton and Muellbauer (1980) developed the AIDS model and applied it using annual post-war British data from 1954 to 1974 inclusive on eight nondurable groups of consumer expenditures: food, clothing, housing services, fuel, drink and tobacco, transport and communication services, other goods, and other services. The model explains a high proportion of the variance of commodity budget shares. Since Deaton and Muellbauer (1980), several researchers have used the AIDS model successfully in estimating consumption parameters and in testing the restrictions of demand theory. Ray (1982) applied AIDS to time series and pooled cross-section household budget survey data from India. Ray extended the AIDS model by including family size explicitly. Blanciforti and King (1986) applied this system to U.S. food consumption data while Capps, et al (1985) studied the demand for convenience and non convenience foods in the United States, including demographic variables in the model.

Other extensions to the AIDS model were developed by Blanciforti, Green and King (1986). They developed a dynamic version of the AIDS model by using Pollak and Wales' method (1969) and incorporating demand estimations. They applied this approach to U.S. consumer expenditure patterns over the postwar period.

The homogeneity and symmetry restriction, which Deaton and Muellbauer (1980) rejected, was tested with the more dynamic generalized AIDS model to determine if the exclusion of dynamic elements may have accounted for the result. However, habit formation was persistent and seems to be the source of the autocorrelation found in the residuals of the demand equation. Barewal and Goddard (1985) applied AIDS to estimate demand elasticities for Canada. While Chesher and Rees (1987) applied AIDS to British National Food Survey data, Fulponi (1989) applied the same approach to french expenditure time series data.

The new versions of AIDS and new developments in the extension of AIDS, including the work of Chalfant (1987), were appropriate in the sense that the AIDS model, with all of these advantages, needs to be improved to overcome some of the arising difficulties, especially flexibility and efficiency. Chalfant introduced a globally flexible Almost Ideal Demand System by combining AIDS with the Fourier series approach of Gallant (1987). He used this approach to estimate an aggregate demand system for meat and fish for the U.S. over the period from 1947 to 1978. He found that this fits better than the AIDS model in the sense that the AIDS model is locally flexible. However, the comparison between these approaches will be based on establishing the small-sample distribution of the asymptotically normal statistics, which he used in comparing the fit. On the other hand, Parikh (1986) found that the AIDS model performed better than the differential AIDS model in predicting a bilateral trade share matrix in the analysis of trade between developing countries in Asia, the Pacific and the rest of the world in the period from 1965 to 1980. Data limitations often prevent explicit inclusion of all prices in demand models. Thus, the assumption of weak separability is often used to reduce the number of parameters included in empirical analysis. Most studies in demand for meat, for example, have assumed weak separability of a meat group from other groups and used expenditure on the meat group as the "income" variable (Murray, 1984; Chalfant and Alston, 1986). Eales and Unnevehr (1988), using AIDS, assumed weak separability and tested this assumption among various groups of meat products. They examined whether consumers allocate expenditure among meats by animal origin or by-product type. They found MRS between whole chickens and hamburgers was independent of changes in quantities consumed of either table cuts or processed chicken parts in the disaggregate data. Heien and Wessells (1988) presented the estimates of AIDS, modified to incorporate demographic effects, and used household food consumption data to study demand for food at home, especially dairy products. They found demographic effects to be highly significant. Hayes (1990) used the AIDS model to test three hypotheses in the Japanese meat demand system. The hypotheses of weak separability with LA/AIDS between meat and fish in Japan were not rejected.

4.6: Conclusion:

In this chapter we have introduced the Almost Ideal Demand System (AIDS) originally developed by Deaton and Muellbauer (1980). In an AIDS the budget shares of the various commodities are linearly related to the logarithm of total expenditure and the logarithm of relative prices.

This approach is based on the consumer's cost function approach to bridge the gap from household models to aggregate behaviour. This approach uses the dual formulation of the consumer allocation problem to transform the consumer's problem from one of maximizing utility, given prices and income, to that of minimizing the cost of reaching a given level of utility with the same prices and income.

The AIDS model has become an attractive and popular approach in analyzing and evaluating demand theory of consumer's consumption behaviour in time series data. The flexibility and testable restriction of import demand also provides simplicity and easy elaboration to make the AIDS model appropriate for studying import demand for meat in Saudi Arabia.

Chapter Five: Research Methodology

5.1 Introduction:

This chapter presents resent econometric methodologies (Cointegration techniques) that are employed in this thesis. The methodologies utilised throughout this chapter are based on a time series approach. The concept of Cointegration can be regarded as one of the most important contributions to modeling multivariate time series. The importance of this concept in linear regression is that the frequency (or trend) components of the spectrum of two or more variables offset each other to result in stationary residuals. The underlying idea is that when two series themselves are trended, the difference between them is constant. If it is assumed that the two series are expressing a long run relationship, where the difference is stationary, then in the context of linear regression the residuals will be stationary and estimation with Ordinary Least Squares (OLS) is feasible.

The concept of equilibrium in cointegration, however, should not be confused with the equilibrium implied by economic theory. For the former equilibrium implies, on average, an observed relationship among a set of variables that is maintained over a long period. Therefore, it has none of the theoretical implications of market clearing or full employment or it implies that the system is at state of rest. Further major developments in modeling time series are seen in the statistical inference and in the estimation of cointegrated systems. It has been demonstrated that the classical statistics associated with OLS are invalid when the variables are cointegrated (Charemza and Deadman, 1997). Also the OLS estimators are subject to bias. For this reason other consistent and efficient methods of estimating a cointegrating system has been proposed in the literature of cointegration. This study will present all these developments in time series analysis and their implications on modeling cointegrated variables. An application of these developments to the meat import demand function in Saudi Arabia will also be presented.

The previous chapter provide a general theoretical framework within which consumption data has been analyzed. This chapter refines this general framework and provides specific models suitable for the type of data used in this research. Three issues are involved with the specification for Saudi meat demand: 1) Theoretical background 2) Unit root tests; 3) Cointegration tests.

5.2 Seasonality:

A seasonal pattern is often observed in time series taken at weakly, monthly or quarterly intervals. Seasonal effects can be of a deterministic as well as stochastic nature. If patterns have a regular occurrence from year to year as in the effects of the weather, then these features can be described as permanent and can be modeled as a deterministic seasonal component. On the other hand if patterns are slowly changing then a stochastic component would be appropriate. This is parallel to the argument cited above in the case of incorporating a time trend. Two examples might illustrate these types of seasonal. The first example, is the tendency of unemployment to rise over the summer months, due to there being more job searchers especially teenagers, and to gradually level off by late fall and winter as firms start increasing their production for Christmas. Such behaviour reflects on the unemployment data by showing a sequence of peaks and valleys which is also generally associated with many economic time series (Walter, 1983).

The second example is that when a firm experienced any type of event, e.g., dock strikes... etc., which influenced its production target at a particular time last year, and then this could affect such a target at the same time this year if the reoccurrence of the events, at the same time, is believed to be highly likely. If this is not the case then the effect of the original event is transitory and thus the correlations between observations in the same season is expected to be small if the distance between years is lengthened. This is suggestive, of a stationary model in which seasonal patterns has the tendency to disappear with the increase in the lead time of forecast.

5.3 Deterministic Seasonal Models:

A superimposition of a deterministic seasonal pattern on a stationary process can be made through the inclusion of a set of seasonal dummy variables into the model. The model in this case can be written as:

$$y_t = s_t + u_t \tag{5.1}$$

$$S_t = \sum_{j=1}^{s-1} \gamma j D_{jt} \tag{5.2}$$

Where:

D_{jt} takes the value of 1 if t corresponds to the seasonal period j and 0 otherwise. With seasonal period equal, s, only (s - 1) dummy variables are needed. In other words s is set to be zero (Patterson, 2000), so that $\gamma j, j \neq s$ represents the j^{th} period seasonal effects as compared with the period s. Equation (5.2) describes the seasonal component S_t as a linear combination of seasonal dummy variables.

Alternatively, this component can be described as a linear combination of sine-cosine functions of various frequencies. In this case S_t can be written in the following trigonometric representation:

$$S_t = \sum_{j=1}^{m} [\alpha_j \sin(2\pi j / s) + \beta_j \cos(2\pi j / s)] \qquad (5.3)$$

where:

m= s/2 if s is even

m= (s-1)/2 if s is odd

The advantage of such representation is that it is possible to describe the seasonal pattern with less than s coefficient (Patterson, 2000).

5.4 Changing Seasonal Pattern:

If it is assumed that the γ in (5.2) are random variables then equivalently the deterministic component in equation (5.3) could be assumed to follow a random walk. To add some degree of flexibility, a white noise disturbance w_t is added:

$$S_t = S_{t-s} + w_t \tag{5.4}$$

where:

w_t independent of u_t

Modeling S_t as a random walk allows the seasonal pattern to change slowly over time. Further, if y_t is assumed to be non-stationary then stationarity can be induced through seasonal differencing (Patterson, 2000). Thus,

$$\Delta_s y_t = w_t + u_t - u_{t-s} \tag{5.5}$$

Where:

Δ_s is the seasonal difference operator.

$$\Delta_s = 1 - L^S \tag{5.6}$$

Provided the variance w_t is strictly positive the right hand side of (5.6) is invertible (Harvey, 1990).

5.5 Granger Causality Test:

Granger Causality is an idea developed by Granger (1969) and gained popularity in recent years because of its close proximity to the concept of exogeneity and the apparent ease of handling it in a Vector Auto Regressive (VAR) framework. This idea comes from the simple fact that the past and present may cause the future but the future cannot cause the past or the present. In econometrics, the most widely used operational definition of causality is the Granger definition of causality; it can be formulated in a simplified way as follows:

y is a Granger cause of x (denoted as $y \rightarrow x$), if present x can be predicted with better accuracy by using past values of y rather than by not doing so, other information being identical (Charemza and Deadman 1997).

A formal definition is as given as:

$$D(X_{t-k} \backslash \Omega_t) \neq D(X_{t-k} \backslash \Omega_t - Y_t) \qquad k>0 \qquad (5.7)$$

where D is the conditional distribution. Ω_t is the information set containing all the information available in the universe at time t. and $(\Omega_t - Y_t)$ is all the information in the universe except the unique information contained by Y_t. If the above statement is true, then it is said that Y_t Granger causes X_t with respect to information set Ω_t. If X_t causes Y_t and Y_t causes X_t, then the process (X_t, Y_t) is called a feedback system.

There are four possible outcomes in Granger causality test:

(a) Neither variable Granger-causes the other. In other words, independence is recommended that when the test of x and y coefficients are not statistically significant in both regressions.

(b) Unidirectional causality from x to y: that is, x causes y, but not vice verse.

(c) Unidirectional causality from y to x: that is, y causes x, but not vice verse.

(d) x and y Granger cause each other. This means that there is a feedback effect or bilateral causality between x and y (Miller and Russek, 1990; Gujarati, 1995).

5.6 Cointegration and Error Correction Modeling:

Cointegration is a technique for establishing the long run equilibrium relationship between variables. A variable (nonstationary time series) y_t is said to be integrated of order d if it achieves stationarity after being differenced d times. This is denoted by $y_t \sim I(d)$. Thus a time series integrated of order zero is stationary in levels while for a time series integrated of order 1, the first difference is stationary. Considers two time series y_t and x_t that are both integrated of the same order b where d ≥ b ≥ 0, then the two series are said to be cointegrated of order d and b denoted by y_t, $x_t \sim$ CI (d, b). This constitutes cointegration between the variables is known as the cointegrating vector.

Assume that economic theory suggests a long run relationship or an equilibrium relationship between consumption and income in the following form:

$$C_t = \alpha\, I_t \tag{5.8}$$

where C_t is real consumption and I_t is the real GDP. If the target consumption, say, C_t^* follows an equilibrium path at each instant, then equation (5.8) will be as follows:

$$C_t^* - \alpha\, I_t = 0 \tag{5.9}$$

In brief, one would not anticipate C and I adjust in accordance with this equilibrium at every point in time, and so, even if equation (5.8) correctly specifies an equilibrium relationship, equation (5.9) does not hold at all instant. We then write equation (5.9) to take into account that the condition is out of equilibrium as below.

$$C_t^* - \alpha\, I_t = U_t \tag{5.10}$$

where stochastic variable U_t represents deviation of C_t from its long run path C_t^* (or U_t may be interpreted as a disequilibrium error). This gives error correction mechanism (ECM) that is defined as:

$$ECM = C_t - C_t^* = C_t - \alpha\, I_t = U_t \tag{5.11}$$

when reformulating the equation above, we can have the following equation:

$$C_t = \alpha I_t + U_t \quad (5.12)$$

where $U_t \sim I(0)$.

In the framework of cointegration, U_t in equation (5.12) stands for deviation from the long run equilibrium path. U_t is the difference between, C_t and I_t. The Error Correction Model (ECM) constructs a case of systematic disequilibria adjustment process through which C_t and I_t are prevented from "drifting too far apart". Charemza and Deadman (1997:p.131) point out that cointegrated series imply that there is an adjustment process, which prevents the errors in the long run relationship becoming larger and larger. Engle and Granger (1987) also show that any cointegrated series has an error correction representation. The reverse is also true. This shows an important correspondence, which exists between cointegrated system and Error Correction (EC) processes. For any set of cointegrated series, the relationship between them may be expressed by an EC representation. This is often called the Granger Representation Theorem (GRT).

As a consequence, if C_t and I_t are cointegrated, the following requirements should exist:

1. The two series C_t and I_t should be integrated of the same order.
2. There should exist a linear combination of the two series, which is integrated of order zero, denoted as $U_t = (C_t - \alpha I_t) \sim I(0)$.

5.7 Unit Root Tests: :

The unit root studies have also shown that using classical estimation methods, such as Ordinary Least Squares (OLS), to estimate relationships with unit root variables gives misleading inferences. In the presence of non-stationary variables, there might be what Granger and Newbold (1974) call a spurious regression. A spurious regression typically had a high R-squared, and t-statistic that appear to be significant, but the results are without any economic meaning. Formally, if the means and variances of the unit root variables change over time, all the computed statistics in a regression model, which applies to these means and variances, are also time dependent and fail to converge to their true values as the sample size increases. Therefore, OLS is not consistent and the customary tests of statistical inference do not hold. Before embarking on the cointegration analysis, it is necessary to test the order of integration of all variables used in the estimations whether they are stationary or not.

To examine stationarity or non-stationarity in an applied time series study, some tests should be employed for unit roots. The existence of unit roots is related to non-stationarity. As demonstrated below, a number of alternative tests are available for the presence of unit roots (testing for the order of integration) whether a series is stationary. The integration analysis is based on the following key definition proposed by Engle and Granger (1987):

If a series has a unit root, a widespread and convenient way to remove non-stationarity from a time series is first differencing the levels of the variables. A non-stationary series which by differencing d times transfers to a stationary one, is called integrated of order d and denoted as I (d) where d is number of times that series needs to be differenced to a chive stationary.

The Dickey-Fuller (DF) (1979) and Phillips-Perron (PP) (1988) and Perron (1989) tests are a very common simple procedure for determining the order of integration of a series. Among these tests, (DF) and (PP) tests in particular has received most attention in the applied econometrics literature. In this thesis, attention will be mainly centred on the DF test or Augmented Dickey Fuller (ADF) test and PP test.

5.7.1 The Dickey-Fuller Test:

Dickey-Fuller (1979) proposed three regression equations to test the stationary of a time series variable, and they are:

$$\Delta\chi_t=\gamma\chi_{t-1}+e_t \tag{5.13}$$

$$\Delta\chi_t=\alpha_0+\gamma\chi_{t-1}+e_t \tag{5.14}$$

$$\Delta\chi_t=\alpha_0+\gamma\chi_{t-1}+\alpha_2 t+e_t \tag{5.15}$$

Equations (5.14) and (5.15) are based on the base equation (5.13) with an additional drift term α_0 and time index t added to the equations. Interest is in testing whether $\gamma = 0$, or equivalently $\alpha_1 = 1$. The procedure is to estimate the above regressions using Ordinary Least Squares (OLS) and then test the significance of γ based on the resulting t statistic. However, the test statistic does not have the conventional t distribution because we are regressing an I (0) series on an I (l) series under the null hypothesis. The test statistics for the three regressions above are usually denoted by τ , τ_μ , and τ_t , respectively, and the relevant critical values vary with each statistic and the sample size (Rao,1994).

Dickey-Fuller tests can be extended to test series with higher orders. Consider the following Auto Regressive (AR) process:

The Augmented Dickey-Fuller test is based on the regression

$$\Delta x_t = \alpha_0 + \gamma x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta x_{t-i+1} + \varepsilon_t \tag{5.16}$$

The lag k in equation (5.16) is chosen to ensure white noise in the error terms. The null hypothesis is still that γ is equal to zero, which implies a unit root in the process. This extension of Dickey-Fuller test is called Augmented Dickey-Fuller (ADF) test. If we fail to reject the null hypothesis, i.e. the series contains a unit root and thus is non stationary, and then we apply the same test on the first difference of the series. If the null hypothesis is rejected when testing the first difference of the series, we then conclude that the series is I (1) because it becomes stationary after differencing once. However, if we still fail to reject the null, we then go on to test the second difference of the series. One basic assumption of Dickey-Fuller test is that error terms need to be homosckedastic and independent. This is why the number of lags k in equation (5.16) should be large enough to induce white noise in the error terms.

5.7.2 Phillips and Perron Test:

The Phillips and Perron (1988) test is a more general form of the Dickey-Fuller test in the sense that it has weak assumptions about the distributions of the errors, allowing heterogeneity in the error process. This test is basically the same as the Dickey-Fuller test for unit root but here it allows the error term to be in a more general form. The error term is assumed to have zero mean.

They considered the following two-regression equation:

$$\chi_t = \hat{\mu} + \hat{\alpha}\,\chi_{t-1} + \hat{u}_t \tag{5.17}$$

$$\chi_t = \bar{\mu} + \bar{\beta}(t - \frac{1}{2}T) + \bar{\alpha}\,\chi_{t-1} + \bar{u}_t \tag{5.18}$$

Where T is the number of observations and u_t is the error term without the restriction of serially uncorrelation. Phillips and Perron (PP) derived the limiting distributions of the above regression coefficients. PP tested equation (5.17) and (5.18) against the null hypothesis that the data generating process is the following AR (l) process that contains a unit root:

$$\chi_t = \chi_{t-1} + \mu_t \tag{5.19}$$

Where μ_t is the error term that satisfies E (u_t) =0. There is no requirement for the error term to be serially uncorrelated. This is the main distinction between DF and PP test. The critical values for the PP test are the same as those for DF test.

5.8 The Cointegration Technique:

One of the most troublesome problems stems from a common prediction of economic theory that there should be a stable long-run relationship among certain economic variables. That is, the economic theory often suggests that the path of certain pairs of variables should not diverge, at least in the long run, though they may diverge in the short run due to many factors. If the variables continue to diverge, market forces or other instruments cause them to begin to reconverge. In this vein, cointegration means that one or more linear combinations of these variables are stationary even though individually they are not. If these variables are cointegrated, they cannot move away from each other (Dickey et al, 1994). In other words, if there is a long run relationship between two or more non-stationary variables, the idea is that deviations from this long run path are stationary (Charemza and Deadman, 1997). In contrast, a lack of cointegration suggests that such variables have no link, they can wander arbitrarily far away from each other.

Cointegration analysis is one of the major developments in econometric theories. Introduced by Granger (1981, 1986) and further developed by Engel and Granger (1987), cointegration analysis provides a useful tool to investigate not only the long-run relationship among variables but also their short-run dynamics. The ability to disclose the long-run as well as short-run information is the key feature of cointegration analysis. Cointegration analysis has been applied to many areas of study in economics.

5.8.1 The Engle and Granger Approach:

Engel and Granger (1987) proposed a cointegration test based on a two-step estimation method. First they perform the cointegration regression using OLS after testing the degree of integration in the variables. Second, a test is conducted to examine whether the residuals from the cointegrating regression are stationary or whether the variables follow the error correction representation. For example, when two variables x_t and y_t are used in a model, first test to see that both series are integrated of the same order. Then test to see if the two series are cointegrated by running the cointegration regressions:

$$x_t = b_1 + b_2 y_t + e_{1t} \tag{5.20}$$

$$y_t = c_1 + c_2 x_t + e_{2t} \tag{5.21}$$

Using OLS or other estimation methods, the null hypothesis that the residuals from the above equations are I(d-b) where b>0 is tested against the alternative that they are not I(d-b). For example if x_t ~I(1) and y_t ~ I(1), in order for x_t and y_t to be cointegrated, e_{1t} or e_{2t} should be I(0). The rejection of the null hypothesis implies absence of any long run relation between x and y. Engle and Granger also showed that if y_t and x_t are CI (1, 1), then there exists an Error Correction Model (ECM) of the following form:

$$\Delta y_t = b_0 + b_1 z_{t-1} + \sum b_{2i} \Delta x_{t-i} + \sum b_{3i} \Delta y_{t-i} + e_t \tag{5.22}$$

Where Δ denotes the first order time difference $\Delta y_t = y_t - y_{t-1}$. The term z_{t-1}

represents the extent of the disequilibrium between levels of y_t and x_t in the previous period. The ECM states that changes in y_t depend not only on changes in x_t but also on the extent of the disequilibrium between the levels of y_t and x_t. The appeal of the ECM formulation is that it combines flexibility in dynamic specification with desirable long run properties and captures the dynamics of the system whilst incorporating the equilibrium suggested by economic theory.

The Engel and Granger approach has received a great deal of attention in recent years. One of the advantages of this approach is that the long-run equilibrium relationship can be modelled by a straightforward regression involving the level of the relevant variables. Holden and Thomson (1992) point out that "this approach is attractive for two reasons: first, it reduces the number of coefficients to be estimated and so, minimize the problem of multicollinearity. Second, it can be estimated by OLS".

5.8.2 The Johansen Approach:

The Engle-Granger approach is being largely superseded by an approach developed by Johansen (1988, 1989) and Johansen and Juselius (1990). As noted by Moosa (1994), the Engle-Granger approach makes the implicit assumption that the cointegrating vector is unique. However, there is no guarantee that any single cointegrating vector is the true long run relationship. In fact it is more likely to be a linear combination of independent cointegrating vectors. Secondly the approach yields results that depend on the direction of normalization. Even though we can treat all the variables in the Engle-Grange Framework also as endogenous variables by running regressions with each variable in turn on the left hand side, the results obtained depend on the direction of normalization. Thirdly, in the E-G approach, the distribution of the test statistics in general, is slightly different in any particular application since they are not invariant with respect to the nuisance parameters, which characterize any particular application. Additionally, the presence or absence of drift terms in the non-stationary variables can crucially affect the form of the distribution. Thus the critical values given by Engle and Granger can be taken only as a rough guide. The Johansen approach, on the other hand, yields results that are invariant with respect to the direction of normalization because it makes all the variables endogenous. Furthermore it provides estimates of all the cointegrating vectors that exist within a system of variables and provides test statistics for determining their number. Another advantage of the method is that the likelihood ratio test statistic has an exact known distribution. Given these distributional properties of the Maximum Likelihood (ML) estimator, specification tests can be carried out on the cointegrating vectors. However, the cointegrating vector from the Johansen approach may also face problems of interpretation as discussed below.

The Johansen approach begins by setting up Vector Auto Regressive (VAR) system of the variables of interest. The basis of the system of equations used is summarized by Lilien et al. (1994) as follows: Consider a system consisting of ρ variables. If the variables are integrated of order zero, that is the levels of the variables are stationary, then a VAR can be formulated in terms of levels of the variables. In effect we have ρ cointegrating equations. If the variables are integrated, say of order 1 and there is no cointegration between them, then again standard time series analysis (such as a VAR) can be applied to the first differences of the data. The system is being driven by ρ. Levels of the series do not appear in the VAR. If the variables are integrated of the first order and there happens to be one cointegrating relationship among them, then one error correction term is added involving the levels of all variables on the right hand side of the VAR. If there are r cointegrating relationships, then r error correction terms involving levels of all the variables are added to the right hand side. There is thus a sequence of nested models in this framework. The most restricted model is that with no cointegrating equation and it is a VAR strictly in first differences. Each cointegrating equation adds the parameters associated with the term involving levels of the series which needs to be added to each equation (Johansen (1988). The Johansen method computes the likelihood ratio statistics for each added cointegrating equation. Implementing the Johansen procedure begins by expressing the data generation process of a vector of variables X, as an unrestricted vector auto regression in the levels of the variables:

$$x_t = \Pi_1 x_{t-1} + \Pi_{12} x_{t-2} \ldots\ldots\ldots\ldots + \Pi_{1k} x_{t-k} + \mu + e_t \qquad t=1,\ldots.,k \qquad (5.23)$$

In the above $x_t, x_{t-1},\ldots\ldots, x_{t-k}$ are vectors of current values of ρ variables all of which are I(1) in the model; $\Pi_1,\Pi_2\ldots\ldots\ldots,\Pi_k$ are matrices of coefficients with $\rho \times \rho$ dimensions; μ is an intercept vector; e_t is a vector of random errors. The minimum lag of the system is chosen at which the residuals are white noise.

Adding $x_t, x_{t-1},\ldots\ldots, x_{t-k}$ and $\Pi_1 x_{t-2},\ldots\ldots\ldots,\Pi_{k-1}, x_{t-k}$ to both sides and arrange term the VAR model will be in the following form:

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \ldots\ldots\ldots\ldots + \Gamma_{k-1} \Delta x_{t-k+1} + \Pi x_{t-k} + \mu + e_t \qquad (5.24)$$

Where

$$\Gamma_i = -(I - \Pi_1 - \Pi_2 - \ldots\ldots\ldots + \Pi_i) \qquad i = 1,\ldots.,k \qquad (5.25)$$

and

$$\Pi = -(I - \Pi_1 - \ldots\ldots\ldots - \Pi_K) \qquad i = 1,\ldots.,k_{-1} \qquad (5.26)$$

I is the identity matrix. The rank of the matrix of coefficient, Π gives the number of long-run relationships between the variables of the system. Since the first differenced variables are I (0), the final term on the right hand side must also be I (0). This will occur only if Π=0 (which also means rank (Π) = 0 or if the parameters of Π, the long run impact matrix, are such that Πx_{t-k} is also I (0). This occurs if the level variables are cointegrated, some linear combination of x_t are stationary. But in this is the case, then the matrix Π must not be full rank, that is the rank, r is less than ρ, the number of variables. If Π is of rank r where r $<\rho$, then there exist r cointegrating vectors or stationary long run relationships among the ρ variables in x_t and $p-r$ common stochastic trends. Thus cointegration is equivalent to a reduced rank of Π and the rank of r determines the number of cointegrating vectors. If rank (Π) = p (r = 0), then all of the variables in x_t are stationary in levels, which contradicts the assumption that all variables are I (1). In the case where Π is of rank r where r < p (there is cointegration), then there exist matrices α and β of dimension p x r such that $\Pi=\alpha\ \beta'$ with α and β being of full rank. The columns of matrix β are the r distinct cointegrating vectors, and α is called the adjustment matrix or error correction parameters. It represents the matrix of weights with which each cointegrating vector enters each equation of the VAR system. Johansen has developed a maximum likelihood procedure for estimating α and β as well as the likelihood ratio test for determining the value of r the number of significant cointegrating vectors. If the x_t vector does in fact cointegrate, then by the Granger representation theorem, it is known that α must contain at least one non-zero element (Johansen and Juselius, 1990).

In order to find the value of r we employ test statistics suggested by Johansen (1988, 1989). Johansen suggests two likelihood ratio tests for the number of cointegrating vectors. The first is the trace test, λ_{trace}. The likelihood ratio test statistics λ_{trace} for the null hypothesis at most r cointegrating vectors against a general alternative of more than r vectors is given by

$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$ (Johansen and Juselius, 1990) where $\hat{\lambda}_{r+1},\ldots\ldots\ldots\ldots,\hat{\lambda}_p$ are the $p-r$ smallest squared canonical correlations and T is the number of observations. The second is the maximal eigenvalue test, whose test statistic is denoted by λ_{max} and which gives the likelihood ratio test statistics for the null hypothesis of r cointegrating vector against the alternative of r+1 cointegrating vectors and is given by $\lambda_{max}(r,r+1) = -T\ln(1-\hat{\lambda}_{r+1})$ (Johansen and Juselius, 1990) where T is sample size. This statistic tests that there are r number of cointegrating vectors and against the alternative that r+1 exist. The null and alternative hypotheses are:

$H_0 : r = 0$ $\qquad$ $H_1 : r = 1$

$H_0 : r \le 1$ $\qquad$ $H_1 : r = 2$

$H_0 : r \le 2$ $\qquad$ $H_1 : r = 3$

The trace statistic is computed by the following formula:

$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$, i=r+1,….., n-1 and the hypotheses are:

$H_0 : r = 0$ $\qquad$ $H_1 : r \ge 1$

$H_0 : r \le 1$ $\qquad$ $H_1 : r \ge 2$

$H_0 : r \le 2$ $\qquad$ $H_1 : r \ge 3$

at the beginning of the procedure, test the null hypothesis that are no cointegrating vectors. If it can be rejected, the alternative hypothesis ($r \leq 1 \ldots r \leq n$) is not to be tested sequentially. If r=0 cannot be rejected in the first place, then there is no cointegrating relationship between the variables, and the procedures stops. Thus the Johansen procedure enables testing for the order of integration and to find the values of the r significant cointegrating vectors. The Johansen procedure may yield quite different estimates for the long run elasticities of a model compared to the static regression suggested in the Engle and Granger procedure since among other things the estimates obtained using the E-G method are based on an arbitrary normalization of the variables whereas the Johansen method uses information from the equation from each of the variables in order to obtain the ML estimates of β which are not dependent upon any normalization. Muscatelli and Hurn (1992) write: "As Johansen (1989) demonstrates, the ML method and the static regression method will only yield identical results in the special case where r=1 and where the error correction term only enters the equation for the variables of interest."

Having found the significant cointegrating vectors, may also test restrictions on these vectors by employing the following likelihood ratio test in order to test the null hypothesis that the restriction is valid:

$$T\sum_{i}^{r} = 1[(1-\tilde{\lambda}_i)/(1-\hat{\lambda}_i)] \tag{5.27}$$

Where r is the order of cointegration, and $\hat{\lambda}_i$ and $\tilde{\lambda}_i$ represent the estimated characteristic roots from the restricted and unrestricted model respectively under the null, this test statistic asymptotically follows a $x^2(r \times s)$ distribution where s is the number of restrictions imposed on the cointegrating vector(s). While finding more than one cointegrating vector indicates a more stable system and hence is desirable, it also has some problems (Moosa, 1994). First it leads to the problem of identifying the single long run relation that may be the relationship of interest since multiple cointegrating vectors span a space in which any linear combination may also be a cointegrating vector (Johansen, 1990; Muscatelli and Hurn, 1992). A course of action often suggested is that one should pick the vector that makes economic sense, that is, one in which the estimated coefficients are close to and have the same signs as those predicted by economic theory (Muscatelli and Hurn, 1992; Moosa, 1994). If more than one cointegrating vector is obtained, an arbitrary selection of one statistically significant cointegrating vector, in order to move from the Johansen framework to the estimation of a single structural equation, involves making the implicit assumption that the conditional model which is isolated is valid. This problem is faced in the Johansen approach because although the approach explicitly recognizes the multivariate nature of the estimation problem by relying on the ML principle, it does not partition the variables into endogenous and (weakly) exogenous variables which are central to estimating a single behavioural equation (Muscatelli and Hurn, 1992). Thus Johansen (1992) argues that the real importance of the approach is that it allows the precise formulation of a number of testable hypothesis including tests for linear structural hypothesis on the cointegrating vectors which are structural in the sense that they do not depend on any normalization of the parameter p (Johansen 1992). He suggests that testing should be used as a device to find out whether any specified structural relation can be contained in the space spanned by β. However Muscatelli and Hurn, (1992) point out that the Johansen procedure "only permits one to impose and test the same restrictions across all cointegrating vectors simultaneously" and therefore the fundamental difficulty regarding the identification of separate long run structural equations still remains.

It is worth emphasizing that the statistical properties of the Johansen procedure are generally better than the E-G procedure. However, they are grounded within different econometric methodologies and thus cannot be directly compared. In this regard, the Johansen method can be used for single equation modeling as an auxiliary tool, testing the validity of the endogenous-exogenous variable division. This may also be regarded to a confirmation test of the single equation model. In this sense, Charemza and Deadman (1997) suggest that it might be more appropriate to use a single equation -based cointegration test as an auxiliary tool, testing the validity of the residual-based test results.

Johansen cointegration test has the following advantages over Engle and Granger's:

1. It is able to identity the number of cointegrating vectors.
2. It is not sensitive to the choice of the dependent variable because it treats all variables as endogenous.
3. It allows tests of restrictions on the coefficients.

5.9 Conclusion:

The introduction and development of cointegration analysis have been a bridge between the economic theorists, applied economists and econometricians Integrated and cointegrated model processes are the two main issues in the cointegration analysis. The former deals with the degree of integration of the time series data before a regression analysis is employed whilst the latter is concerned with estimating, testing and modeling long-run economic relationships using time series data.

Cointegration techniques allow us to avoid spurious regression results when we use non-stationary data. These techniques also provide a possibility which can enable us to test the validity of an economic theory. If the long-run economic relationship exists, these mean that the cointegration regression is supposed to capture the existence of the equilibrium relationship. In other words, cointegration test attempts to establish the interrelationship between the long-run movements in economic time series. Contrary to common belief, the concept of cointegration does not advocate that there exists clear-cut solution in constructing and estimating the dynamic time series models in economics.

One important point of the cointegration analysis is that it easily gives a simple framework for testing long-run economic relationship from the actual data. In the literature, cointegration analysis has been used for tasting some economic theories such as permanent income hypothesis, rationality of expectations, market efficiency in different markets and economics growth.

In this chapter, following the unit root tests and Engle- Granger cointegration analysis, the Johansen cointegration procedure is explained and discussed in detail. In this regard, we summarize and simplify the different techniques used in the concept of cointegration analysis of both the Engle-Granger and the Johansen procedures. These procedures will be used to test the determinants of import demand for meat in Saudi Arabia.

Chapter Six: Consumption of Meat in Saudi Arabia

6.1 Introduction:

In this chapter, a brief discussion of the sources of the data used in estimating the Saudi meat consumption model will be provided. The structure of Saudi meat consumption is also presented. The collection, compilation and publication of meat statistics are the combined responsibility of the Ministry of Agriculture and Water, the Ministry of Finance and National Economy and the Ministry of Planning in Saudi Arabia. The data relevant to this study consist of the observations of quantity imported with group of meat of beef, camel, lamb, poultry and fish. The consumption of pork is forbidden to Muslims. The Central Department of Statistics of the Ministry of Planning annually publishes "The Statistical Yearbook". This contains information regarding the quantities of meat imports. The prices of commodities are the monthly average retail prices published by the Saudi Arabian Central Department of Statistics (CDS) in the Ministry of Finance and National Economy. The CDS publishes monthly and annual averages of retail and wholesale prices in the Kingdom of Saudi Arabia for the whole period. Detailed information about retail prices for imported meat has been available only since 1970.The KSA imports only beef (male) or lamb, fresh or frozen. All meat shipments must be accompanied by a certificate that indicates that slaughtering has taken place at an officially licensed slaughterhouse and in accordance with Muslim procedures (a recognized Islamic Centre should legalize such a certificate). This certificate must also accompany shipments of meat into Saudi Arabia.

6.2 Major Factors Affecting Saudi Meat Consumption:

During the last three decades, the demand for meat commodities has increased dramatically in Saudi Arabia. There are several variables that cause per capita consumption of meat commodities to change in the long–run. These include relative prices, income, changes in tastes and preferences, and the introduction of new products, changes in occupation, urbanization, and changes in the age composition of the population. In the short-run, the socioeconomic factors rather than prices, income and population are assumed to be constant. Thus, in the short-run, changes in per capita consumption will be influenced by changes in prices and income while changes in total consumption will be influenced by changes in prices, income and population.

6.3 Saudi Arabian Culture:

Many aspects of consumption are greatly influenced by culture. Knowledge of culture will help the researcher to understand and predict consumer behaviour in Saudi Arabia.

6.3 .1 Definition of Culture:

It is difficult to define culture in simple terms since there is no agreement on one definition and there are many. Definitions of culture, in fact, tend to be generalized, diffuse and subject to various exigencies. A consensus of anthropological belief, however, may be found in Hofstede's (1984, p.21) reporting: "Culture consists of patterned ways of thinking, feeling and reacting, acquired and transmitted mainly by symbols, constituting the distinctive achievements of human groups, including their embodiments in artefacts; the essential core of culture consists of traditional (i.e. historically derived and selected) ideas and especially their attached values". Thus culture composes of language, religion, values and attitudes, law, education, politics, technology and material culture, and social organization.

Finally, an investigation of 'culture' in a Saudi Arabian context is essential to provide relevant background data in order to highlight the main factors which shape and influence Saudi consumer behaviour. However, it will be necessary to focus only on those aspects which are of specific relevance to the cultural context of the KSA. These are presented in the following sections:

6.3.2 Religion: The Islamic Faith:

Islam has shaped the Saudi society and it is the strongest cultural force within the country. Saudi Arabia is, indeed, the birthplace of the Islamic faith and all its people are Muslims. Islam guides Saudi individuals in their daily life, governing their culture (Hartley, 1985).

6.3.3 Islam – Background:

'Islam' is an Arabic word connoting submission, surrender and obedience to Allah (God). Islam is the religion propagated by the Prophet Muhammad in the beginning of the seventh century AD (6O4-632) and his followers are called Muslims. Islam has five pillars of belief and practice; briefly, these are as follows:

(1). The absolute unity of God and the affirmation that Mohammed is his last messenger; (2) praying five times a day; (3) giving to the needy; (4) fasting during the month of Ramadan; (5) pilgrimage to Makkah (Hajj) once in a lifetime for those who can afford (Ministry of Hajj, 1998). However, Islam is much more than a specific set of fundamental tenets. It lays down standards and guidelines for all aspects of human activity e.g. social, economic, personal, political, civil and criminal law. It is not possible to investigate all these aspects in detail; however, the most significant for this subject are those which have most effect on meat consumption in Saudi Arabia. These are as follows:

6.3.4 Ramadan:

Ramadan occurs in the ninth month of the Islamic Hijri (lunar) calendar during which Muslims abstain from food, drink during day time from dawn to sunset. Fasting also makes a Muslim feel the needs of his poor people who do not get sufficient food, clothes or housing and therefore he/she inquires about their conditions and sees to their needs and requirements.

During Ramadan, per capita consumption of meat increases more than for any other months because in this month people in Saudi Arabia give away meat as charity to poor people according to Islamic Law.

6.3.5: Hajj time

Hajj comes about two months after Ramadan on the twelve month of the Islamic year according to the Hijri (lunar) calendar (Zul-hajjah). It is the Festival of Sacrifice and marks the end of Hajj (Ministry of Hajj, 1998). During Hajj time per capita consumption of meat increases more than during any other month because in this month people in Saudi Arabia give away sacrifices of meat to neighbours, friends and poor people according to Islamic Law.

We expected a seasonality pattern during Ramadan and Hajj because the effects of religion, and therefore these features can be described as permanent and can be modelled as a deterministic seasonal component.

6.3.6 Social Structure Background:

There are certain practical and social issues which should be considered to understand the meat consumption in KSA. Generally speaking, Saudi Arabia's social structure is very similar to that of many other Arab countries (Abunabaa, 1981). It can be summarized as follows:

1. The Nomad: Nomads are people who travel with their animals in the desert searching for food and water, and they comprise many tribes. However, over the last decade, and with the full support of the Saudi government, many tribes have been settled in new tribal villages. Today, these tribal villages provide almost all the modern essentials of life e.g. electricity, schools, etc. Thus, the standard of living of the nomads has significantly increased. Camels and goats are the most important items of consumption.
2. Rural Areas: Generally, the rural areas consist of many villages which are of two types: tribal villages (discussed above) and non-tribal villages, usually created in an agricultural area. The centre of rural districts, especially the larger ones, is the souk (marketplace) which may include

many small shops.

3. The Cities: Most of the business and commercial activities are based in the cities. There are three major commercial cities: Riyadh in the centre, Dammam in the east and Jeddah in the west.

The inhabitants of the cities have a stronger purchasing power and more alternative product brands available to them than those in the villages.

Socio-economic changes at the micro-family level will also be significant. The extended family structure is gradually being replaced by smaller, family units. Children are becoming economically independent at a much earlier age. Literacy rates are rising and are especially high for those under the age of 25 years. The Kingdom is also undergoing changes in attitudes, life styles, social values, and education and income levels. As disposable incomes rise, spending on leisure and luxury goods will increase and quality will become increasingly important (SAMA, 1999).

Saudis have large families. Dining at fast food restaurants and shopping at modern supermarkets have become popular and are a major form of entertainment for the Saudi family. Over half of Saudis are in their teens.

The role of Saudi women is undergoing a change. Women are making more purchasing decisions than before. Many have recently entered the workplaces, especially in the areas of education and healthcare. The Saudi consumer is becoming more enlightened as to quality, nutritious value, price and packaging. In store promotions, television and print media, advertising is keenly observed by Saudis. Saudi consumers have become more price-conscious and seek good value for money, but will pay extra for premium quality products. Products from the United States are viewed favourably and are generally considered of premium quality.

6.4 Economic Factors:

The economic factors which contribute to the rising trend in meat consumption are as follows:

6.4.1 Rise in Per Capita Income:

The level of government revenues in the Kingdom has been strongly affected by conditions prevailing in the world oil market during the past years. The buoyant conditions in the world oil market during the development plans resulted in raising the per capita income of the Saudi citizen from SR. 3750 in 1969 to SR. 32106 in 2000 (SAMA, 2000).

6.4.2 Cost of Living:

One of the most important positive developments during the last two decades has been the decline in the cost of living, where the general cost living index for all cities in the Kingdom of Saudi Arabia fell by 1.3 percent, a development which reflected the rapid increase in the supply of goods and services. The decline in the cost of living index included five out of eight main commodity groups, comprising the index number of consumer prices with about 63 percent of relative weight and the commodity groups of foodstuffs, fabrics, apparel and house furnishings, with a combined weight of 51 percent. These witnessed high levels of decline (by 4.0 percent, 2.6 percent and 2.5 percent, respectively) (Ministry of Agricultural and Water, 2000). Since these three groups comprise basic commodities for private consumption, it can be concluded that the decline in the costs of the living index over the last two decades have had a significant positive impact on the real incomes of the broad base of the population.

6.4.3 Increasing Number of Expatriates:

Due to the lack of indigenous labour, the Saudi government called on foreign expatriates to work in the development projects constructed as a result of the increase in oil wealth. Expatriates are primarily from the African, Asian and Far Eastern countries (Egypt, India, Pakistan, Bangladesh, the Philippines, Yemen, Sri Lanka, Indonesia, Sudan etc.). About 40,000 Americans reside in the Kingdom and a smaller number of Europeans. Consequently, the foreign population has increased from 314,000 in 1975 to 3,660,000 in 1998, (SAMA, 1970-1999).

The per capita income for most nationalities, with the exception of Americans and Europeans is substantially less than that of Saudis. Moreover, most expatriates work in Saudi Arabia out of economic necessity. The changing structure of the expatriate population, which constitutes a sizeable portion of the domestic market for food, household goods, consumer products and services, will, in effect, change spending patterns. These spending patterns will be adjusted due to the increased numbers of expatriate families of non-American and non - European nationalities.

6.4.4 Changing Dietary Habits:

Consumption patterns have also changed and the consumption of some food has increased considerably. Even though the Saudi people are careful with their diets, they are ready to eat fast foods. This has led to the expansion of the restaurant industry with a resulting impact on the consumption of meat.

6.4.5 The Kingdom's Population Growth and Urbanization:

Saudi Arabia has experienced a rapid increase in population from six million in 1970 to twenty two million in 2000. Improved medical facilities, reduced infant mortality and a high birth rate were responsible for the high population growth. The natural rate of growth in the 1970-84 periods was estimated to be in the range of 3 to 3.5 percent per annum. Between 1963 and 1980, the rural population declined from about 75 percent of the total population to approximately 45 percent. With increasing population and urbanization, changes can be expected in the demand for meat. The Saudi population is forecast to reach 30 million over the next 20 years. The baby boom of the 1960s, 1970s and 1980s will have a significant and positive effect on overall consumption levels in the Kingdom (SAMA, 1970-1999).

6.4.6 Others:

The number of supermarkets, commercial malls and other self-service outlets is on the rise throughout the Kingdom. It is not just the growth of these supermarkets, but the quality of products and the wide range of services provided that is significant. A supermarket outing is now a major form of family entertainment. Many have large play areas for children. The large malls of commercial centres will continue to offer recreation and convenient shopping for family units. With the increase in the number of retail facilities, advertising will play a more important role in Saudi Arabia.

The structure and pattern of consumption has been changing among the Saudi population. Residents have increasingly adopted technology for storing frozen foodstuffs, thus keeping foods for longer periods of time, yet maintaining their nutritional value.

6.5 Consumption of Meat and Fish in Saudi Arabia:

The domestic demand for meat has increased dramatically since 1970 because of increases in per capita income, changes in consumption patterns, a population growth rate of 3.5 percent, rapid urbanization, increased levels of education, and growth in the number of guest workers.

Per capita consumption of meat, including beef, camel, poultry, lamb and fish are calculated in kilograms (kg) per month. Per capita consumption is calculated by total meat imports less exports, divided by the total population except for religious visitors.

The data for frozen and dried salted meat (price and quantity) are calculated from the Statistical Yearbook issued by the Ministry of Agriculture and Water in Saudi Arabia. Camel meat is the sum of the camel meat imports and camel meat produced. However, there are no data reported for carcass weight. The only data available are the number of camel slaughtered in slaughter houses. Therefore, these numbers are converted to a net meat weight. The estimated weight of a camel carcass is 195 kg. Other imported live animals are converted to net weights using 120 kg, 16.5 kg and 13 kg, for cattle, mutton and goat respectively. Therefore, per capita consumption of other meat is calculated by adding the total consumption of camel, frozen meat and chilled, dried and salted meat divided by the population figures.

Total meat consumption increased from 570.000 tons in 1981 to 854.000 tons in 2000 at a growth rate of 48 percent (see Figure 6.1). Yearly per capita consumption of meat increased from about 32.479 kg in 1981 to 84.45 kg in 2000, at a growth rate of 94 percent (see Figure 6.2).

Per capita consumption of meat, except fish, increased during Ramadan and Hajj time more than in any other month during the year, because in these two months people in Saudi Arabia give away charity in the form of meat to poor people according to Islamic law (see Figure 6.3). This seasonal pattern is a regular occurrence from year to year during Ramadan and Hajj because the effects of religion and, therefore, these features can be described as permanent and can be modelled as a deterministic seasonal component.

The difference between the Gregorian and Hijri calendars is about eleven days each year and it is important to realize that, using the Gregorian calendar, Ramadan and Hajj come at a different time each year. For example Ramadan and Hajj come in months 6 and 8 in 1981, but in 1990, they come in months 4 and 6 respectively

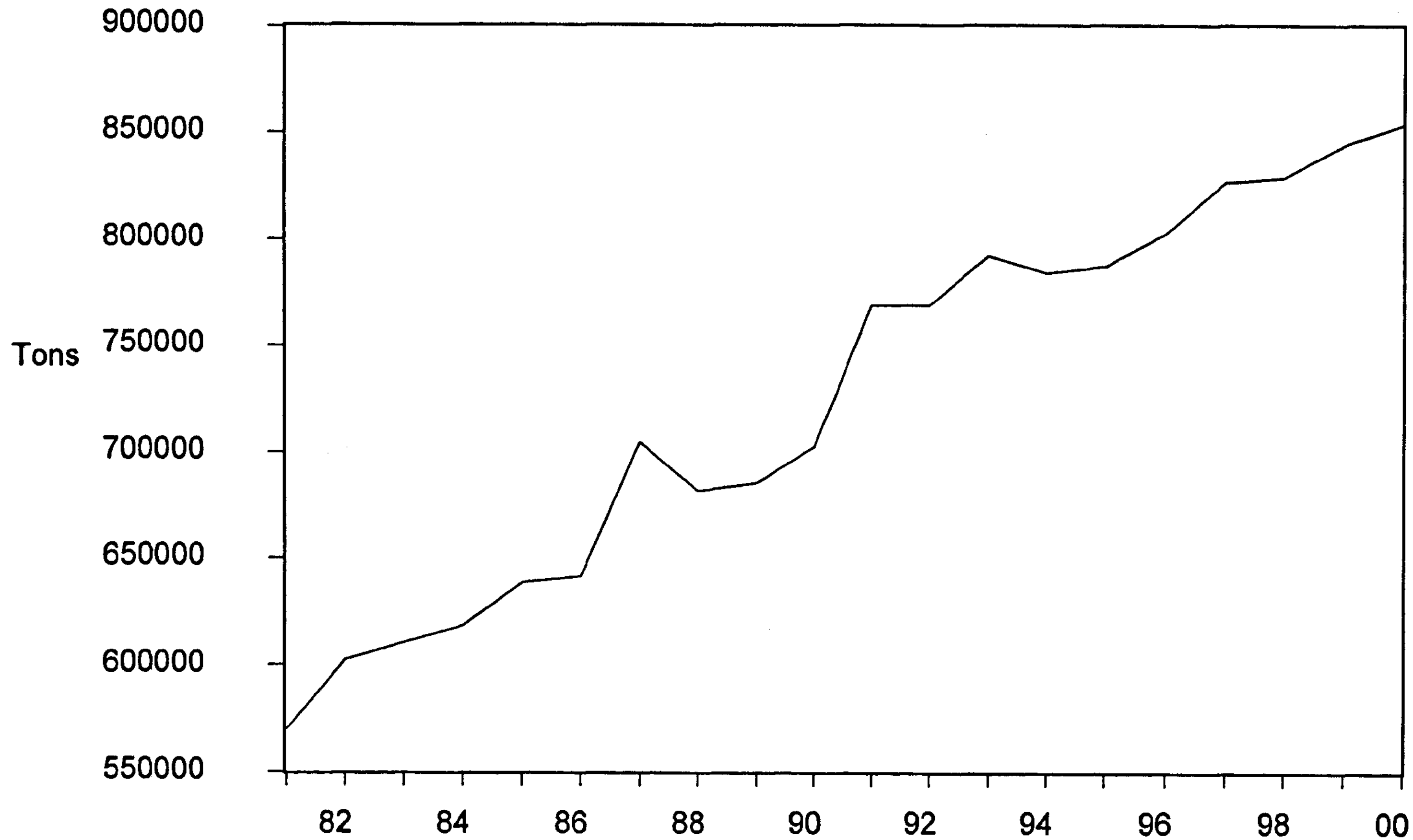


Figure 6.1: Annual Total Meat and Fish Consumption in KSA.

Figure 6.2: Annual Per Capita Consumption of Meat and Fish

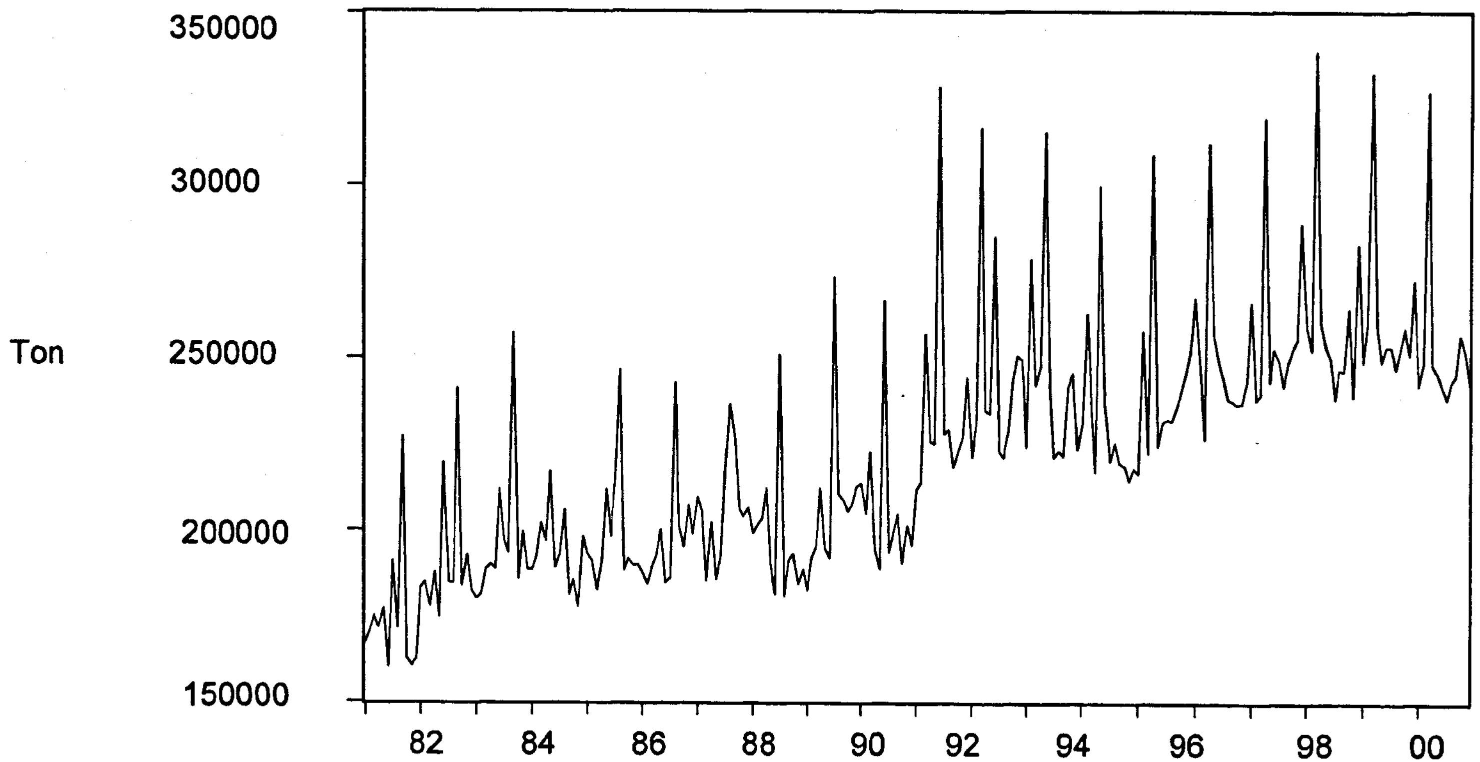


Figure 6.3: Monthly Total Meat and Fish Consumption in KSA.

6.6 Per Capita Consumption of Meat and Fish:

The per capita consumption of meat is presented in Table 6.1. Per capita consumption of lamb increased from 11.48 kg in 1981 to 28.38 kg in 2000 at a growth rate of 8 percent (see Figure 6.4). In 1981, per capita consumption of camel decreased from 8.56 kg to 2.52 kg in 2000 (see Figure 6.5). Per capita consumption of fish increased from about 0.64 kg in 1981 to 13 kg in 2000 at a growth rate of 18 percent (see Figure 6.6). Per capita consumption of beef increased from 1.72 kg in 1981 to 8 kg in 2000, at a growth rate of 5 percent (see Figure 6.7). Per capita consumption of poultry increased from about 10.09 kg in 1981 to 32.54 kg in 2000 at a growth rate of 7 percent (see Figure 6.8).

Detailed data in 1981, on per capita consumption show that per capita consumption of lamb occupied the first position, with a relative share of 36 percent of the total meat consumption. Poultry came next in second position, with a relative share of 31 percent. Camel held the third position with a relative share of 26 percent while beef coming next, with a relative share of 5 percent. Fish has the lowest relative share with 2 percent of the total meat consumption. While in 2000, per capita consumption shows that, per capita consumption of lamb occupied the first position, with a relative share of 37 percent of the total meat consumption. Poultry came next in second position, with a relative share of 35 percent. Fish held the third position with a relative share of 15 percent while beef coming next, with a relative share of 9 percent. Camel has the lowest relative share with 4 percent of the total meat consumption The reason for this situation is that Lamb and Poultry are the traditional meats consumed and the most important staple food for citizens in Saudi Arabia (see Figure 6.9A,B).

Undoubtedly, the profile of per capita consumption of meat growth achieved between 1981 and 2000 was a positive indicator of the continuing demand for meat in Saudi Arabia. This study examines this trend in more detail in order to understand the causal factors involved and to provide policy advice.

Table 6.1: Per Capita Consumption of Meat and Fish in KSA.

(Kg)

Year	Beef	Camel	Poultry	Lamb	Fish	Total Per Capita
1981	1.72	8.56	10.09	11.48	0.64	32.49
1982	1.98	7.71	11.82	12.15	1.05	34.71
1983	2.36	6.78	12.80	12.66	1.10	35.69
1984	2.61	6.73	12.02	14.33	1.47	37.15
1985	2.81	6.38	13.37	14.43	1.64	38.63
1986	3.05	6.54	13.70	14.37	1.84	39.50
1987	3.14	6.31	15.86	15.58	2.84	43.72
1988	3.61	5.97	16.30	16.22	3.08	45.18
1989	3.86	5.70	16.89	17.97	3.23	47.65
1990	4.21	5.33	17.84	17.28	4.90	49.56
1991	4.39	4.34	19.76	19.29	7.87	55.66
1992	4.60	4.04	20.65	19.11	8.10	56.51
1993	5.20	3.61	21.34	19.37	9.62	59.15
1994	5.48	3.03	21.95	20.90	9.55	60.91
1995	5.77	2.86	22.78	23.35	9.53	64.29
1996	6.14	2.80	23.19	22.92	10.97	66.00
1997	6.38	3.01	24.86	24.34	11.02	69.61
1998	6.92	2.87	27.22	25.36	11.41	73.79
1999	7.49	2.81	30.15	26.94	11.89	79.28
2000	7.99	2.52	32.54	28.38	13.02	84.45

Source: Ministry of Agriculture and Water, Department of Economic Studies and Statistics 1970-2000, Saudi Arabia, Riyadh.

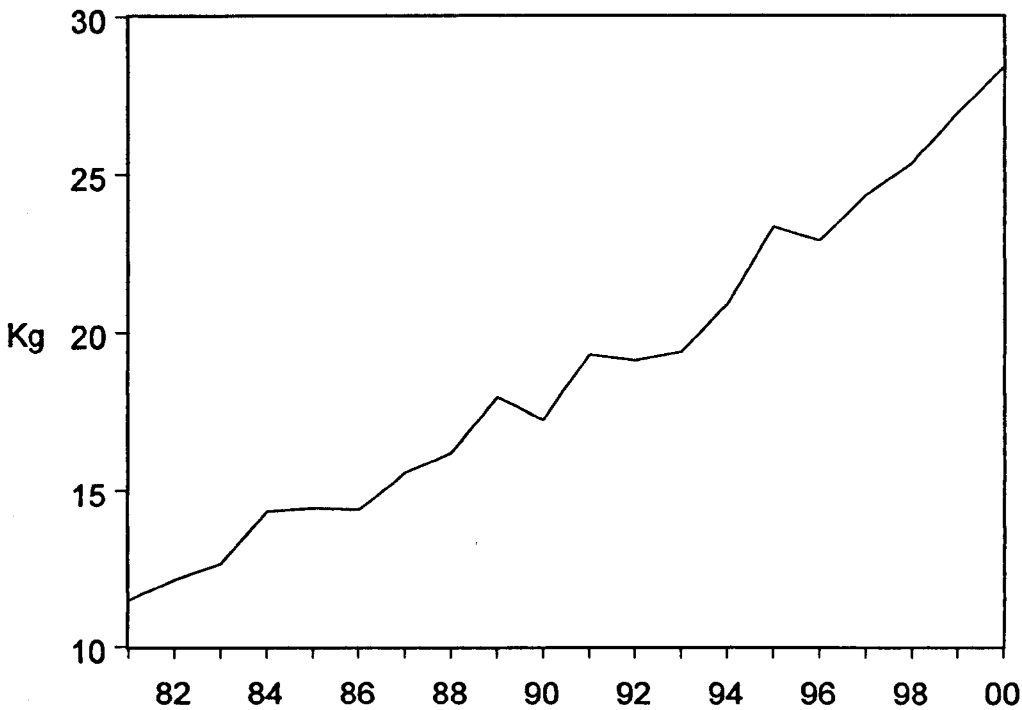


Figure 6.4: Per Capita Consumption of Lamb

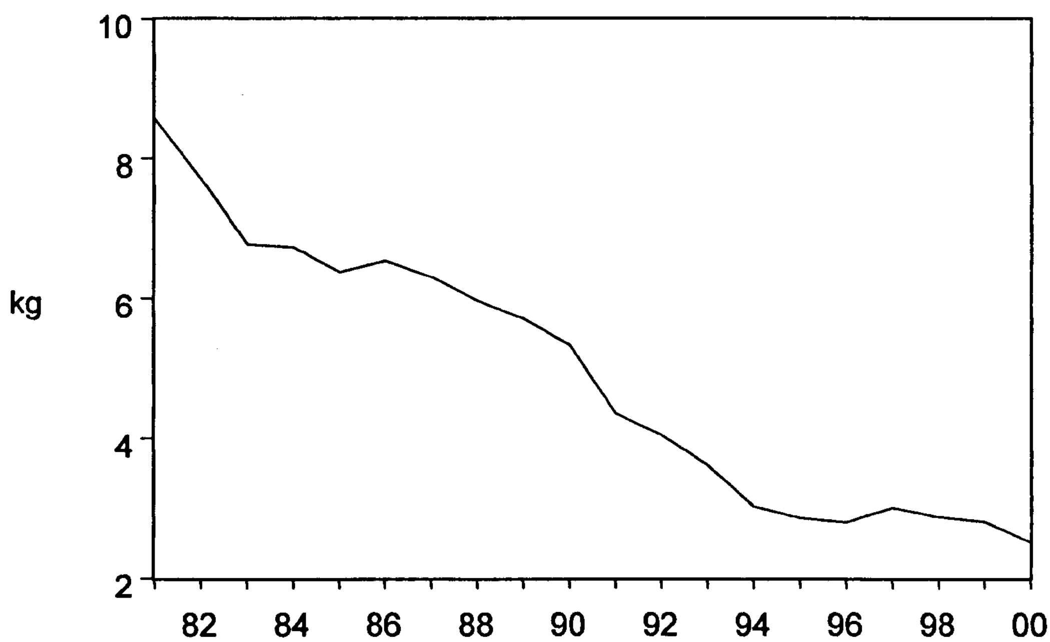


Figure 6.5: Per Capita Consumption of Camel

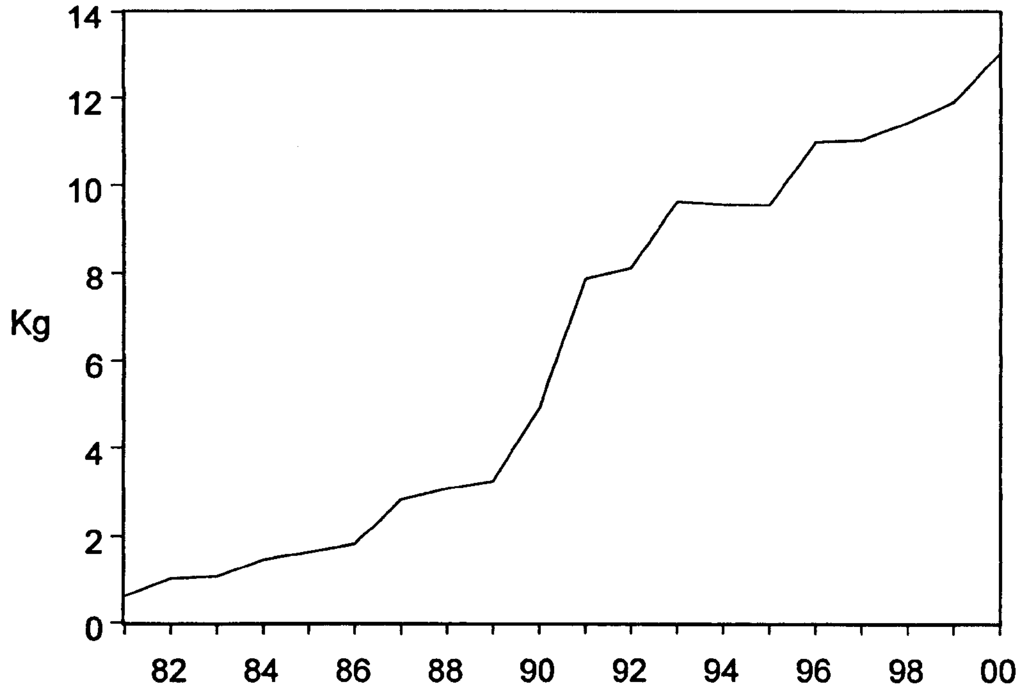


Figure 6.6: Per Capita Consumption of Fish

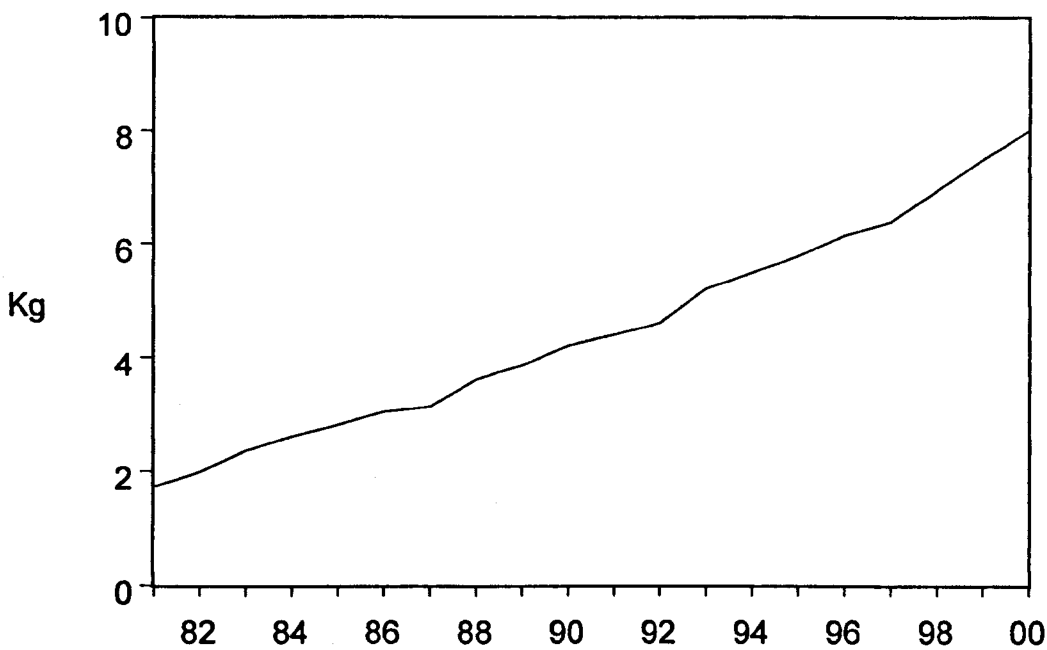


Figure 6.7: Per Capita Consumption of Beef

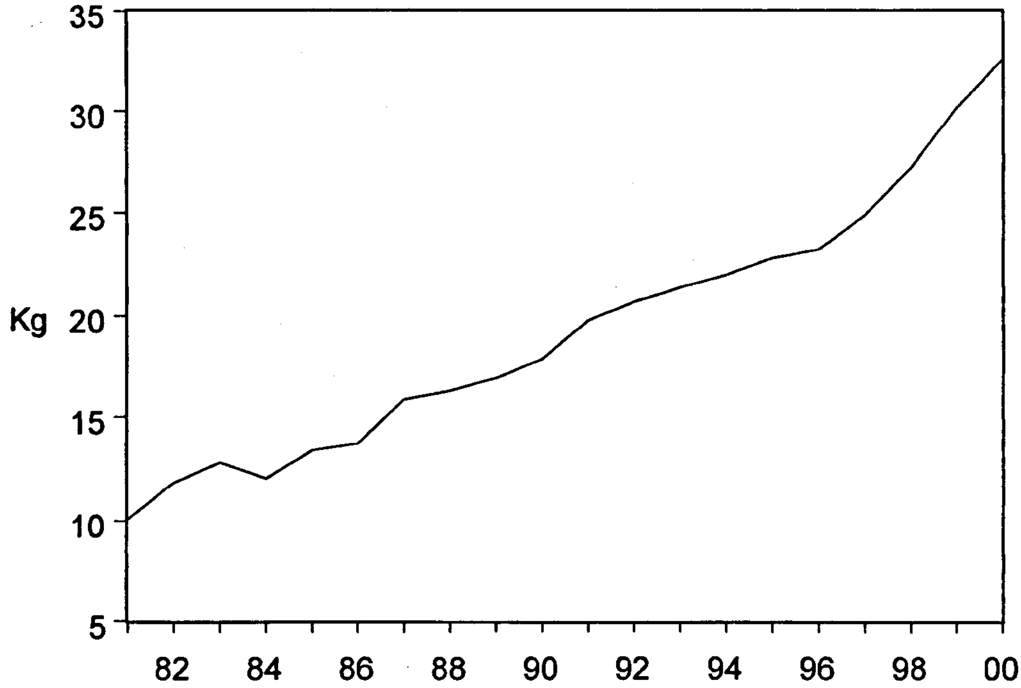
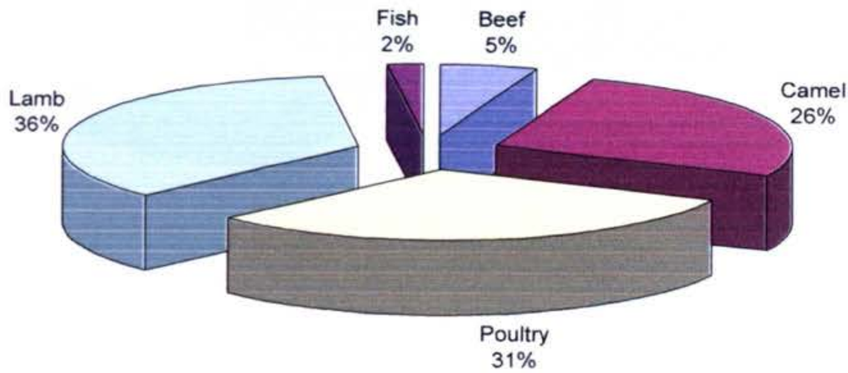
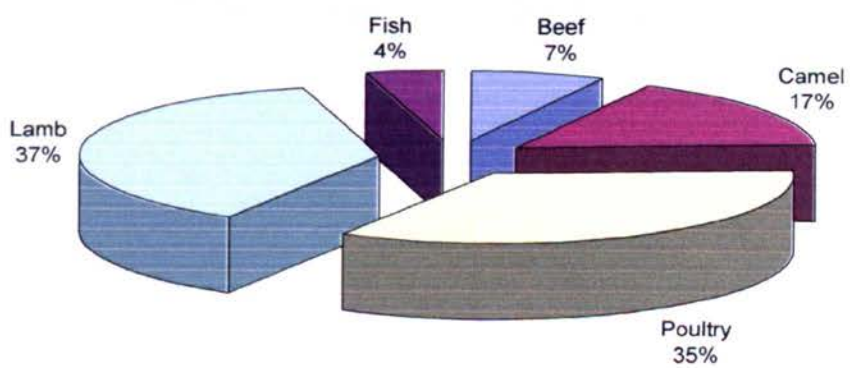


Figure 6.8: Per Capita Consumption of Poultry



1981



1985

Figure 6.9A: Percentage Distribution of Consumption by Type of Meat and Fish.

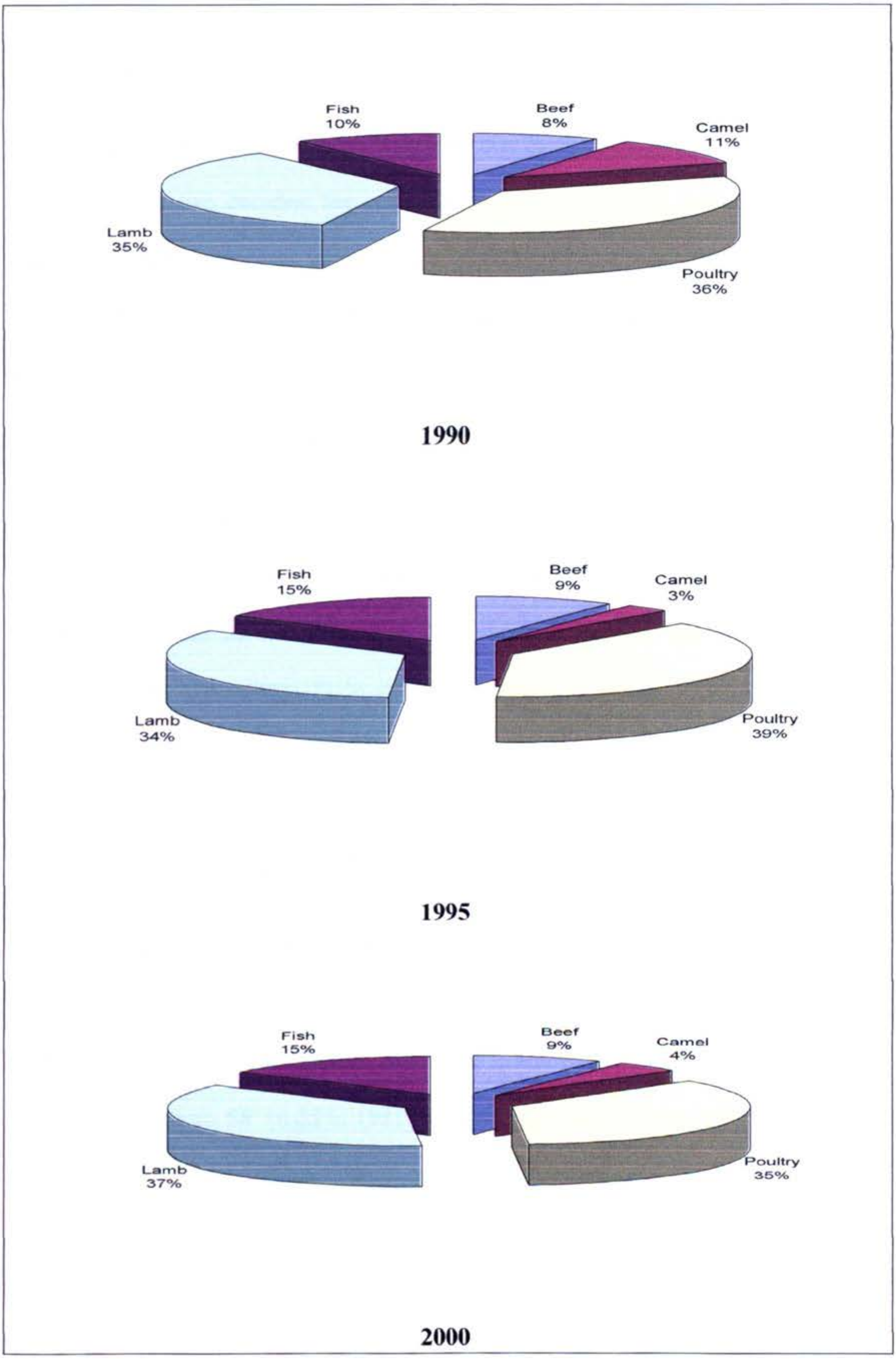


Figure 6.9B: Percentage Distribution of Consumption by Type of Meat and Fish

6.7 Price Indices:

The price situation in the Kingdom has been characterized by stability during the last two decades; the cost of living index recorded a decline of 0.2 percent during the ten years, while the non oil GDP deflator registered a small rise of 0.1 percent (SAMA, 1970-1999). The most important factors accounting for this are the stability of wages and costs in general. This was reflected in the continued improvement in the Riyal's nominal and real effective exchange rates.

The prices presented here are the monthly average retail prices of five meats (beef, camel, lamb, poultry and fish) in Saudi Riyals (SR) per kilogram. Their use, instead of the Consumer Price Indices, assures that price time's quantity equals expenditure. Price indices are shown in Table 6.2. However, the price of poultry increased from SR 7.75 per kg in 1981 to SR 8.70 in 2000. In 1981, the price of lamb decreased from SR 22 per kg to about SR 20.40 in 1988, and then increased to SR 23.07 in 2000.

Fish price increased from SR 14.5 in 1981 to SR 15.88 in 1987, and then decreased to SR 12.5 in 2000. Also, the price of camel increased from SR 12.59 in 1981 to SR 20.6 in 1994, and then decreased to SR 18.55 in 2000. The price of beef increased from SR 16.65 in 1981 to SR 22.2 in 2000. Since 1990, the price levels of lamb, beef, poultry, camel and fish increased about 10 percent; the reason that contributed for this situation is the Gulf war.

The general price indices for all cities rose by 4.6 percent during the last decade; the increases in price appear to have been caused mainly by the large rise in liquidity in the economy. However, rises in the prices of imports were also a contributory factor. This was mainly due to a rise in domestic demand, and production costs related to import transactions such as the rise of freight and insurance charges. The rise in freight insurance charges was caused by the Gulf War in 1991.

Table 6.2: Average Price Indices

(Saudi Riyal)

Year	Beef	Camel	Fish	Lamb	Poultry
1981	16.65	12.59	14.54	22.15	7.75
1982	16.82	13.37	14.95	22.05	7.10
1983	16.90	14.95	15.60	21.29	6.92
1984	17.20	15.04	17.60	20.44	6.95
1985	16.84	15.25	17.03	20.54	7.21
1986	17.04	15.57	15.73	21.07	7.68
1987	17.45	15.42	15.88	20.48	7.63
1988	16.78	15.17	15.86	20.41	7.58
1989	16.85	15.28	15.51	20.87	7.87
1990	17.79	15.62	13.96	22.57	8.30
1991	23.15	17.36	13.12	23.13	8.27
1992	23.15	17.40	13.27	23.50	8.41
1993	23.00	19.50	13.23	24.06	8.30
1994	23.07	20.60	13.10	23.34	8.37
1995	23.31	20.47	13.36	22.57	8.21
1996	22.92	20.44	13.07	22.93	8.58
1997	23.33	19.98	12.89	22.66	8.73
1998	22.97	19.61	12.80	23.35	8.64
1999	22.20	19.39	12.22	23.92	8.52
2000	22.22	18.55	12.50	23.07	8.70

Source: Ministry of Agriculture and Water, Department of Economic Studies and Statistics, 1970-2000, Saudi Arabia, Riyadh.

6.8 Per Capita Expenditure:

The total meat expenditure increased from SR 1.5 billion in 1981 to SR 3.1 billion in 2000. Total meat expenditure is rising and could continue to the end of the Seventh Development Plan (2005) (see Figure 6.10).

Per capita expenditure of beef, lamb, poultry and fish increased from 3.35, 23.34, 36.95 and 6.46 percent respectively of the total meat expenditure in 1981 to 9.02, 30, 45 and 13.60 percent respectively of the total meat expenditure in 2000. (see Table 6.3). Per capita expenditure of camel decreased from 13.56 percent of the total meat expenditure in 1981 to 3.31 percent in 2000. Undoubtedly, the profile of per capita expenditure on camel achieved between 1981 and 2000 is an indicator of decreasing demand for camel in Saudi Arabia. The implications for consumer demand, as a result, are significant. With the population being so young, education on the increase, the influence of satellite TV, and the fast pace of life offered now, purchasing patterns of the growing adults are expected to change and will ultimately resemble more closely those of the West.

Lamb, poultry and fish account for and 30, 45 and 13.60 percent of meat expenditure; these are the highest shares among the meat commodity groups, because lamb, poultry and fish are the meats that are traditionally consumed in Saudi Arabia (see Figure 6.11A,B).

Over the period 1981 to 2000, Brazil and France dominated the Saudi market for imported chicken. Africa and Australia, on the other hand, supplied most of the imported lamb. However, Africa's small share results from converting live animals to net meat weights while it is important to note that fresh meat is generally preferred to frozen or chilled meat. However, although Saudi consumers are buying Australian mutton in increasing quantities, they prefer the lean lamb and mutton of the local and African breeds. The most preferred lamb in the Saudi market is Noaimi. Noaimi sheep are lean and tender and come mostly from Syria and Jordan and the most preferred camel in the Saudi market is the Hashee (the small camel) (Ministry of Agriculture and water, 1999).

Table 6.3: Percentage Expenditure on Meat and Fish in KSA.

Year	Beef	Camel	Fish	Lamb	Poultry
1981	3.35	13.56	6.46	23.34	36.95
1982	4.31	13.48	6.47	23.83	37.76
1983	4.36	13.24	7.77	24.53	38.23
1984	4.51	12.74	8.38	25.76	35.36
1985	4.49	11.63	8.83	26.11	36.73
1986	5.12	11.21	8.95	27.36	37.67
1987	5.97	10.52	8.99	26.65	38.53
1988	6.41	10.16	9.03	30.15	39.75
1989	7.41	8.88	9.05	27.60	40.55
1990	7.49	7.99	9.21	28.33	40.93
1991	8.05	7.43	9.36	30.06	42.86
1992	8.08	6.34	9.45	28.91	40.85
1993	8.07	5.85	10.22	28.25	41.89
1994	8.59	5.17	10.61	28.67	42.03
1995	8.94	4.69	12.97	29.01	43.04
1996	9.13	4.61	13.05	29.68	43.38
1997	9.03	4.30	13.20	29.71	43.51
1998	9.13	3.56	13.38	29.85	44.05
1999	9.07	2.87	13.50	30.06	44.33
2000	9.02	2.21	13.60	30.13	45.01

Source: Ministry of Agriculture and Water, Department of Economic, 1970-2000, Saudi Arabia, Riyadh.

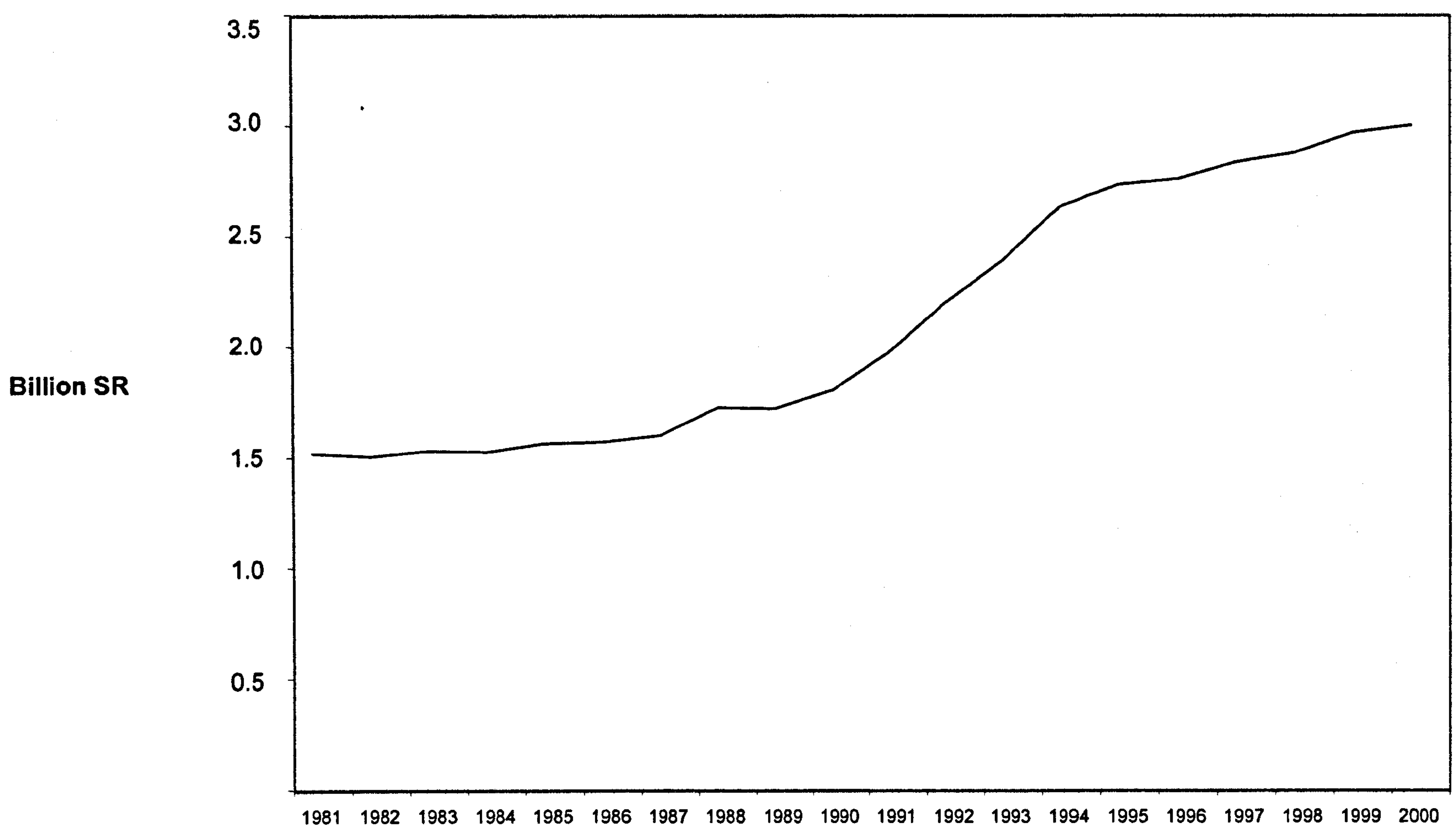
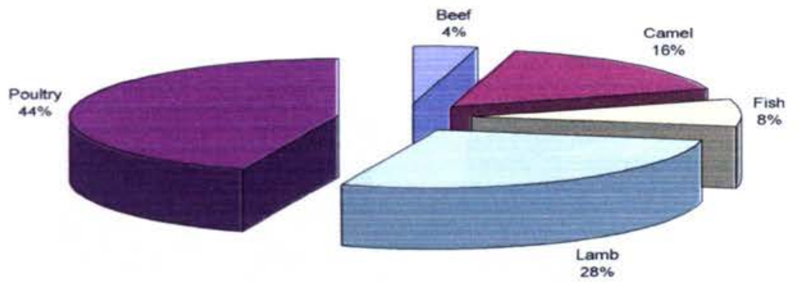
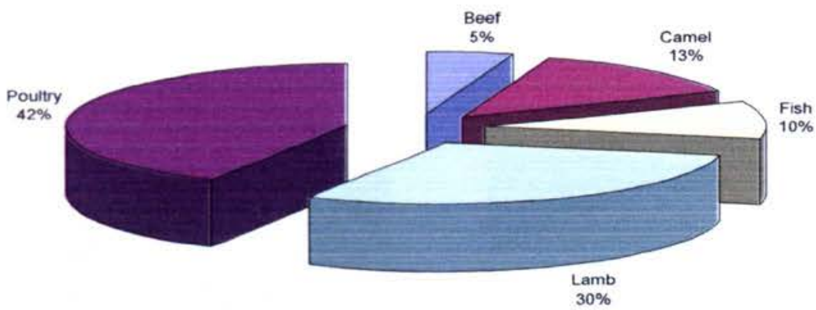


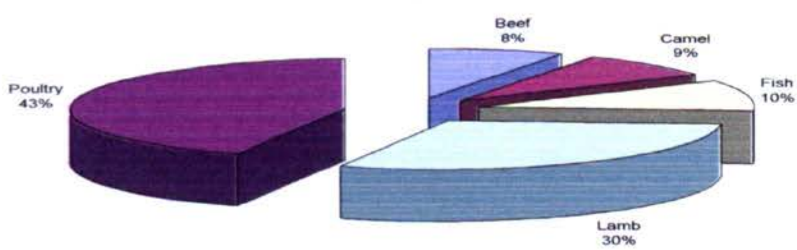
Figure 6.10: Total Meat and Fish Expenditure



1981

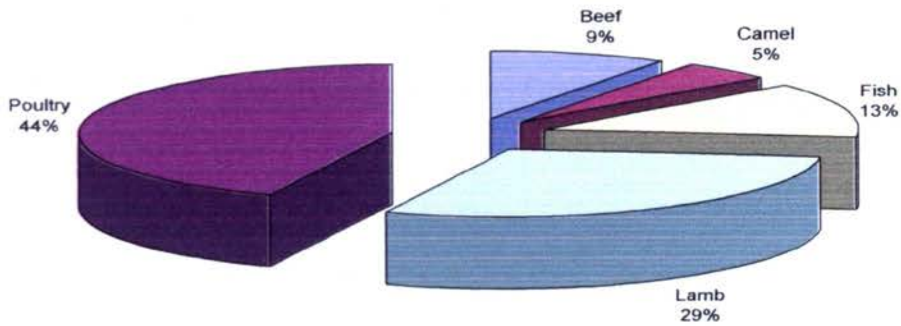


1985

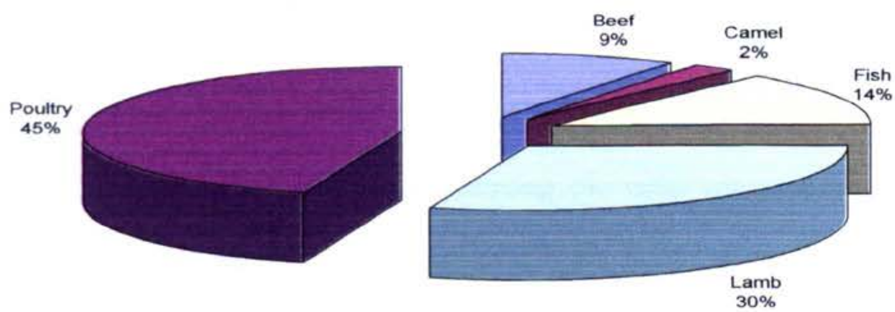


1990

Figure 6.11A: Percentage Distribution of Expenditure by Type of Meat and Fish in KSA.



1995



2000

Figure 6.11B: Percentage Distribution of Expenditure by Type of Meat and Fish in KSA.

6.9 Conclusion:

This chapter provides a brief discussion on per capita consumption and expenditure on meat. We found that there are many important characteristics that affect the Saudi meat consumption:

First, per capita consumption of meat increased from about 32.479 kg in 1981 to 84.45 kg in 2000 a growth rate of 94 percent.

Second, per capita consumption of meat, except fish, increased during Ramadan and Hajj time more than in any other month during the year because in these two months people in Saudi Arabia give away charity in the form of meat to poor people according to Islamic law

Third, lamb, poultry and fish account for 30.13, 45 and 13.60 percent of meat expenditure; these are the highest shares among the meat commodity groups, because lamb, poultry and fish are the meats that are traditionally consumed in Saudi Arabia.

Fourth, religion, culture and Gulf war are the exogenous variables that affected per capita consumption of meat in Saudi Arabia.

Chapter Seven: Empirical Results

7.1 Introduction:

The aim of this chapter is to analyse empirically the import demand for meat in Saudi Arabia by using the AIDS developed by Deaton and Muellbauer, 1980, in which the budget shares of the various commodities are linearly related to the logarithm of real total expenditure and the logarithm of relative prices. This system can be used to test the restrictions of homogeneity and symmetry through linear constraints on parameters.

The econometric modeling utilised throughout the study is based on a time series systems approach. In the literature, general to specific modeling has been used to deal with the system estimations and has played an important role in recent applied econometrics.

A number of recent studies (Ng, 1995; Buse and Chan, 2000; Karagiannis and Velentzas, 2000) have used time series panel data to investigate the meat demand model. The lack of research regarding the Saudi meat market calls for a full investigation of the meat import demand in Saudi Arabia; to the best of my knowledge, there has been no study that comprehensively investigates meat import demand in Saudi Arabia. The analysis of the demand for meat in Saudi Arabia will provide solid indications of future consumption and offer a basis for the design of future policies. Such analyses may support meat consumption and lead to new policies that integrate the Saudi meat market into international markets, especially in beef, lamb, poultry and fish, where consumption has increased rapidly during the past decade.

The structure of this chapter is as follows. Section 1 provides empirical studies on meat demand. Section 2 discusses the specifications of the expenditure share of meat functions. Section 3 provides empirical results, which consist of establishing the long-run relationship by using the Engle Granger, and Johansen cointegration procedures. Section 4 identifies the cointegration vectors and the short and long run price elasticities. The error correction mechanism will be presented in Section 5, while section 6 concludes.

7.2 Empirical Studies on meat demand:

There are many arguments about the use of AIDS model in the demand analysis. Here, we introduce some of the main concepts and issues.

Ng (1995) re-examined the evidence for homogeneity in light of recent developments in time series econometrics with special emphasis on the treatment of trends, he found the demand system to be stochastically but not deterministically cointegrated. Using techniques developed for estimating cointegrating vectors in the presence of deterministic trends, he re-estimated the demand system and found that homogeneity holds in many cases.

Buse and Chan (2000) explored the issue of price index invariance in the AIDS. They establish that the Stone index, which lacks invariance, and the recently proposed invariant Laspeyres and Paache indices all generated biased and inconsistent estimators. Second, they examined the merits of the widely used conditional Maximum Likelihood (ML) estimator of the non-linear Almost Ideal

System in which a prior value is chosen for the "subsistence" parameter.

Recently, one study has attempted to incorporate dynamic elements into the AIDS; as it proposes the cointegration analysis procedure for estimating the AIDS model. Karagiannis and Velentzas (2000) present a dynamic specification of the AIDS based on recent developments in cointegration techniques and the error correction model. Based on Greek meat consumption data over the period 1958-1993, it was found that the proposed formulation performs well on both theoretical and statistical grounds, as the theoretical properties of homogeneity and symmetry are supported by the data. Regardless of the time horizon, beef and chicken may be considered luxuries while mutton-lamb and pork as viewed as necessities. In the short run, beef was found to have price elastic demand, pork an almost unitary elasticity, whereas mutton-lamb, chicken and sausage had inelastic demand; in the long run, beef and pork were found to have a demand elasticity greater than one, whereas mutton-lamb, chicken and sausage still had inelastic demand. All meat items are found to be substitutes for each other except chicken for mutton-lamb and pork for chicken.

Our study builds on previous work by Karagiannis and Velentzas (2000) and to some extent expands on it. Further exploration was made on the methodology for testing and setting an error correction form of demand systems by presenting a more complete set of alternative tests that can be used to establish long run demand relationships. Moreover, given the structure of an Error Correction Model (ECM), short and long run demand responses can be analysed.

7:3 The Data:

The variables that are used in this study are all taken from a number of issues (1981-2000) from the Central Department of Statistics, published by the Ministry of Planning and Ministry of Agricultural and Water in the Kingdom of Saudi Arabia. Meat expenditure is aggregated into five categories: beef, camel, lamb, poultry and fish. The sample period, from January 1981 to December 2000, consisted of 240 monthly observations for each variable. Monthly data were used because increasing the frequency of observations while keeping the sample span fixed tends to increase the power of unit root tests. Maddala and Kim (1998), states that in practice the highest frequency data available should be used. Hence, using monthly data is better than quarterly data. The log of all variables is then taken. The reason for taking the natural logs is that economic time series data tend to exhibit variation, which increases dispersion in proportion to their absolute levels. Logarithmic transformation typically suppresses this heteroscedasticity, to the benefit of econometric procedures. Additionally, a model expressed in log-linear form facilities the investigation of elasticities since these may be expressed as log-log derivatives.

The notation throughout the study is as follows: if a variable is used in logarithms then the name of the variable as below is used. If the variable is used in first differences then a D is added in front of the name of the variable. For example, DLBP means the first difference of the log of the beef price.

Figures 1A and 2A (in the Appendix) plot all variables that are used in our study. All variables are in logarithms. From this picture, it is clear that all expenditure variables have a positive trend and a similar pattern. There are seasonal peaks during the months of Ramadan and Hajj (see Chapter Six).

The definitions of the variables are as follows:

BP = Price of Beef.

CP = Price of Camel.

FP = Price of Fish.

LP = Price of Lamb.

POP = Price of Poultry.

BX= Expenditure on Beef.

CX= Expenditure on Camel.

FX = Expenditure on Fish.

LX = Expenditure on Lamb.

POX = Expenditure on Poultry.

TX = Total Meat Expenditure.

DH = Dummy variable for Hajj time.

DR= Dummy variable for Ramadan time.

7.4 The Model: The Almost Ideal Demand System (AIDS) Model:

The Almost Ideal Demand System (AIDS), introduced by Deaton and Muellbauer (1980), is one of the most widely used flexible demand specifications. This model has some advantages and gives an arbitrary first order approximation to any demand system; it satisfies the axioms of choice exactly; it aggregates perfectly over consumers without invoking parallel linear Engle curves; it has a functional from which it is consistent with known household-budget data; it is simple to estimate, largely avoiding the need for non-linear estimation; and it can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters (Deaton and Muellbauer, 1980).

In our study an Error Correction Model (ECM) version of the AIDS will be used. Based on the time series properties of the data and as long as cointegration between the dependent and independent variables is ensured, an ECM for AIDS can be established and econometrically estimated with the cointegration procedure. In the analysis, it is assumed that consumers' preferences are weakly separable with respect to meat, an implying two-stage budgeting process (Karagiannis and Velentzas 2000).

In the first stage, consumers decide how much of their total expenditure will be allocated to meat.

In the second stage, the demand for each meat item is determined by the price of the individual meat items and meat expenditures.

Our study is investigating only the second stage of this two stage process, in the AIDS model, the expenditure on one commodity (beef, camel, poultry, lamb and fish) depends on the price of that commodity, the prices of other commodities in the group and total expenditure on that group of commodities.

The empirical specification of the budget share is:

$$S_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln(\frac{m}{p}) + e_t \qquad (7.1)$$

where S_i is the budget-share of the *ith* commodities, α_i , β_i , γ_i are parameters; p_j is the price of the *jth* commodity; m represents total meat expenditure; p is an aggregate price index. In the equation (7.1), linearity arises from the way of specifying the aggregate price index, which in the linear formulation of the AIDS is treated as exogenous. Most often, the aggregate price index is approximated by Stone's price index. Deaton and Muellbauer also propose an alternative measurement by some form of price index, P*, linear in logarithms, and to estimate the system of equation (7.1) by linear techniques. The estimated parameters may then be used to calculate a new approximation to LP= log a (P) and the process may be iterated. Deaton and Muellbauer have suggested that when prices are highly correlated, as is the case with annual time series data or consumption, it is unnecessary to iterate. A linear approximation of the estimating equation can be found by using Stone's index:

$$\log P^* = \sum_{k} w_k \log P_k \qquad (7.2)$$

where $P = \theta P^*$, that is, P is assumed to be approximately proportional to P*. Other studies (Pashardes, 1993; Buse, 1994; Moschini, 1995), suggest that this approximation is reasonably accurate. The advantage of the approximation is that the demand system is linear in the structural parameters.

The theoretical restrictions of adding-up, homogeneity and symmetry implied by demand theory, are satisfied by following parametric restrictions (on the AIDS model). The utility maximization implies the following constraints on parameters of the AIDS share equations:

$$\sum \beta_i = 1, \sum \beta_{ij} = 0, \sum_i \beta_{ij} = 0 \qquad \text{(Adding up)} \qquad (7.3)$$

$$\sum_j \beta_{ij} = 0 \qquad \text{(Homogeneity)} \qquad (7.4)$$

$$\beta_{ij} = \beta_{ji} \qquad \text{(Symmetry)} \qquad (7.5)$$

The theoretical restrictions of adding-up, homogeneity and symmetry defined in equations 7.3, 7.4 and 7.5, and which are expressed in terms of the model's estimated coefficients, may be imposed or tested. Provided that equations 7.3, 7.4 and 7.5, hold, the estimated demand functions which add up to the expenditures share (7.3) are homogenous of a zero degree in prices and total meat expenditure taken together (7.4). They thus satisfy Slutsky's symmetry (7.5).

In the case of five goods: beef, camel, lamb, poultry and fish the homogeneity restriction is ($\beta_{i1} + \beta_{i2} + \beta_{i3} + \beta_{i4} + \beta_{i5} = 0$). With these restrictions imposed, estimating the parameters of the expenditure share equations can provide a test for homogeneity.

In this study, monthly data for the period 1981-2000 have been used; the sample data available for this study are 240 observations for each variable, to estimate the demand function for meat in Saudi Arabia using equation 7.1. Meat expenditures are aggregated into five categories: beef, camel, lamb, poultry and fish. Dividing current by constant expenditures provides the price index corresponding to each meat group.

7.5: The Estimation Procedures:

1. A dynamic specification of the AIDS based on cointegration techniques and the error correction model, is used. The sample data available for this study comprise 240 observations for each variable.
2. This model has five equations, one for each of the meats (beef, camel, lamb, poultry and fish). The variables in each equation are the price of each commodity, real total expenditure and the expenditure share of each commodity.
3. The Augmented Dickey-Fuller test and Phillips-Perron tests will be used to test the order of integration of each variable in equation 7.1.
4. In order to examine the relationship between the expenditure of meat and the price of meat in Saudi Arabia, this research includes a Granger Causality test.
5. For the cointegration test, the Engle Granger and Johansen tests will be used and the hypotheses of linear homogeneity and symmetry will be tested.

6. Having established that all the variables in equation 7.1 are I (1) processes and cointegrated a useful alternative approach is the Error Correction Almost Ideal Demand System (ECM) of the AIDS. This is given as:

$$\Delta S_i = \alpha + \sum_{j=1}^{n} \gamma_{ij} \Delta \ln p_j + \beta_i \Delta \ln(\frac{m}{p}) + \lambda_i \mu_{it-1} + u_t \qquad (7.6)$$

where Δ refers to the difference operator, μ_{it-1} are the estimated residuals from cointegration equation, and error corrections require $\lambda_i < 0$.

7.6 Empirical Results:

This section presents the empirical results of the study of the import demand for meat in Saudi Arabia; the data used are monthly data and the sample period covers January 1981 to December 2000. An important initial step in time series analysis is to visually examine the plots of the variables because these plots can provide general ideas about how these variables evolve over time (see Figures 1A and 2A in the Appendix). The used inspection shows that the data are non-stationary.

7.7 Statistical Measurements:

The descriptions of all variables included in the model are provided in Tables 7.1 and 7.2. These statistics include the mean and standard deviation. The first descriptive statistics is used as the measures of the central tendency of the data being studied while the standard deviation shows how the data used are dispersed around the central point (the mean) (Watsham and Parramore, 1997).

Summary statistics for the raw variables are given in Table 7.1 this provides some statistical measurements that describe the basic characteristics of those time series. The most impressive figures are the maximum and minimum levels of the expenditure share of fish. This started at the minimum of 0.04 of total meat expenditure at the beginning of the sample period and ended at 0.12 at the end of the sample period, implying a growth of more than 53 percent during the twenty year period. The level of total meat expenditure started at a minimum of SR 184 million at the beginning of the sample period and ended at SR 328 million at the end of the sample period. From the Table 7.1, it can be seen that standard deviations for expenditure variables are quite low and BX and FX have small means.

Finally, the correlation between these variables was examined. Table 7.2 presents the correlation matrixes of eleven variables, among which are expenditures and prices. An interesting feature of this matrix is that there is quite a high level of correlation between CP and all commodity prices (BP, FP, LP, and POP). These equal (0.904, -0.6993, 0.6490, 0.7549) respectively and the correlation between CX and POX equals (-0.9264). POP has correlation with BP and FP and equals (0.8049, -0.8306) respectively.

Table 7.1: Summary Statistics

The following table provides the summary statistics of the variables under study. The variables are: beef, camel, lamb, poultry and fish meat expenditure, and total real meat expenditure. The sample period covers January 1981 to December 2000 and consists of 240 monthly observations for each variable.

	BX	FX	LX	CX	POX	BP	FP	LP	CP	POP	TX
Mean	0.032	0.078	0.282	0.102	0.503	19.982	14.311	22.219	17.077	7.986	233000000
Maximum	0.041	0.125	0.349	0.163	0.588	24.210	18.780	24.630	21.030	8.830	328000000
Minimum	0.027	0.047	0.236	0.028	0.432	16.140	11.550	19.990	11.920	6.690	184000000
Std. Dev.	0.001	0.015	0.019	0.027	0.032	3.0054*	1.6732	1.2829	2.5115	0.608	37100000
Observations	240	240	240	240	240	240	240	240	240	240	240

* The high standard deviation is due to the dramatic increase in the price of beef since 1991.

Table 7.2: Correlation matrices

This table shows the correlation coefficients between beef, camel, lamb, poultry and fish meat expenditure, and the total real meat expenditure. The sample period covers January 1981 to December 2000 and consists of 240 monthly observations for each variable.

	BX	FX	LX	CX	POX	BP	FP	LP	CP	POP	TX	DH	DR
BX	1.000												
FX	-0.390	1.000											
LX	0.014	-0.745	1.000										
CX	0.411	-0.049	0.129	1.000									
POX	-0.233	0.0511	-0.370	-0.926	1.000								
BP	-0.544	0.5294	-0.516	-0.553	0.567	1.000							
FP	0.3741	-0.638	0.6229	0.1693	-0.246	-0.803	1.000						
LP	-0.275	0.5321	-0.677	-0.322	0.4529	0.7829	-0.808	1.000					
CP	-0.478	0.4596	-0.408	-0.504	0.4889	0.9045	-0.699	0.649	1.000				
POP	-0.349	0.5845	-0.479	-0.093	0.1179	0.8049	-0.830	0.717	0.754	1.000			
TX	-0.332	0.5679	-0.667	-0.538	0.6167	0.8797	-0.744	0.748	0.817	0.771	1.000		
DH	0.2414	0.3393	-0.387	-0.118	0.1638	-0.001	0.0019	-0.017	0.013	-0.014	0.366	1.000	
DR	0.1198	0.0367	-0.311	-0.139	0.2833	0.0289	-0.001	0.0182	0.026	0.0169	0.111	-0.093	1.000

7.8 Pretesting the Variables for Non-stationarity:

Formally, a series that is stationary in the weak sense indicates that the mean and the variance and the autocorrelation structure of the time series do not change as a result of change in the time origin. Unit root studies have shown that using classical estimation methods, such as Ordinary Least Squares (OLS), to estimate relationships with stochastically trended variables may give misleading inferences. In the presence of non-stationary variables, there might be what Granger and Newbold (1974) call a spurious regression i.e. an appearance of cause and effect where the variables are in fact independent of each other. A spurious regression typically has high R-squared and t-statistics that appear to be significant, but the results are without any economic meaning.

Before embarking on the cointegration analysis, it is necessary to test the order of integration of all variables used in the estimations. The relevant tests for the presence of unit roots, or testing for integration levels in applied time series data, fall into the following categories: visual inspection of the series and of the sample autocorrelations of the series, the Durbin-Watson (IDW) statistic test, and a regression-based t test such as Dickey-Fuller (DF) (1979), the Dickey-Pentula (DP) (1987), Phillips-Perron (PP) (1988) and Perron (1989). Among these tests the Dickey-Fuller (DF) and Phillips Perron (PP) tests are very common simple procedures for determining the order of integration of a series.

In this research, following the established practice, we will use the Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) tests. The idea behind this involves running an autoregressive process on the differenced series and testing whether the Auto Regressive AR (1) parameter is different from one. The Dickey Fuller test was specified as:

$$Y_t=\mu+\beta t+\rho Y_{t-1} + e_t \tag{7.7}$$

and tests whether ρ is equal to one. Engle and Granger (1987) suggest estimating the system in differences which will make the series a stationary linear process. The Augmented Dickey Fuller test involves running the following regression[1]:

$$\Delta Y_t=\mu+ \beta t +\rho Y_{t-1}+\sum_{i=0}^{p}\varphi_i \Delta Y_{t-i}+e_t \tag{7.8}$$

and testing $H_0 : \rho = 1$. If the H_0 is rejected, there is no unit root in the process. If it cannot be rejected, then the process is not stationary. In addition, the trend term β is important in the sense that, if the unit root test is not rejected for a series without the trend term, and the unit root test is rejected when the trend term is included, stationarity is achieved with the inclusion of the trend term. Thus, that series is called trend stationary.

---

[1] The DF test does not take account of possible autocorrelation in the error process. Dickey and Fuller (1981) suggest a simple solution for this weakness of the DF test using lags for the left hand side variables as additional explanatory variables to eliminate the autocorrelation problem. This procedure is called the augmented Dickey-Fuller (ADF) tests.

However, if the stationarity is achieved after differencing then that series is called difference stationary. Before testing for the unit roots it has been suggested that the correct specification of the ARIMA process should be selected. To select p in the above equation, a lag selection criteria based on Akaike Information Criterion (AIC) has been used. The results of carrying out the ADF and PP tests are presented in Tables 7.3 and 7.4. (These results are obtained by using the Microfit 4.0 and EViews). The third column gives the ADF and PP tests when only the intercept is concluded, and the sixth column gives the results of the tests when both the intercept and the trend terms are included. The second model is more appropriate since they are strongly trended variables. As can been seen from the sixth column of Tables 7.3 and 7.4, the hypothesis of the existence of a unit root in these series cannot be rejected except in BX, LX, CX, FX and POX. The results shows that a 95% level of significance.

In the next step, the same tests are applied to the first differences of the levels. The results show that all variables become stationary after differencing once, as is clear from Tables 7.3 and 7.4. After differencing, the null hypothesis of non-stationarity at all significance levels is rejected. The result indicates that not all variables are stationary in the level, but their first differences are stationary. These results seem to confirm the findings of Nelson and Plosser (1982) in that most macroeconomic series are of I (1) or, in some cases, I (2).

Table 7.3: Testing the level of the series for unit roots using Augmented Dickey-Fuller tests.

		Intercept	Number of lags	C.V (5%)	Intercept and Trend	Number of lags	C.V (5%)
BP	Level	-1.2423	0	-2.873	-1.6660	0	-3.430
	First difference	-15.58188	0	-2.873	-15.56079	0	-3.429
LP	Level	-1.6943	1	-2.873	-2.5489	1	-3.430
	First difference	-18.09724	0	-2.873	-18.060843	0	-3.429
CP	Level	-2.4841	2	-2.873	-1.6405	2	-3.430
	First difference	-18.11438	0	-2.873	-18.38108	0	-3.429
FP	Level	-1.0871	4	-2.873	-2.9334	4	-3.430
	First difference	-19.04006	0	-2.873	-19.01801	0	-3.429
POP	Level	-1.0742	2	-2.873	-3.2138	2	-3.430
	First difference	-16.01982	0	-2.873	-16.00633	0	-3.429
BX	Level	-3.7222	4	-2.873	-4.2550	4	-3.430
	First difference	-26.04910	0	-2.873	-25.99643	0	-3.429
LX	Level	-3.2343	2	-2.873	-4.2172	2	-3.430
	First difference	-26.61083	0	-2.873	-26.55512	0	-3.429
CX	Level	-5.0231	1	-2.873	-5.1057	1	-3.430
	First difference	-23.33634	0	-2.873	-23.30154	0	-3.429
FX	Level	-4.0773	2	-2.873	-5.4171	2	-3.430
	First difference	-22.26088	0	-2.873	-22.21493	0	-3.429
POX	Level	-3.6042	2	-2.873	-3.6767	2	-3.430
	First difference	-23.93569	0	-2.873	-23.90395	0	-3.429
TX	Level	-2.1846	2	-2.873	-3.2439	2	-3.430
	First difference	-26.74464	0	-2.873	-26.98912	0	-3.429

The corresponding critical values for 240 number of observations at the 5% significance levels are obtained from Mickinnon (1991) and reported by Microfit 4.0. It is worth noting that the intercept and trend terms are in the ADF equations. We chose the Akaike Information Criterion (AIC) to determine ADF values.

Table 7.4: Testing the level of the series for unit roots using Phillips-Perron tests.

		Intercept	Number of lags	C.V (5%)	Intercept and Trend	Number of lags	C.V (5%)
BP	Level	-1.252198	0	-2.873	-1.724647	0	-3.430
	First difference	-15.58188	0	-2.873	-15.56079	0	-3.429
LP	Level	-1.93654	1	-2.873	-3.20858	1	-3.430
	First difference	-18.0962	0	-2.873	-18.06084	0	-3.429
CP	Level	-2.4082	2	-2.873	-1.565583	2	-3.430
	First difference	-18.1143	0	-2.873	-18.38108	0	-3.429
FP	Level	-2.03005	4	-2.873	-4.544472	4	-3.430
	First difference	-19.04006	0	-2.873	-19.01801	0	-3.429
POP	Level	-1.18542	2	-2.873	-3.672431	2	-3.430
	First difference	-16.01982	0	-2.873	-16.00633	0	-3.429
BX	Level	-9.9683	4	-2.873	-11.28653	4	-3.430
	First difference	-26.049	0	-2.873	-25.99643	0	-3.429
LX	Level	-9.52936	2	-2.873	-11.26820	2	-3.430
	First difference	-26.61083	0	-2.873	-26.55512	0	-3.429
CX	Level	-7.03272	1	-2.873	-7.306184	1	-3.430
	First difference	-23.3363	0	-2.873	-23.30154	0	-3.429
FX	Level	-6.61852	2	-2.873	-8.315174	2	-3.430
	First difference	-22.2608	0	-2.873	-22.21493	0	-3.429
POX	Level	-5.8531	2	-2.873	-6.189022	2	-3.430
	First difference	-23.9356	0	-2.873	-23.90395	0	-3.429
TX	Level	-2.07162	2	-2.873	-3.802548	2	-3.430
	First difference	-26.7446	0	-2.873	-26.68912	0	-3.429

The corresponding critical values for 240 numbers of observations at the 5% significance levels are reported by Eviews. It is worth noting that the intercept and trend terms are in the PP equations.

In order to see the direction of causality between expenditures on meat and prices of meat, the next step is to empirically test the causal relationship between the expenditure of meat and the price of meat in Saudi Arabia by following Granger Causality test.

7:9 Granger Causality Tests:

Granger Causality is a useful concept in Vector Autoregressive (VAR) settings in determining the causal ordering and strict exogeneity of variables: a variable y is said to cause x if the specific information added by y improves the predictions of x. A formal definition is as given as:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + .. + \alpha_p x_{t-p} + b_1 y_{t-1} + b_2 y_{t-2} + ... + b_p y_{t-p} + \varepsilon_t \quad (7.9)$$

If the following null hypothesis can be rejected, it is then concluded that y_t Granger causes x_t, denoted by $y_t \rightarrow x_t$.

$$H_0 : b_1 = b_2 = b_3 = ... = b_p = 0 \quad (7.10)$$

Hence, a variable y_t is said to cause x_t if the specific information added by y_t improves the prediction of x_t. Then y_t must contain information about x_t.

In the literature, there exist a number of tests for determining Granger causality in a bivariate system. Among them, Guilkey and Salemi (1982) and Geweke and Dent (1983) recommend the use of the ordinary least squares version of the Granger test, because it has eased implementation, power and robustness in finite sample. Causality between public expenditure and national income was evaluated by Singh and Sahni (1984). An example of time series approach for investigating money and price causality is that of Ghatak and Deadman (1989).

In order to examine the relationship between the expenditure of meat and the price of meat in Saudi Arabia, we performed a Granger Causality test. In our sample, monthly data from January 1981 to August 2000 have been used. Since it was found that the variables involved were integrated of order one, that is stationary in first differences, these have been expressed in first differences. F-tests were computed for the null hypothesis of this test. Also, the lag length throughout was chosen as three, which is the lag length chosen by the lag order selection process.

Results for these studies are summarized in Table 7.5. These are:

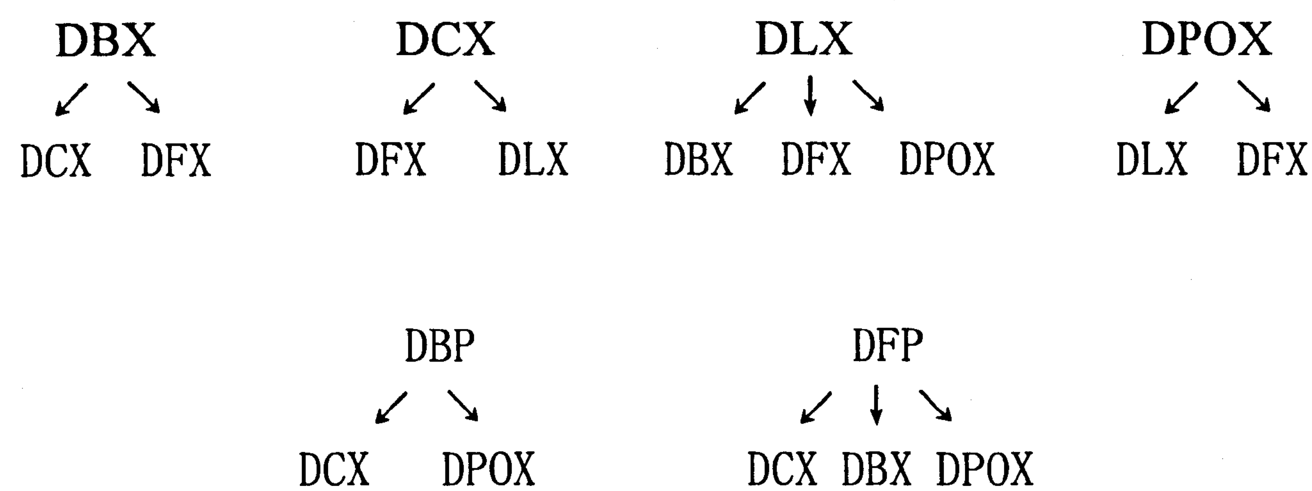
1. The changes in expenditure on fish (DFX) Granger cause changes in all other expenditure on meat.
2. The changes in expenditure on poultry (DPOX) Granger cause changes, in expenditure on lamb (DLX) and expenditure on fish (DFX).
3. The changes in expenditure on beef (DBX) Granger cause changes, in expenditure on camel (DCX) and expenditure on fish (DFX).
4. A significant causality has been found running from expenditure on camel (DCX) to expenditure on fish (DFX) and expenditure on lamb (DLX).
5. Expenditure on lamb (DLX) shows Granger causes on all expenditures on meat except expenditure on camel (DCX).
6. The changes in price of beef (DBP) Granger cause changes, in expenditure on camel (DCX) and expenditure on poultry (DPOX).

7. The changes in price of fish (DFP) Granger cause changes, in expenditure on camel (DCX) and expenditure on beef (DBX) and expenditure of poultry (DPOX).

Our results show that expenditure on lamb (DLX), expenditure on poultry (DPOX) and expenditure on fish (DFX) are the variables which most often cause other expenditure on meat. The result of the Granger causality test indicates that expenditure on lamb, poultry and fish are the variables which cause changes in expenditure on other meats, because lamb, poultry and fish are the most important staple meats in Saudi Arabia.

Table 7.5: Granger Causality Test

This table provides summary of the Granger causality test results using the full data set.



DFX → DBX, DCX, DLX and DPOX

For more details see Table A1 in Appendix.

7.10 Testing for Cointegration:

In order to construct long-run relationships among the variables, the Engel Granger cointegration test and the Johansen Likelihood Ratio procedure are employed. The results of the Augmented Dickey Fuller and Phillips Peron tests indicate that variables in equation 7.1 are non-stationary in levels but all variables stationary in the first difference. In the other words, the ADF and PP tests results for unit roots confirm that all variables are integrated of order one, I(1) in the levels but integrated of order zero in the first difference. To check for cointegration for each individual commodity, two different tests the Engel Granger cointegration test and the Johansen Likelihood Ratio Test, are used.

The next step is to test for cointegration between the relevant variables; the Engle and Granger two-step is employed.

7.11 The Engel-Granger Test:

The Engle and Granger (E-G) (1987) approach has received a great deal of attention in recent years. One of the advantages of this approach is that the long-run equilibrium relationship can be modelled by a straightforward regression involving the level of the relevant variables. Holden and Thomson (1992) point out that "this approach is attractive for two reasons: first, it reduces the number of coefficients to be estimated and so, minimize the problem of multicollinearity. Second, the first step can be estimated by OLS".

Another important advantage of Engle and Granger approach is that it provides a useful tool to investigate, not only the long run relationship among variables, but also their short run dynamics. The ability to disclose the long as well as short run information is the key feature of cointegration analysis. The formulation of the short run dynamics is also important in terms of the information it carries on the short run adjustment behaviour of economic variables.

In order to test for cointegration between the relevant variables (which are all I (1)), a residual based cointegration technique is used to test the existence of a long run relationship among the variables. The most widely used residual-based cointegration test is the residual-based DF-ADF test suggested by Engle and Granger (1987)[1].

Engle and Granger (1987) proposed a cointegration test based on a two-step estimation method.

First, they performed the cointegration regression using OLS after testing the degree of integration in the variables.

Secondly, tests were conducted to examine whether the residuals from the cointegrating were stationary or whether the variables follow the error correction representation.

---

[1] Haug (1993) suggest that Engle-Granger's residual-based ADF test indicates the least size distortion among seven different residual based tests based on Monte Carlo analysis. See McKinnon (1991) and Engle and Granger (1987) for the critical values of the residual based ADF cointegration test.

A sufficient condition for joint cointegration among the variables in the long run regression is that the error term should be stationary. This test consists of running an OLS for the variables in the level with a constant. Then an Augmented Dickey Fuller test is conducted on the residuals from this regression to test the null hypothesis of no cointegration. A linear formation of the Almost Ideal Demand System (AIDS) is used for the budget share form:

$$E_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln (\frac{m}{P}) + Dr + Dh + e_t \qquad (7.11)$$

where E_i is the budget share of the *ith* commodity, p_j is the price of the *jth* commodity, *m* represents total meat expenditure and *P* is an aggregate price index, *Dr* is dummy variable for Ramadan time and *Dh* is dummy variable for Hajj time. It is noteworthy that, without the dummies, a cointegration relation among the variables is not established. This situation provides a justification for the inclusion of the dummy variables for all expenditure equations because of the presence of seasonality in meat demand especially during Ramadan and Hajj, also represents the effects of Islamic religion[1].

---

[1] For more information, see Chapter Six.

The results are shown in Table 7.6. Two separate regressions are run for each commodity; the first is an OLS for commodity expenditure of meat as a dependent variable against a constant term, commodities price and total meat expenditure. The second regression is the same as the first but with the inclusion of a time trend. The results of both tests show that all coefficients are statistically significant. The null hypothesis of no cointegration can be rejected at the 5% level of significance in all equations, which indicates that there is evidence of a long run relationship between expenditure on meat with commodity prices and total meat expenditure. This means that expenditure on beef (BX), expenditure on lamb (LX), expenditure on poultry (POX) and expenditure on fish (FX) are cointegrated with commodity prices and total meat expenditure at 5% and 10% significance level.

Cointegration ensures that changes affecting commodity prices or real meat expenditure will be reflected on different expenditure shares in a similar way, showing that these variables are moving together in the long run. These results coincide with Karagiannis and Velentzas (2000) where they found cointegration for three commodities (beef, lamb and poultry) using the Engle Granger Cointegration Test.

Table 7.6: Cointegration: The Engle Granger Test

Variables	ADF Statistic a	ADF Statistic b
BX	-5.97300 **	-6.03086 **
FX	-6.02827**	-6.05642 **
LX	-6.27523 **	-6.31961 **
POX	-6.37187 **	-6.35562 **

a. Based on residuals from the regression of commodity expenditures on constant, the price of each commodity and real total meat expenditure.

b. Based on residuals from the regression of commodity expenditures on constant, time trend, the price of each commodity and real total meat expenditure.

Rejection of the null hypothesis at the 5% and 10% level of significance is denoted by (**) and *. The 5% and 10% critical values with constant are (-2.8739) and (-2.5733) respectively. 5% and 10% critical values with constant and time trend are (-3.4300) and (-3.1383) respectively.

The next step is to confirm the existence of cointegration vectors. Here, the Johansen cointegration procedure (the Maximum Likelihood ML) test is employed.

7.12 Johansen Likelihood Ratio Test:

In order to establish long run relations among the variables in the system, the Maximum Likelihood (ML) test was adopted. Johansen (1988) and Johansen and Juselius (1990) proposed a cointegration test based on the likelihood ratio method. Johansen cointegration test has the following advantages over Engle and Granger's: it is able to identity the number of cointegrating vectors; it is not sensitive to the choice of the dependent variable because it treats all variables as endogenous and it allows tests of restrictions on the coefficients.

It is worth emphasizing that the statistical properties of the Johansen procedure are generally better than the Engle-Granger procedure. However, they are grounded within different econometric methodologies and thus cannot be directly compared. In this regard, the Johansen method can be used for single equation modelling as an auxiliary tool, testing the validity of the endogenous-exogenous variable division. This may also referred as a conformation test of the single equation model. In this sense, Charemza and Deadman (1997) suggest that it might be more appropriate to use system-based cointegration test as an auxiliary tool, testing the validity of the residual-based test results.

In this section the long-run properties of the model are examined. The cointegration analysis is done by using the maximum likelihood estimation technique as originally suggested by Johansen (1988, 1990). This procedure (as explained in Chapter Five) makes it possible to estimate an error correction model for non-stationary variables. It involves determining the order of the rank of cointegration, imposing restrictions on the cointegrating vectors ($\beta's$) and the adjustment coefficients ($\alpha's$) in order to identify the cointegrating vectors. When the rank of $\Pi=\alpha\beta'$, where both α and β are p times r, is less than full r<p, there are r cointegrating relationships that are stationary and when r>1, and there is more than one cointegration relationship. The interpretation of the cointegration vectors as long-run equilibrium is difficult to determine and interpret. However, using this procedure, it is possible to identify independent stationary long-run relations by restricting the $\alpha's$ and $\beta's$, and to test economically meaningful restrictions on long-run relationships.

The procedure to implement Johansen's cointegration test can be summarised in the following steps:

1. For variables to be cointegrated, they should be integrated with the same order. In order to construct a long-run relationship among the variables, the Johansen Likelihood Ratio procedure is employed. The results of the Augmented Dickey Fuller and Phillips Peron tests are presented in Tables 7.3 and 7.4 indicating that variables in equation 7.1 are non-stationary in levels but that all variables are stationary in the first difference. In other words, the ADF and PP tests results for unit roots confirm that all variables are integrated of order one, I(1) in the levels but integrated of order zero in the first difference.

2. Johansen's cointegration test results might be sensitive to the number of lags used in the VAR system. The second step is to determine the appropriate number of lags, using a general to specific model reduction approach that starts with a higher order system, and then deletes one lag at a time. The Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) are the most commonly used information criteria in econometrics and these are the most reliable diagnostics which are generally used. (Maddala and Kim, 1998).

The results determine the appropriate number of lags using AIC and SBC, including expenditure on beef, lamb, poultry and fish, and the price of beef, lamb, poultry and fish, and real meat expenditure. The dummy variable for Hajj time and the dummy variable for Ramadan time used in the model are considered as exogenous I (0)[1]. By looking at table A2[2], it is possible to see that the Schwarz Bayesian Criterion[3] (SBC) picks lag length 1, and the Akaike Information Criterion (AIC) selects lag length 3. With monthly data of 240 observations, the lag length of the VAR representation (k) was set equal to three.

---

[1] See Pesaran and Pesaran (1997).

[2] The Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) results are presented in the Appendix.

[3] These two information criteria are available in the econometric package Microfit Software Version 4 used in this study. These criteria are also considered for determining the lag length. Adding more lags entails a problem with the estimation of more coefficients, hence a loss of degree of freedom (Enders, 1995).

3: The third step involves transforming the VAR system determined in the previous step into the following form:

$$\Delta y_t = \alpha + \Gamma_1 \Delta y_{t-1} + \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots + \Gamma_{k-1} \Delta\ y_{t-k+1} + \Pi\ y_{t-k} + v_t \qquad (8.12)$$

where

$$\Gamma_i = -(I - A_1 - \dots\dots\dots\dots - A_i) j = 1, \dots\dots\dots\dots, k-1 \qquad (7.13)$$

$$\Pi = -(I - A_1 - \dots\dots\dots\dots - A_k) \qquad (4.14)$$

I = Identity matrix.

The rank of the long-run information matrix Π in equation 7.12 is then tested because its rank r determines the number of cointegrating vectors. Johansen proposed the following two test statistics:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \qquad (7.15)$$

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \qquad (7.16)$$

where $\hat{\lambda}_i$ are the estimated eigenvalue (characteristic roots) ranked from largest to smallest. The former is called the trace statistic, which is a likelihood ratio test statistic for the hypothesis that there are, at most, r cointegrating vectors. The latter statistic $\lambda_{\max}$ (the Max statistic), tests the hypothesis of r cointegrating vectors against the hypothesis of $r-1$ cointegrating vectors. If eigenvalue $\hat{\lambda}_i$ are all zero, then λ_{trace} and $\lambda_{\max}$ will be zero too. Therefore, intuitively they are reasonable statistics to test the number of cointegrating vectors. The long-run information matrix (Π) can be decomposed into the product of two components: ($\Pi = \alpha \beta$) where α and β are $n \times r$ matrices. Matrix β represents the cointegrating parameters and matrix α can be viewed as the speed of adjustment parameters because it determines how each cointegrating vector enters the VAR system.

After determining the lag length in the VAR system, Johansen's (1988) cointegration test is then conducted. This test is used to determine the number of cointegrating equations or the cointegration rank for eleven variables: expenditures of beef, lamb, fish and poultry and prices of beef, lamb, poultry and fish, and total meat expenditure including a dummy variable for Hajj time and a dummy variable for Ramadan time. The lag length of VAR representation (k) was set to equal three.

However, both expenditure on camel and the price of camel are omitted from the variables eventually used. This is because preliminary tests with the other variables did not yield a plausible cointegrating relationship and this was insignificant in the equation that was finally estimated. It is believed that the camel is separable from all other meats.

To determine the cointegration rank, two statistics are suggested by Johansen (1988, 1990): $\lambda_{\max}$ and trace statistics. The null hypothesis that there are, at most, r cointegration vectors and unit roots in the system, amounts to testing whether the first r eigenvalue that arises as a result of the reduced rank regression of the Johansen procedure, is non-zero. Both tests are standard likelihood ratio tests. The results of these cointegration rank tests are reported in Table 7.7. The Johansen approach to the model is applied using the Microfit econometric programme. This programme allows tests to be conducted under three basic conditions:

The VAR assumes no deterministic trend in the data; The VAR assumes a linear deterministic trend in the data; The VAR assumes a quadratic deterministic trend in the data. Since most of the variables have a trend, the analysis is carried out under the basic assumption that there is a linear trend in the data.

After having computed both trace and maximal eigenvalue statistics, we may proceed to compare them with the critical values provided by Johansen and Juselius (1990). In practice, it is recommended to begin by testing the null hypothesis that there exists no cointegrating vector (r =0). If this hypothesis is not rejected, the testing procedure stops; however if it is rejected it is possible to consider sequentially the null hypotheses that $r \leq 1, r \leq 2, r \leq 3$ and so on. According to the maximum eigenvalue $\lambda_{\max}$ and trace statistics λ_{trace} (see Table 7.7) there are six long run stable relationships in system. These need to be identified as the demand for meat equation. Therefore, the first four cointegrating vectors in system, which have the highest eigenvalues, will be further investigated to identify the discussed relationships. In other words, the first four vectors corresponding to the most stationary relations in the model. However, there may be cases where the evidence of a number of cointegrating relations from these two tests is mixed. Moreover, Robertson and Wickens (1994) report that the statistical tests for the number of cointegrating vectors, and the cointegrating vectors themselves, are quite sensitive to the specification, the presence and absence of dummy variables and sample length. Hansen and Juselius (1995) suggest that, in the cases, it might be useful to investigate the eigenvalues of the long-run matrix. Doornik and Hendry (1994) argue that one can restrict the rank of Π, that is the number of cointegrating relationships and this restriction will produce a new long-run matrix. They suggest that choosing the number of cointegrating vectors, the rank of Π , which produce the long-run matrix that is the closest to the unrestricted long-run matrix, Π. Economic theory might be helpful by suggesting the restrictions needed to obtain the estimated vectors and implied long-run relations, which, in turn, plays a major role in shaping the structure of the model.

The presence of cointegration suggests that the variables of expenditure share a long run equilibrium relationship and ensure that changes affecting commodity prices or real expenditure will be reflected in different expenditure shares in a similar way, showing that these variables are moving together in the long run and obey an equilibrium constraint. Although the variables are individually integrated of order one, the linear combination of these variables are integrated of order zero. Finding cointegration means that the budget share of beef, lamb, poultry and fish are cointegrated with commodity prices and real expenditure at a 5% significance level. It is worth noting that the shortcoming of the Johansen procedure in the case of applied consumer demand analysis is that there is no a priori information to exclude some vectors as theoretically inconsistent whenever more than one cointegrated vector is found. This is because the sign of the elements of the cointegrated vectors, indicating substitutability or complementary behaviour between goods, cannot a priori be restricted. Neither is the sign of the elements is corresponding to own-price effects sufficient to exclude some of the cointegrated vectors, as even a positive sign may under certain circumstances, result in a downward sloping demand (Karagiannis and Velentzas, 2000). The economic explanation of the short and long run elasticities are provided in Section 7.16.2 (Page 214).

Table 7.7: Results of the Johansen Maximum Likelihood Cointegration Test

This table summarises the cointegration test based on Johansen's Likelihood Ratio Test and based on both maximal eigenvalue and the trace test of stochastic matrix. The variables considered in the analysis are BP, FP, LP, POP, BX, FX, LX, POX, TX, DH and DR.

		λ_{max}			λ_{trace}		
H_0	H_1	Statistic	C.V at 5%	C.V at10%	Statistic	C.V at 5%	C.V at 10%
r = 0	r = 1	339.7679	60.4800	57.3700	664.7131	213.4000	206.3700
r<= 1	r = 2	76.0459	54.1700	51.2600	324.9453	174.8800	168.2300
r<= 2	r = 3	72.2554	48.5700	45.7500	248.8993	140.0200	134.4800
r<= 3	r = 4	55.1653	42.6700	39.9000	176.6439	109.1800	104.2700
r<= 4	r = 5	49.5034	37.0700	34.1600	121.4787	82.2300	77.5500
r<= 5	r = 6	35.2238	31.0000	28.3200	71.9753	58.9300	55.0100
r<= 6	r = 7	17.2328	24.3500	22.2600	36.7515	39.3300	36.2800
r<= 7	r = 8	14.5510	18.3300	16.2800	19.5186	23.8300	21.2300
r<= 8	r = 9	4.9676	11.5400	9.7500	4.9676	11.5400	9.7500

r indicates the number of cointegrating relationships, λ_{max} is the maximum eigenvalue statistic and λ_{trace} is the trace statistics. DH and DR are considered as exogenous I(0) variables. VAR3, based on SBC and AIC, is used in the Johansen procedure and unrestricted intercepts and unrestricted trends in the VAR model.

C.V: The critical value.

7.13 Estimation and Hypothesis Testing of the Cointegration Vector:

Once it is determined how many cointegration vectors there are, it is possible to impose certain restrictions on the long-run coefficients presented in the β matrix. Such restrictions can be those motivated by economic arguments such as a homogeneity restriction or zero-restriction to test the significance of the variables. As far as economic theory and econometric issues are concerned, a number of restrictions may be imposed on coefficients expenditure shares and commodity prices. In order to test the significance of each long-run coefficient, zero-restrictions can be imposed on the columns of the standardized β matrix and then tested using the similar Likelihood Ratio (LR) statistic.

7.13.1 Johansen Approach:

When the likelihood ratio test for cointegration is applied at the same time the estimated coefficients of the cointegration relation are obtained. To account for this, the Johansen approach is used to estimate the coefficients and to test for their significance. Each cointegrating vector is expenditure on commodity, with negative effects from its commodity price and a positive effect from substitute commodity prices and total meat expenditure. According to these results reported in Table 7.8, it is possible to say the following in terms of the results:

The first cointegrating vector is the expenditure from beef equation. The result shows that the null hypothesis of the coefficient being statistically significantly equal to zero at a 5% and 10% significant level is rejected for the price of beef, the price of poultry and total meat expenditure. However, the null hypothesis of the coefficient being statistically significantly equal to zero cannot be rejected for the price of fish and the price of lamb since it was found that these had a negative coefficient sign and is statistically insignificant. The results indicate that the expenditure on beef has a negative effect on the price of beef, and a positive effect from the price of poultry and total meat expenditure. In other words, expenditure on beef is determined by the price of beef, the price of poultry and total meat expenditure.

The second cointegrating vector is the expenditure from fish equation. According to these results, the coefficients of price of beef and price of lamb are statistically significantly different from zero, except the price of fish is statistically insignificant, while price of poultry and total meat expenditure, which have a negative coefficient sign. The result shows that expenditure on fish is determined by the price of beef and the price of lamb.

The third cointegrating vector is the expenditure from lamb equation. According to these results, the null hypothesis of the coefficient being statistically significantly equal to zero at a 5% and 10% significant level for all variables is rejected, except the price of beef has negative coefficient signs and the price of fish is statistically insignificant. The results indicate that expenditure on lamb has a negative effect on the price of lamb, a positive effect on the price of poultry and total meat expenditure. In other words, the expenditure on lamb is determined by the price of lamb, the price of poultry and total meat expenditure.

The fourth cointegrating vector is the expenditure from poultry equation. According to these results the null hypothesis of the coefficient being statistically significantly equal to zero at a 5% and 10% significant level for all variable is rejected except for the price of beef and the price of fish which have negative coefficient signs and are statistically insignificant. The result shows that expenditure on poultry has a negative effect on the price of poultry, a positive effect on the prices of lamb and total meat expenditure. In other words, expenditure on poultry is determined by the price of poultry, the price of lamb and total meat expenditure.

The test results for all budget shares can be summarized. The test reveals that total meat expenditures have a positive sign and are statistically significantly different from zero for all budget share equations except expenditure on fish. The positive relation means that total meat expenditure increases the consumption of that commodity. whereas the prices of a commodity have a negative sign and are statistically significantly different from zero for all budget share equations (except price of fish) implying an inverse relationship between the quantity consumed and the price. Similarly, most of the coefficients of price of alternative commodities for each commodity have the expected right sign and are statistically significantly different from zero for all budget share equations. Finally, because of the results obtained above, the expenditure share of meat commodities in Saudi Arabia will change significantly with changes in the prices of commodities and total meat expenditure.

Table 7.8: Hypothesis Testing: Johansen Approach

Coefficients in the long-run cointegration relationship based on Johansen's procedure to estimate coefficients between expenditure share on each meat commodity and its determinants.

	BP		FP		LP		POP		TX	
	Coefficient	*t* Statistic	Coefficient	*t* Statistic	Coefficient	*t* Statistic	Coefficient	*t* Statistic	Coefficient	*t* Statistic
BX	- 1.4453 (0.66568)	-2.1711 **	- 0.063124 (0.18762)	-0.3364	0.23357 (0.35622)	0.6556	0.76331 (0.39685)	1.923 **	0.79461 (0.70655)	1.124 *
FX	4.8722 (1.1820)	4.1219 **	- 0.13409 (0.38342)	-0.34972	2.8001 (0.69753)	4.0143 **	-1.8953 (0.75396)	-2.5137 **	- 5.7707 (1.2528)	-4.600 **
LX	-0.97883 (0.31688)	-3.0889 *	0.072663 (0.11267)	0.6449	-1.1211 (0.19737)	-5.6801 **	1.0214 (0.20883)	4.89105**	0.87670 (0.33561)	2.6122 **
POX	-0.066306 (0.096593)	-0.6864	- 0.017579 (0.032949)	-0.5389	0.22485 (0.058163)	3.8658 **	-0.45581 (0.062046)	-7.3463 **	0.30534 (0.10236)	2.9830 **

Significant 5%, 10% coefficients are denoted by **,*.

7.14 Modeling the Short run Vector Error Correction Model (VECM):

Empirical analysis can be finalized by estimating the short run dynamics in the error correction model framework, after identifying the cointegrating relations. Obtaining long run estimates of the cointegration relationships is only an initial step to estimating the complete model. The formulation of the short run dynamic is also important in terms of the information it carries on the short run adjustment behaviour of economic variables. In order to seek short run relationships between variables, the Engle Granger procedure is utilised as explained in chapter five. The results of the regressions are reported in Table 7.9. The second column shows the individual coefficient estimates. The third column shows the t statistic. According to these results, it is possible to say the following:

The results show that the null hypothesis of the coefficients of expenditure on beef being statistically significantly equal to zero at a 5% and 10% significant level for all variables except for the prices of fish and lamb. These results indicate that the short run fluctuation expenditure on beef is determined by the price of beef, the price of poultry and total meat expenditures.

According to expenditure on fish, all coefficients are statistically significantly different from zero, except prices of beef and lamb. It is clear that the expenditure on fish is determined by the price of fish, the price of poultry and total meat expenditure. While the null hypothesis of the coefficients of expenditure on lamb being statistically significantly equal to zero at a 5% and 10% significant level are rejected for the prices of lamb, poultry, and the price of fish. These results indicate that the expenditure on lamb is determined by the prices of lamb, poultry, the price of fish and total meat expenditure. Finally, null hypothesis of the coefficients of expenditure on poultry being statistically significantly equal to zero at a 5% and 10% significant level for all variables except the prices of beef and fish, which have a negative coefficient sign. These results imply that expenditure on poultry is negatively affected by the price of poultry and positively affected by the price of lamb and the total meat expenditure.

7.15 Conclusion:

The test results for all budget shares can now be summarized. The expenditure on poultry in short-long run are determined by the price of lamb, price of poultry and total meat expenditure, while the expenditure on beef in short-long run is determined by the price of beef, price of poultry and total meat expenditure. Expenditure on lamb in short run is determined by the price of lamb, price of fish, price of poultry and total meat expenditure, while in long run it is determined by the price of lamb, price of poultry and total meat expenditure. Finally, the expenditure on fish in short run is determined by the price of fish, price of poultry and total meat expenditure while in the long run it is determined by price of beef and price of lamb. It is worth noting that the price of fish was statistically insignificant for all expenditure on meat commodities. In other words, the price of fish has no effect on expenditure of beef, lamb and poultry. This means that fish is separable from all other type of meat.

Table 7.9: Hypothesis Testing: Engle-Granger Approach

Coefficients in the short-run cointegration relationship based on Engle-Granger procedures to estimate coefficients between expenditure share on each meat commodity and their determinants in Saudi Arabia, 1981-2000.

	BP		FP		LP		POP		TX	
	Coefficient	*t* Statistic	Coefficient	*t* Statistic	Coefficient	*t* Statistic	Coefficient	*t* Statistic	Coefficient	*t* Statistic
BX	-0.72612 0.177667	-4.0870**	0.092872 0.080231	1.157557	0.255373 0.222511	1.147687	0.779228 0.220887	3.527724**	0.068077 0.044270	1.537762*
FX	0.357341 0.438470	0.874973	-.0.842155 0.19792	-4.2539**	0.232306 0.547490	0.424311	1.263186 0.551749	2.289419**	0.228323 0.108135	2.01114**
LX	-0.005247 0.120151	0.043673	0.185889 0.054187	3.4305**	-0.453143 0.151269	-2.995616**	0.312101 0.151927	2.05428**	0.480489 0.029508	15.2831**
POX	-0.035734 0.054863	-0.651328	0.032837 0.024724	1.328138	0.293148 0.069845	3.767613**	-0.320219 0.068112	-4.70136**	0.202840 0.013481	15.0466**

Significant 5%, 10% coefficients are denoted by **,*.

7.16 Analysis of Elasticities:

While the previous section concerned the statistical aspect of the results, this section is devoted to economic implications of the parameter estimates by the analysis of related elasticities; three kinds of elasticities are involved. These elasticities are commodity price, cross-price elasticities and expenditure elasticities. Tables 7.10, 7.11 and 7.12 present price, cross-price elasticities and expenditure elasticities. Estimates of short run elasticities are obtained by using the Almost Ideal Demand System, while their long run counterparts are measured by using the same formulas and the estimated parameters of the cointegration equations (Johansen, 1997).

7.16.1 Short and long run Price Elasticities:

The direct price elasticity of demand is defined as the degree of responsiveness of the quantity demanded of a commodity to changes in its price. Economic theory requires direct compensated price elasticities to be negative. Compensated and uncompensated price elasticities often have the same sign and the former is usually smaller than the latter in absolute value.

The short and long run price elasticities for all meat items are reported in Table 7.10. These results show that the coefficients of price are found to be negative, as expected, implying an inverse relationship between expenditure and price. However, short run expenditure (compensated) for beef, lamb, poultry and fish is expected to increase by 0.72612, 0.45314, 0.32021 and 0.84215 percent, respectively, while long run expenditure will increase by 1.4453, 1.211, 0.45581 and 0.13409 when the price of an individual meat falls by one percent.

The magnitude of elasticities indicates that the demand for poultry and fish, in both the short and long run are price inelastic. This indicates that short run elasticities are smaller than their long run counterparts for these meat items.[1] The demand for beef and lamb in the short run is price inelastic but in the long run these are found to have unit elasticity.

Table 7.10: Elasticity estimates for short run and long run terms for commodity price

	Commodity Price	
	Short-run	Long-run
Beef	-0.72612	-1.4453
Fish	-0.84215	-0.13409
Lamb	-0.45314	-1.1211
Poultry	-0.32021	-0.45581

Different approaches have been run on the relevant regressions above; these approaches are Engle-Granger and the Johansen approach.

[1] The LeChatrlier principle states that long run demand functions are more price sensitive than their short run counterparts. Thus, at the optimum, price elasticities are greater in the long rather than the short run (Silberberg, 1992, pp.216-222).

7.16.2 Short and long run Cross Price Elasticities:

Cross-price elasticities may be either positive or negative depending on whether the two goods are substitutes or complements. However, it is important to understand that the sign is not indicative of the technical relationship between the two goods, but rather of consumer behaviour regarding the importation of meat classes. This is an important distinction as several of the estimated cross-price elasticities are negative although conventional wisdom portrays all meat classes as substitutable (Watson and Sturgess, 1978).

The results show that the cross-price elasticities of lamb, beef, poultry and fish have a positive sign, as expected. This indicates the highest competitive relationship between each other. In the short run, the expenditure on beef is expected to increase by 0.09287, 0.2553 and 0.77922 for one percent increase in the price of lamb, poultry and fish, respectively, while in the long run it will increase by 0.23357 and 0.76331 for a one percent increase in the prices of lamb and poultry, respectively (see Table 7.11). The expenditure on fish is expected to increase in the short run by 0.357341, 0.23230 and 1.26318 percent for one percent increase in the prices of beef, lamb and poultry. While in the long run it will increase by 4.8722 and 2.8001 percent for a one percent increase in the price of beef and lamb respectively (see Table 7.12). The result also shows that in the short run expenditure on lamb is expected to increase by 0.185889 and 0.312101 percent, while in long run it will increase by 0.072663 and 1.0214 percent for a one percent increase in the prices of fish and poultry (see Table 7.13).

The expenditure on poultry is expected to increase in the short run by 0.03283 and 0.29314 percent for one percent increase in the prices of fish and lamb, but in the long run it will increase by 0.22485 percent for a one percent increase in the price of lamb (see Table 7.14).

7.16.3 Conclusion:

The results of short run cross-price elasticities indicate that lamb is a substitute for beef, fish and poultry. Beef is a substitute for fish only. Poultry is a substitute for beef, lamb and fish. Fish is a substitute for beef, lamb and poultry. Also the results show that beef is a complement for lamb and poultry.

The long run cross-price elasticities indicate that lamb is a substitute for beef, poultry and fish. Beef is a substitute for fish only. Poultry is a substitute for beef and lamb. Also the results show that beef is a complement for lamb and poultry. Fish is a complement for poultry and beef. Poultry is a complement for fish. It is interesting to note that lamb, and poultry in short-long run are substitutes for all meat items. These results coincide with consumer behaviour in Saudi Arabia because lamb and poultry are the most important staple meats in Saudi Arabia.

Table 7.11: Beef Expenditure

Coefficients in the short-long-run elasticities based on Engle-Granger and Johansen's procedure to estimate coefficients between expenditure on beef and prices of meat commodity

BX	FP	LP	POP
	Coefficient	Coefficient	Coefficient
Short run	0.092872	0.255373	0.779228
Long run	- 0.063124	0.23357	0.76331

Table 7.12: Fish Expenditure

Coefficients in the short-long-run elasticities based on Engle-Granger and Johansen's procedure to estimate coefficients between expenditure on fish and prices of meat commodity

FX	BP	LP	POP
	Coefficient	Coefficient	Coefficient
Short run	0.357341	0.232306	1.263186
Long run	4.8722	2.8001	-1.8953

Table 7.13: Lamb Expenditure

Coefficients in the short-long-run elasticities based on Engle-Granger and Johansen's procedure to estimate coefficients between expenditure on lamb and prices of meat commodity

LX	BP	FP	POP
	Coefficient	Coefficient	Coefficient
Short run	-0.005247	0.185889	0.312101
Long run	-0.97883	0.072663	1.0214

Table 7.14: Poultry Expenditure

Coefficients in the short-long-run elasticities based on Engle-Granger and Johansen's procedure to estimate coefficients between expenditure on poultry and prices of meat commodity.

POX	BP	FP	LP
	Coefficient	Coefficient	Coefficient
Short run	-0.035734	0.032837	0.293148
Long run	-0.066306	- 0.017579	0.22485

7.16.4 Short and long run Expenditure Elasticities:

The estimated total meat expenditure elasticities in the short and long run are reported in Table 7.15. The results show that the short and long run total meat expenditure elasticities are found to be positive, as expected, implying a positive relationship between total meat expenditure and expenditure on one commodity, with the exception of fish. In the short run, total meat expenditure elasticity shows that given a one percent increase in the total meat expenditure, expenditure on beef, lamb, poultry and fish increases by 0.06807, 0.48048, 0.202840 and 0.2283 percent, respectively, while in the long run, expenditure on these commodities increases by 0.79461, 0.87670, 0.30534, -5.7707 percent, respectively. The magnitude of short and long run expenditure elasticities indicates that beef, lamb, poultry and fish were found to have a short run elasticity of less than one. In the long run, beef, lamb and poultry exhibited similar behaviour with regard to expenditure changes, indicating that these three meat items can be considered to be necessities. On other hand, fish is found, in the short run to be necessities but in the long run as a luxury. Finally, short run elasticities are smaller than their long run counterparts for all meat items (Silberberg, 1992).

To summarise these results, prices have dominated the effects on expenditure compared to total expenditure on these goods. The magnitude of elasticities indicates the strength of the price effect. Consumers appeared to react more to price changes than to expenditure changes in the demand for all the meat items involved. According to these results, lamb, poultry and beef are classified as necessities, while fish is classified as a luxury.

Compared with previous findings by Karagiannis and Velentzas (2000) on meat demand in Greek, the estimated price elasticities in our study are greater for lamb and beef and smaller for poultry. Accordingly, *the estimated* expenditure elasticities are smaller compared to the findings of Karagiannis (2000) for all meat items. Also, this result can be compared with the previous findings of Al-Zagee (1987) regarding demand for lamb and fish in Kuwait. The estimated short run price elasticities in the present study are greater for fish and smaller for lamb. This difference may be due to the different time period covered, the econometric estimation technique and cultures.

Table 7.15: Elasticity estimates for short run and long run terms for meat expenditure.

	Total meat expenditure	
	Short-run	Long-run
Beef	0.06807	0.79461
Fish	0.22832	-5.7707
Lamb	0.48048	0.8967
Poultry	0.202840	0.30534

Different approaches have been run on the relevant regressions above; these approaches are Engle-Granger and the Johansen approach

Having established that all the variables in equation 7.11 are I (1) and cointegrated the next step is to estimate Error Correction Model (ECM) of the Almost Ideal Demand System (AIDS).

7.17 Error Correction Model:

To estimate an error correction model by which the short run dynamic can be described, a simple but widely applicable single equation error correction model can be written as:

$$\Delta y_t = z\alpha + \beta(y_{t-1} \ \lambda x_{t-1}) + \gamma\Delta x_t + u_t \qquad u_t \sim d(0,\sigma^2) \qquad (7.17)$$

The dependent variable here is y_t and the principal independent variable is x_t. These two variables are assumed to be I (1) and cointegrated, which implies that the error correction term is I (1). The row vector includes a constant term and any other independent variables, all of which are assumed to be either nonstochastic or I (1). If λ were known, there would clearly be no problem estimating 7.17 by least squares. The repressors would be either nonstochastic or I (1). But in most cases λ will not be known.

There are then several ways to proceed. The simplest is the Engle-Granger two step method proposed by Engle and Granger (1987). According to the Granger representation theorem, if a group of variables are all integrated and of order one, i.e are stationary in their first differences, and if they are cointegrated, then it is possible to present them in the form of an ECM. An ECM combines short-run fluctuations with a long–run static equilibrium relation, and the short-run fluctuations disappear over time (Ghatak, 1998).

An alternative to estimate the Error Correction Model (ECM) was provided by the Johansen test. A shortcoming of the Johansen procedure in the case of applied consumer demand analysis is that there is no a priori information to exclude some vectors as theoretically inconsistent whenever more than one cointegrated vector is found. This is because the sign of the elements of the cointegrated vectors, indicating substitutability or complementary behaviour between goods, cannot a priori be restricted. Neither is the sign of the elements is corresponding to own-price effects sufficient to exclude some of the cointegrated vectors, as even a positive sign may under certain circumstances, result in a downward sloping demand (Karagiannis, Velentzas, 2000). For these reasons, the Error Correction Model will be estimated by using Engle Granger's two-step procedure in equation 7.11 are I (1) and cointegrated, the estimated ECM of the AIDS is given as:

$$\Delta S_i = \alpha + \sum_{j=1}^{n} \gamma_{ij} \,\Delta \ln \rho_j + \beta_i \,\Delta \ln(\frac{m}{p}) + \lambda_i \mu_{it-1} + u_t \qquad (7.18)$$

In equation 7.18, Δ refers to the difference operator, μ_{it-1} are the estimated residuals from cointegration equations, and λ_i is expected to be negative and statistically significant. The negative sign implies that the short-run fluctuations around the long-run equilibrium relation disappear over time. The economic meaning of an error correction formulation, such as equation 7.18, is that, although the expenditures and prices series may wander considerably because both are non-stationary, they still do not drift too far apart (Ghatak, 1998).

The equilibrium relation is a stationary point characterised by forces that tend to push the economy back toward equilibrium whenever it moves away. There are two alternative estimation procedures: the two-step method of Engle and Granger (1987) and a nonlinear regression technique carried out by substituting equation 7.11 for μ_{it-1} in equation 7.18. The Engle and Granger two-step method (1987) is applied by substituting the estimated parameter values from the cointegration equation 7.11 into the ECM equation to obtain parameter estimates in equation 7.18 (Karagiannis and Velentzas, 2000). This is equivalent to using the estimate in equation 7.18. For the purposes of the present study, Engle and Granger's two-step method is used. An ECM is constructed by regressing the first difference of all variables and one period lag of the residual from the cointegration relationship as well as on seasonal dummies. Since the existence of joint cointegration among the variables in long-run regressions in equation 7.11 is confirmed, the next step is to model the short dynamic with the use of ECM. In order to model the expenditure share on meat, an ECM can be obtained by adding the residuals from equation 7.11. An ECM is therefore employed to test for short-run adjustment towards long-run equilibrium and to explore the relationship between variables. The results of estimating by the error correction model by using equation 7.18 are presented in Table 7.16. The table shows that the estimated parameters of the error correction term, λ_i all have the correct sign (negative) and are statistically significant, indicating that deviations from long-run equilibrium are corrected within the time period. [1]

[1] Fore more details, see Tables A3,A 4,A 5 and A6 in the Appendix.

7.17.1 Expenditure on Beef:

Table 7.12 shows that the error correction term's coefficient is negative and significant at the 1% level. The magnitudes of the corresponding coefficients show that 76% of the last period's disequilibrium is corrected after one month. In other words, the expenditure share on beef adjusts to its equilibrium level very quickly and the error correction term gives further evidence that the variables in the equilibrium regression are cointegrated. It is worth noting that the price of beef and the price of substitute commodities explain 44% of the total variation of the equation on the expenditure share of beef. The appropriately signed and significant error correction term for the model confirms the earlier findings that the price of each commodity and total meat expenditure has a long-term effect on the expenditure share of beef.

7.17.2 Expenditure on Fish:

The results show that the error correction term's coefficient is negative and significant at the 1% level. The magnitude of the corresponding coefficients shows that 43% of the last period's disequilibrium is corrected after one month. In other words, the expenditure share on fish adjusts to its equilibrium level quickly and the error correction term gives further evidence that the variables in the equilibrium regression are cointegrated.

The results indicate that the price of fish and the price of substitute commodities and total meat expenditure explain 34% of the total variation of the expenditure share on fish equation. It is worth noting that the signed and significant error correction term for the model confirms the earlier findings that the price of each commodity and total meat expenditure has a long-term effect on the expenditure share of each meat.

7.17.3 Expenditure on Lamb:

The results indicate that the error correction term's coefficient is negative and significant at the 1% level. The magnitude of the corresponding coefficients shows that 54% of the last period's disequilibrium is corrected after one month. In other words, the expenditure share on lamb adjusts to its equilibrium level quickly and the error correction term gives further evidence that the variables in the equilibrium regression are cointegrated. The results also show that the price of lamb and the price of substitute commodities explain 80% of the total variation of the expenditure share in the lamb equation. The appropriately signed and significant error correction term for the model confirms the earlier findings that the price of each commodity and total meat expenditure has a long-term effect on the expenditure share of each meat.

7.17.4 Expenditure on Poultry:

Table 7.12 shows that the error correction term's coefficient is negative and significant at the 1% level. The magnitude of the corresponding coefficients shows that 73% of the last period's disequilibrium is corrected after one month. In other words, the expenditure share on poultry adjusts to its equilibrium level very quickly and the error correction term gives further evidence that the variables in the equilibrium regression are cointegrated. It is worth noting that the price of poultry and the price of substitute commodities and total meat expenditure explain 76% of the total variation of the expenditure share of the poultry equation. The appropriately signed and significant error correction term for the model confirms the earlier findings, that the price of each commodity and total meat expenditure has a long-term effect on the expenditure share of poultry.

The test results for all expenditure share equations can be summarised thus: the error correction coefficient is statistically significant in all equations, has the expected negative sign and it is significant at the 1% level. In the other words, output adjusts towards its equilibrium level and the error correction terms provide further evidence that the variables in the equilibrium regression are cointegrated.

Table 7.12: Error Correction Modelling

Estimated parameters of an AIDS-ECM for meat demand in Saudi Arabia, 1981-2000.

Variable	Beef	Fish	Lamb	Poultry
C	-0.00816 (-2.037)	-0.018833 (-1.911)	0.008563 (3.170)	-0.001622 (-1.315)
DBP	-0.72612 (-4.087)	0.357341 (0.814)	0.005247 (0.043)	0.035734 (0.651)
DFP	0.092872 (1.157)	-0.842155 (-4.253)	0.185889 (3.430)	0.032837 (1.328)
DLP	0.255373 (1.147)	0.232306 (0.424)	-0.453143 (-2.995)	0.263148 (3.767)
DPOP	0.779228 (3.527)	1.263186 (2.289)	0.115081 (0.757)	-0.320219 (-4.701)
DTX	-0.06808 (-1.537)	0.228323 (2.111)	-0.480489 (-16.283)	0.20284 (15.046)
DH	0.067257 (3.956)	0.174183 (4.202)	-0.028467 (-2.513)	-0.014042 (-2.706)
DR	0.028593 (2.063)	0.016689 (0.487)	-0.060513 (-6.385)	0.03134 (7.286)
λ_i	-0.76623 (-10.317)	-0.429864 (-5.584)	-0.548985 (-6.542)	-0.729643 (-8.323)

Notes: t-statistics are in parentheses and all diagnostic pass at the 5% or 1% level of significance.

7.18 Conclusion:

This chapter presents the empirical results of the study of the demand for meat in Saudi Arabia. A dynamic specification of the Almost Ideal Demand System (AIDS) based on cointegration techniques and the error correction models have been used. We used monthly data and the sample period covers January 1981 to December 2000. Employing this monthly data series were found to be non- stationary in levels, but stationary in difference.

In order to see the direction of causality between expenditures on meat and prices of meat, Granger causality tests have been employed. Results of the Granger causality test indicate that expenditure on lamb, expenditure on poultry and expenditure on fish are the variables which cause changes in expenditure on other types of meat, because lamb, poultry and fish are the most important staple meats in Saudi Arabia.

In order to construct long-run relationships among the variables, the Engel Granger cointegration test and the Johansen Likelihood Ratio procedure were employed. At this point, we included two dummy variables to capture the effects of Ramadan and Hajj time. The results of both tests show that most of the coefficients are statistically significant. The null hypothesis of no cointegration can be rejected at the 5% level of significance in all equations. Thus there is evidence of long-run relationship between expenditure on meat with commodity prices and total meat expenditure. Cointegration ensures that changes affecting commodity prices or real meat expenditure will be reflected on different expenditure shares.

The results for all budget shares elasticities indicate that the demand for poultry and fish, in both the short and long-run are price inelastic. The demand for beef and lamb in the short-run is price inelastic but in the long-run these have unit elasticity.

The short and long-run cross-price elasticities indicate that lamb is substitute for all meat items; poultry is substitute for lamb and beef. These results coincide with consumer behaviour in Saudi Arabia because lamb and poultry are the most important staple meats in Saudi Arabia.

The magnitude of short and long-run expenditure elasticities indicate prices have dominated the effects on expenditure compared to total expenditure on these goods. Consumers appeared to react more to price changes than to expenditure changes in the demand for all the meat items involved. Finally, lamb, poultry and beef are classified as necessities, while fish is classified as a luxury good.

Having established that all the variables are I (1) and cointegrated, we estimate ECM form of the AIDS. The error correction coefficient has the expected negative sign and is significant at the 1% level in all equations. In other words, output adjusts towards its equilibrium level and the error correction terms provide further evidence that the variables in the equilibrium regression are cointegrated.

Chapter Eight: Summary and Conclusion

8.1: Introduction

This research represents a dynamic specification of the AIDS based on recent developments on cointegration techniques and error correction models. The AIDS is adjusted accordingly to give rise to an AIDS-ECM. Based on Saudi meat consumption data over the period, 1981-2000, it was found that the proposed formulation performs well on both theoretical and statistical grounds. In particular, the theoretical properties of homogeneity and symmetry are supported by the data and thus the obtained elasticity estimates are valid for policy issues analysis.

The major objectives of this study are to summarise the patterns of meat and fish expenditure in Saudi Arabia. We estimate the econometric parameters of the model for beef, lamb, poultry and fish imports, and consider the relevance of such information in addressing certain policy issues that relate to consumption and imports. The remaining sections of this chapter summarise the findings of the study, draw conclusions, and consider the ways these results might contribute to the knowledge in this area. The limitations of the study are also noted.

8.2: Summary of the findings

Chapter two discusses the performance of the Saudi economy between 1970 and 2000. It was found that the Saudi economy experienced two different stages of economic development. In the first stage (1970-1985), which represented the oil-boom years, all the major economic indicators, such as the components of non-oil GDP and total gross domestic expenditure, experienced remarkable growth. In the second stage, these indicators registered low growth rates, due to the noticeable decreases in government expenditure resulting from a sharp decline in oil revenue and the completion of major development projects. Finally, in this chapter, the economic and agricultural developments during the six Saudi development plans (1970-2000) are highlighted, shedding some light on the major import trends between 1970 and 2000 in Saudi Arabia.

Chapter three encompasses a large number of empirical studies. It explains many models of import demand for several countries with diverse characteristics. Differences in the behaviour of import demand in developed and developing countries can be summarized as follows:

First, the income elasticities of demand for imports in developed countries show appropriate magnitudes and signs, but the inferences with respect to prices are ambiguous with many insignificant estimates and a few incorrect signs. Second, the income elasticities for import demand in developing countries are significantly positive for some countries but for others the income elasticities are negative and insignificant, suggesting that prices do play an important role in the determination of import demand in developing countries. Third, despite the importance of demand parameters, there has been no attempt to estimate a complete elasticity matrix for meat import demand in Saudi Arabia. It is important to identify the structure of the meat imports and the main factors affecting the demand for these commodities.

Chapter four introduces the Almost Ideal Demand System (AIDS) developed by Deaton and Muellbauer (1980). In an AIDS, the budget shares of the various commodities are linearly related to the logarithm of total expenditure and the logarithm of relative prices. It was found that the AIDS model has become an attractive and popular approach in analyzing and evaluating demand theory of consumers' consumption behaviour in time series data. The flexibility and testable restriction of import demand also provides simplicity and easy elaboration to make the AIDS model appropriate for studying import demand for meat in Saudi Arabia.

Chapter five introduces the unit root tests, Engle- Granger cointegration analysis and the Johansen cointegration procedure. We summarize and simplify the different techniques used in the concept of cointegration analysis of both the Engle-Granger and the Johansen procedures. One important point of the cointegration analysis is that it easily gives a simple framework for testing long-run economic relationship for import demand for meat in Saudi Arabia.

Chapter six provides a brief discussion on per capita consumption and expenditure on meat. It was found that per capita consumption of meat increased from about 32.479 kg in 1981 to 84.45 kg in 2000, at a growth rate of 94 percent. Lamb, poultry and fish account for 30.13, 45 and 13.60 percent of meat expenditure; these are the highest shares among the meat commodity groups, because lamb, poultry and fish are the meats that are traditionally consumed in Saudi Arabia. Finally, religion, culture and the Gulf War are the exogenous variables that affect per capita consumption of meat in Saudi Arabia.

Chapter seven presents a dynamic specification of the AIDS based on recent developments on cointegration techniques and error correction models. The model uses Saudi meat import demand data over the period 1981-2000. The results of the Granger causality test indicate that expenditure on lamb, expenditure on poultry and expenditure on fish are the variables which cause changes in expenditure on other types of meat, because lamb, poultry and fish are the most important staple meats in Saudi Arabia. In order to construct long-run relationships among the variables, the Engel Granger cointegration test and the Johansen Likelihood Ratio procedure are employed. The results of both tests show that all coefficients were statistically significant in all equations. Thus, there is evidence of a long-run relationship between expenditure on meat with commodity prices and total meat expenditure. Cointegration ensures that changes affecting commodity prices or real meat expenditure will be reflected in different expenditure shares. The results for all budget share elasticities indicate that the demand for poultry and fish, in both the short and long run have inelastic price demand. However, in the case of the demand for beef and lamb, in the short-run this is inelastic but in the long run it was found to have unit elasticity. The magnitudes of short and long run, cross-price elasticities indicate that lamb is substitute for all meat items; poultry is substitute for lamb and beef. These results coincide with consumer behaviour in Saudi Arabia. The magnitudes of short and long-run expenditure elasticities indicate prices have dominated the effects on expenditure compared to total expenditure on these goods. Consumers appeared to react more to price changes than to expenditure changes. Finally, lamb, poultry and beef are classified as necessities, while fish is classified as a luxury good. We estimated the Error Correction Model (ECM) form of the Almost Ideal Demand System (AIDS). The error correction coefficient has the expected negative sign and is significant at the 1% level in all equations. In other words, output adjusts towards its equilibrium level and the error correction terms provide further evidence that the variables in the equilibrium regression are indeed cointegrated.

Empirical results show that, in the case of Saudi Arabia, the formulation of the import demand function for meat in this study is appropriate for estimating elasticities of meat import demand. The new parameters that have been obtained in our study differ significantly from those based on the other demand specifications. Differences in demand parameters and price trends for meat commodities identified in the demand system lead to different results in expected projections of per capita meat consumption for Saudi Arabia. Due to the results obtained in this study, the expenditure share of meat commodities in Saudi Arabia will change significantly with changes in the prices of commodities and in total meat expenditure. Lamb and poultry are substitutes for all meat items and poultry is a complement for fish only. These results coincide with consumer behaviour in Saudi Arabia, because lamb and poultry are the most important staple meats in KSA. The magnitude of elasticity results indicates the strength of the price effect. Consumers appeared to react more to price changes than to expenditure changes in the demand for all the meat items involved. The price of fish has no effect on expenditure on meat, implying that the expenditure on fish is separable from all other expenditure on meat. Finally, religion, culture and the Gulf War are the exogenous variables that affected per capita consumption of meat in Saudi Arabia.

Policy implications

The following policy implications can be drawn from the results of our analysis:

1. The large cross price elasticity in the long run implies that domestic inflation tends to increase the volume of imports that will eventually affect the balance of payments. Therefore, the government should control inflation by controlling expenditure and the money supply so that inflation is kept at a low rate and the balance of payments deficit may be reduced in turn. The results indicate a fairly large response of import values to changes in competing prices of imports in the long run. Furthermore, consumers tend to respond more to changes in import prices. The large price elasticities of imports could be a sign that Saudi Arabia has made progress in developing import substitute industries.
2. Production costs in Saudi Arabia with the possible exception of poultry industry are not competitive with production costs in other countries. Industrial modernization in Saudi Arabia will depend mainly on government support.
3. Producers in Saudi Arabia should improve their production health labelling and packaging. Moreover, marketing strategies and advertising have been ignored completely by domestic producers.
4. Consumers in Saudi Arabia are changing their consumption patterns by consuming healthier food such as fish.

8.3: Study limitations and further research

This study has some limitations. These limitations exist because data on some variables which are recommended to explain the complete import demand system are not available. The present study has focused on a demand sub-system of five meat types; this does not include other food and non-food expenditure e.g expenditure on education, healthcare, etc. which are also important in the analysis of a complete demand system.

Another limitation of this study is that demographic characteristics have not been included. Similarly, in an import demand systems for meat, our study does not consider factors like interest rates, subsidies and export credit, which are also important in studying import demand. Ideally, national government assistance to poultry producers in the EC, Brazil and the rest of the world should also be included. Further research could expand this study and include other food and non-food consumption in Saudi Arabia.

Table A 1: Granger Causality Test

This table provides summary of the Granger causality test results using the full data set. The tests are based on the following regression equation:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + .. + \alpha_p x_{t-p} + b_1 y_{t-1} + b_2 y_{t-2} + ... + b_p y_{t-p} + \varepsilon_t$$

If the following null hypothesis can be rejected, it is then concluded that y_t Granger causes x_t, denoted by $y_t \rightarrow x_t$.

Null Hypothesis:	F-Statistic	Probability
DFX → DBX	4.77479	0.00301
DBX → DFX	5.55487	0.00107
DLX → DBX	6.88898	0.00018
DBX → DCX	2.16005	0.09352
DBP → DBX	2.5152	0.05912
DLP→ DBX	2.5585	0.05588
DPOP→ DBX	3.14892	0.02582
DBX → DPOP	3.68373	0.01276
DLX → DFX	11.6732	3.80E-07
DFX → DLX	4.91326	0.00251
DCX → DFX	6.53317	0.00029
DFX → DCX	1.80113	0.14775
DPOX → DFX	15.7901	2.30E-09
DFX → DPOX	3.98915	0.00852
DFX → DPOP	2.18021	0.09113
DTX → DFX	12.0384	2.40E-07
DCX → DLX	3.91076	0.00945
DPOX → DLX	8.13856	3.60E-05
DLX →DPOX	6.28726	0.00041
DLP → DLX	2.22766	0.08574
DLX → DLP	1.84739	0.13935
DPOP → DLX	3.21229	0.02376
DTX → DLX	3.12201	0.02675
DLX → DTX	11.4302	5.20E-07
DBP → DCX	4.06199	0.00774
DFP → DCX	4.83615	0.00277
DCX → DFP	3.36429	0.01945
DCP→ DCX	3.06495	0.02883
DCX → DTX	2.75781	0.04311
DBP → DPOX	2.23868	0.08453
DFP → DPOX	2.88541	0.03648
DPOP → DPOX	2.44716	0.06457
DPOX→ DTX	4.45121	0.00462
DFP → DBP	1.90475	0.12958
DBP → DCP	2.16122	0.09338
DBP → DTX	2.71781	0.04542
DFP → DCP	4.02376	0.00814
DTX → DFP	2.39177	0.06937
DPOP → DTX	4.18774	0.00655

Table A2: Selecting the order of the VAR model

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model
Based on 230 observations from 1981 to 2000. Order of VAR = 10
List of variables included in the unrestricted VAR:
BX FX LX POX BP FP LP POP TX
List of exogenous variables: DH and DR.

Order	LL	AIC	SBC	LR test	Adjusted LR test
10	5467.1	4639.1	3215.8	-----	-----
9	5408.5	4661.5	3377.4	CHSQ(81)= 117.1793[.005]	70.3076[.796]
8	5329.9	4663.9	3519.0	CHSQ(162)= 274.4695[.000]	164.6817[.427]
7	5257.3	4672.3	3666.6	CHSQ(243)= 419.7132[.000]	251.8279[.335]
6	5178.1	4674.1	3807.7	CHSQ(324)= 577.9841[.000]	346.7905[.184]
5	5115.7	4692.7	3965.6	CHSQ(405)= 702.8306[.000]	421.6984[.274]
4	5050.8	4708.8	4120.9	CHSQ(486)= 832.6404[.000]	499.5843[.325]
3	4985.9	4724.9	4276.2	CHSQ(567)= 962.5374[.000]	577.5224[.371]
2	4898.8	4718.8	4409.3	CHSQ(648)= 1136.8[.000]	682.0592[.171]
1	4809.6	4710.6	4540.4	CHSQ(729)= 1315.2[.000]	789.0987[.061]
0	2081.3	2063.3	2032.4	CHSQ(810)= 6771.7[.000]	4063.0[.000]

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

Table A3: Estimated parameters of an AIDS-ECM for beef demand in Saudi Arabia, 1981-2000.

Dependent Variable: DBX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.008155	0.004003	-2.037341	0.0428
DBP	-0.726124	0.177667	-4.087001	0.0001
DFP	0.092872	0.080231	1.157557	0.2482
DLP	0.255373	0.222511	1.147687	0.2523
DPOP	0.779228	0.220887	3.527724	0.0005
DTX	-0.068077	0.044270	-1.537762	0.1255
DH	0.067257	0.016998	3.956640	0.0001
DR	0.028593	0.013853	2.063960	0.0401
RESIDBX(-1)	-0.766226	0.074263	-10.31770	0.0000
R-squared	0.441641	Mean dependent var		-0.000539
Adjusted R-squared	0.422220	S.D. dependent var		0.068717
S.E. of regression	0.052233	Akaike info criterion		-3.029269
Sum squared resid	0.627510	Schwarz criterion		-2.898356
Log likelihood	370.9976	F-statistic		22.74015
Durbin-Watson stat	2.099248	Prob(F-statistic)		0.000000

Table A4: Estimated parameters of an AIDS-ECM for fish demand in Saudi Arabia, 1981-2000.

Dependent Variable: DFX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.018833	0.009852	-1.911599	0.0572
DBP	0.357341	0.438470	0.814973	0.4159
DFP	-0.842155	0.197972	-4.253908	0.0000
DLP	0.232306	0.547490	0.424311	0.6717
DPOP	1.263186	0.551749	2.289419	0.0230
DTX	0.228323	0.108135	2.111472	0.0358
DH	0.174183	0.041449	4.202362	0.0000
DR	0.016689	0.034204	0.487905	0.6261
RESIDFX(-1)	-0.429864	0.076976	-5.584402	0.0000

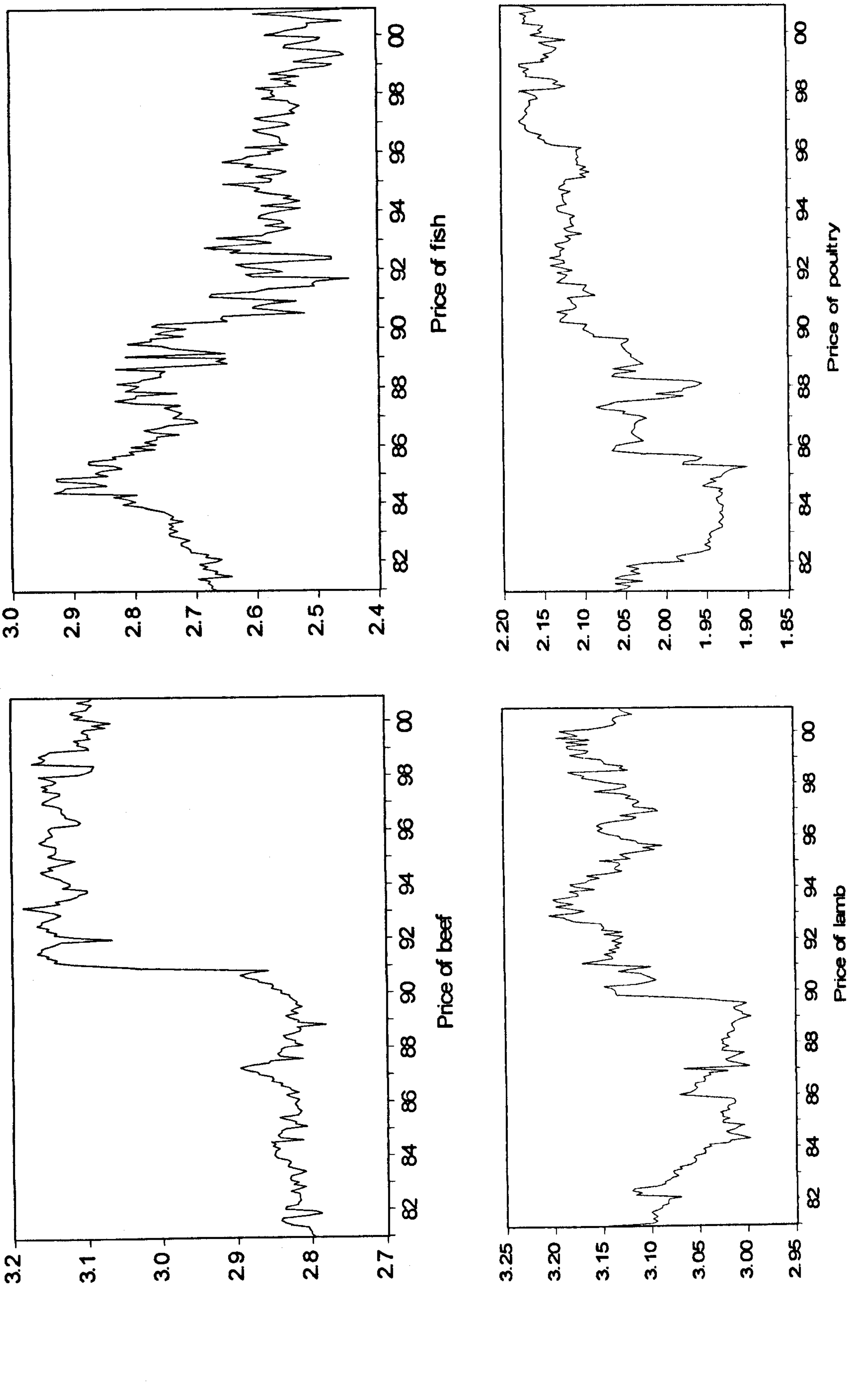
R-squared	0.344564	Mean dependent var	-0.000999
Adjusted R-squared	0.321766	S.D. dependent var	0.156530
S.E. of regression	0.128911	Akaike info criterion	-1.222467
Sum squared resid	3.822122	Schwarz criterion	-1.091554
Log likelihood	155.0848	F-statistic	15.11392
Durbin-Watson stat	2.167619	Prob(F-statistic)	0.000000

Table A5: Estimated parameters of an AIDS-ECM for lamb demand in Saudi Arabia, 1981-2000.

Dependent Variable: DLX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008563	0.002701	3.170425	0.0017
DBP	0.005247	0.120151	0.043673	0.9652
DFP	0.185889	0.054187	3.430503	0.0007
DLP	-0.453143	0.151269	-2.995616	0.0030
DPOP	0.115081	0.151927	0.757477	0.4495
DTX	-0.480489	0.029508	-16.28317	0.0000
DH	-0.028467	0.011326	-2.513397	0.0126
DR	-0.060513	0.009476	-6.385970	0.0000
RESIDLX(-1)	-0.548985	0.083916	-6.542062	0.0000
R-squared	0.805119	Mean dependent var		0.000237
Adjusted R-squared	0.798341	S.D. dependent var		0.078569
S.E. of regression	0.035283	Akaike info criterion		-3.813916
Sum squared resid	0.286321	Schwarz criterion		-3.683003
Log likelihood	464.7629	F-statistic		118.7759
Durbin-Watson stat	2.167889	Prob(F-statistic)		0.000000

Table A6: Estimated parameters of an AIDS-ECM for poultry demand in Saudi Arabia, 1981-2000.

Dependent Variable: DPOX				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001622	0.001233	-1.315184	0.1898
DBP	0.035734	0.054863	0.651328	0.5155
DFP	0.032837	0.024724	1.328138	0.1854
DLP	0.263148	0.069845	3.767613	0.0002
DPOP	-0.320219	0.068112	-4.701365	0.0000
DTX	0.202840	0.013481	15.04663	0.0000
DH	-0.014042	0.005188	-2.706872	0.0073
DR	0.031340	0.004301	7.286067	0.0000
RESIDPOX(-1)	-0.729643	0.087665	-8.323120	0.0000
R-squared	0.762451	Mean dependent var		8.07E-05
Adjusted R-squared	0.754189	S.D. dependent var		0.032472
S.E. of regression	0.016099	Akaike info criterion		-5.383143
Sum squared resid	0.059614	Schwarz criterion		-5.252230
Log likelihood	652.2856	F-statistic		92.27777
Durbin-Watson stat	1.987293	Prob(F-statistic)		0.000000


Price of fish
Price of beef
Price of poultry
Price of lamb
82 84 86 88 90 92 94 96 98 00
3.0 2.9 2.8 2.7 2.6 2.5 2.4
3.2 3.1 3.0 2.9 2.8 2.7
2.20 2.15 2.10 2.05 2.00 1.95 1.90 1.85
3.25 3.20 3.15 3.10 3.05 3.00 2.95

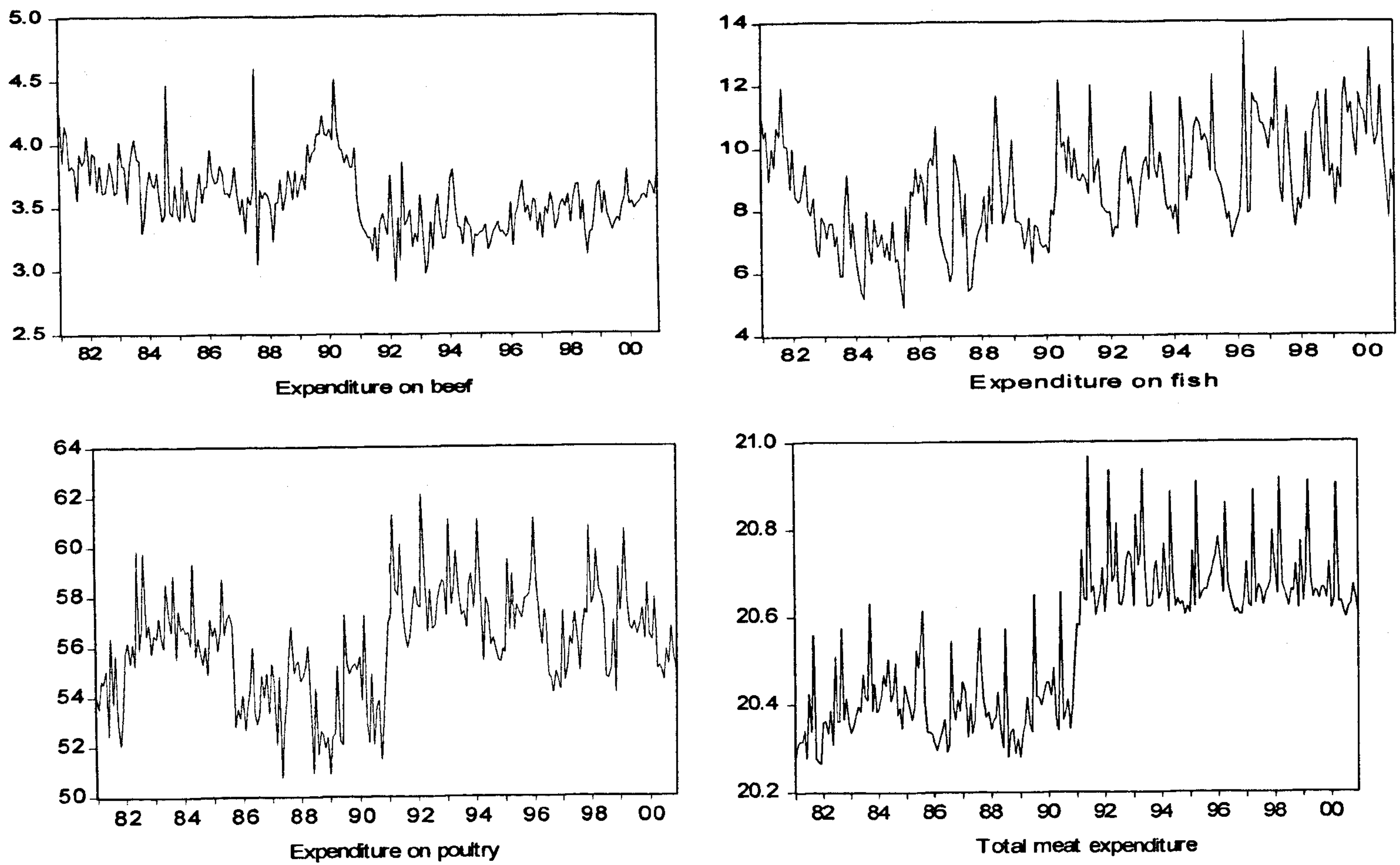

5.0
4.5
4.0
3.5
3.0
2.5
82 84 86 88 90 92 94 96 98 00
Expenditure on beef
14
12
10
8
6
4
82 84 86 88 90 92 94 96 98 00
Expenditure on fish
64
62
60
58
56
54
52
50
82 84 86 88 90 92 94 96 98 00
Expenditure on poultry
21.0
20.8
20.6
20.4
20.2
82 84 86 88 90 92 94 96 98 00
Total meat expenditure

Figure (2A)

References

Abu Mouti, Ahmed (1993), "Food Expenditure Patterns in the Kingdom of Saudi Arabia", *King Saud University*, Riyadh.

Awudu, Devendra K. Jain and Ashok K Sharma (1999), "Household Food Demand Analysis in India", *Journal of Agricultural Economics*, Vol. 50, No 2.

Abigail and Richard Tiffin (1999), "Estimates of Food Demand Elasticities for Great Britain", *Journal of Agricultural Economics*, Vol. 50, No1.

Abuunaba, A. (1981), "*An Analysis of Marketing in Saudi Arabia and American Marketing Executives*" PhD Thesis, North Texas State University.

Akbay ,Cuma and Ismet Boz (2001), "Food Consumption Patterns in Turkey", *Economics Meeting in Ankara*, Turkey.

Akhtar, M. A. (1981), "Income and Price Elasticities of Non- Oil Imports for Six Industrial Countries", *The Manchester School*, pp. 334-347.

Alghamdi, Mosleh (1990), "A dynamic Analysis of Demand for Fish in The Kingdom of Saudi Arabia". *King Saud University*, Riyadh.

Al-Ghanim, Abdullah (1991), "The Demand on Foodstuff Imports in Qatar". *Gulf Cooperation Council.*

Alston, Carter, Green, and Pick (1990), "Applied the Armington Model". *American Journal Agricultural Economics*, pp. 614-629.

Al-Mallah and Al-Gazaz (1996), "*The Local Demand for Dates in the Kingdom of Saudi Arabia*", King Saud University, Riyadh.

Al-Jwaili, Ahmed (1983), "The External Trade In Both Egypt and the Sudan", *Alexandria Journal of Agricultural Research,* Vol 18, pp.18-30.

Arize, Augustine (1987), "The Elasticities and Structural Stability of Import Demand Function for Nigeria", *Social and Economic Studies*, Vol. 36, pp. 171-185.

Alzagee, Abdullah (1987), "Demand for lamb and fish in Kuwait" *Gulf studies*, vol 221, (Arabic)

Babalola, Olajide (1995),"An Empirical Analysis of Nigeria Import Demand Function", *Dalhousie University*, MS Thesis.

Banerjee, A., Dolado, J., Galbraith,J.,and Hendry(1993), Cointegration, Error Correction, and the econometric Analysis of Non- Stationary Data, *Oxford University Press*, New York.

Barewal, S., and D Goddard (1985), "The Parameters of Consumer Food Demand in Canada". Marketing and Economics Branch Working Paper. Ottawa: *Agriculture Canada*, p. 15.

Berndt, E. R. and N.B. Savin (1975). "Estimation and Hypothesis Testing in Singular Equation Systems with Autoregressive Disturbances", *Econometrica,* p.p 937-57.

Blanciforti, Laura, Richard D. Green, and Gordon A. King (1986) "US Consumer Behaviour Over the Postwar Period: An Almost Ideal Demand System Analysis" Giannini Foundation Monograph, No. 40. *Berkeley: University of California.*

Bhaskara, Rao, B. (1994).Cointegration for Applied Economist, *The Macmillan Press.*

Buse, A. (1994), "Evaluating the linearized almost ideal demand system", *American Journal Agricultural Economics* 76, pp.781-793.

Buse, A. and Chan, W. (2000), "Invariance, price indices and estimation in almost ideal demand system.", *Empirical Economics,* 25,pp.519-39.

Capie,Forrest (1974), "Demand for Meat in England and Wales", *University of Warwick,* No. 40.

Capps, Oral, John R .Tedford, and Joseph Havucek (1985) "Household Demand for Convenience and Non conveniences Food", *American Journal of Agricultural Economics,* No.67: pp. 862-69.

Charemza, Wojciech., & Deadman,D. (1997), New Directions in Econometric Practice, Second Edition, *Edward Elgar Publishing Limited,* England

Choi, In (1992), "Effects of Data aggregation on the power of tests for a unit root". *Economics Letters,* 40:pp.397-401.

Chalfant, James (1987). "A Globally Flexible, Almost Ideal Demand System." *Journal of Business and Statistics* 5, pp. 233-42.

Chalfant, James, and Alston, J.M.(1986), "Testing for Structural Change in a System of Demand Equations for Meat in Australia." Paper presented at *the AAEA Post-Conference Workshop on Consumer* Research into the Demand for Meat in Australia, Canberra, Feb.

Chesher, A and Rees, H. (1987). "Income Elasticities of Demand for Food in Great Britain", *Journal of Agricultural Economics*, No. 25: pp. 435-48.

Davies, Pendleton, M, and Chard R I. (1984), *The Green Book Guide for Living in Saudi Arabia.* 4th edition. Middle East Editorial Associates, Washington, DC, 1984.

Deaton, Angus and John Mullbauer (1980), "An Almost Ideal Demand System", *American Economic Review*, No. 70: p. 312-26.

Deaton, Angus (1986) " Demand Analysis" In Handbook of Econometrics, *ZviGriliches and Michael D. Amsterdam: North-Holland*, pp. Vol. 3, pp.1797-1839.

Dickey, David A., and Wayne A. Fuller (1979). "Distribution of Estimators for Auto-regressive Time Series with a Unit Root". *Journal of American Statistical Association* 74: pp. 427-431.

Dickey, D.A. and Fuller, W.A. (1981) "Likelihood Ratio Statistics for Autoregressive time series with a unit root", *Econometrica*, 49, pp.1057-72.

Dickey, D.A. and S.S., Pautula (1987) "Determining The Order of Differencing in Autoregressive Processes", *Journal of Business and Statistics* 5, pp. 455-461.

Dickey, D.A. and Rossana, R.J. (1994), "Cointegrated Time Series: A Guide to Estimation and Hypothesis Testing.". *Oxford Bulletin of Economics and Statistics*, Vol. 56, pp.325-353.

Doornik, J. A. and D. F. Hendry, (1994), *Interactive Econometric Modelling of Dynamic Systems*, London: International Thomson Publishing.

Eales, J.,Unnevehr,L. (1988)."Demand for beef and chicken products". *American Journal Agriculture Economics*, 70:pp.521-532.

Enders, Walter (1995). Applied Econometric Time Series. New York, Wiley & Sons.

Engle, Robert E.,and Clive W.J. Granger (1987)."Cointegration and Error Correction: Representation, Estimation, and Testing". *Econometrica* 55: pp. 251-276.

Engle,R.F. , Granger, C.W.J, and Yoo, B.s. (1991) "Cointegrated economic time series: an overview with new results in the long run economic relationships": Reading in cointegration, R.F. Engle and C.W.J Granger, *Oxford University Press*, New York.

Food and Agricultural Organization, *Statistical Yearbook*, various issues, (1970-1999).

Frisch, R. (1959), "A complete Scheme for Computing All Direct Cross Demand Elasticities in a Model of Many Sectors", *Econometrica*, No. 27: pp. 177-96.

Fulponi, L. (1989) "The Almost Ideal Demand System: An Application of Food and Meat Groups for France". *Journal of Agricultural Economics* 40, pp.82-92.

Gallant, A.R. (1987), "Nonlinear Statistical Models" John Wiley and Sons, Inc., New York.

Geweke, J., R. Meese, and W., Dent (1983) "Comparing Alternative Tests of Causality in Temporal Systems" *Journal of Econometrics*, 21, 161-194.

Geary, R. C. (1950), "A Note on a Constant Utility Index of the Cost of Living". *The Review of Economic Studies*, No.18:p. 65-66.

Ghatak, S (2003), *Introduction to Development Economic*, Fourth edition, Routledge, New York.

Ghatak, S and D. Deadman (1989), "Money, price and stabilisation policies in some developing countries", *Applied Economics* 21, pp.853-865.

Ghatak, Anita (1998), "Aggregate Consumption Functions for India", A cointegration analysis under structural change" *Journal of Applied Statistics*, Vol. 25, No. 4.

Granger, C.W.J. (1969), "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods", *Econometrica*, 37, pp. 24-36.

Granger, C.W.J. and Newbold (1974), "Spurious Regressions in Econometrica", Journal of *Econometrica*, 35, p.143-159.

Granger, C.W.J. (1981) "Some Properties of Time Series Data and Their se in Econometrics Model Specification" *Journal of Econometrics*, 16, p.121-130.

Granger, C.W.J. (1987) "Developments in the Study of Cointegrated Economic Variables" *Oxford Bulletin of Economics and Statistics*, 48/3, p.213-228.

Guilkey, D.K. and M.K., Salemi (1982) "Small Sample Properties of Three Tests For Granger-Causal Ordering in a Bivariate Stochastic System", *Review of Economics and Statistics*, 64, p. 668-680.

Gujarati, D.N. (1995), *Basic Econometrics*, 3rd edition. McGraw-Hill.

Hansen, H. and K. Juselius, (1995), CATS in RATS *cointegration Analysis of Time Series.*

Harvey, A. (1990), The Econometric Analysis of Time Series, 2nd edition, Phillip Allan, Hemel Hempstead.

Harvey, Cutler, and Phillips, Ronnie (1998)."Domestic exchange rates and regional economic growth in the United State". *The Journal of Economic History* 58:p. 1010-1026.

Hartley, R F. (1985.) Marketing Successes Historical to Present Day. John Wiley and Sons, New York.

Haug, A.A. (1993) "Residual based tests for cointegration: a Monte Carlo study of size distortions", *Economics Letters*, 41, p.345-51.

Hayes, D. (1990) "Meat Demand in South Korea: A Systems Estimate and Policy Projections" *Agribusiness* 7, pp.433-466.

Heien, M. Dale and Wessells (1988) "The Demand for Dairy Products: Structure, Prediction, and Decomposition, *American Journal of Agricultural Economics*, 5: pp. 121-132.

Hofstede, G.(1984), *Culture's Consequences.* Sage Publication, London, 1984.

Holden, K. and J., Thompson (1992) "Cointegration: An Introductory Survey", *British Review of Economic Issues,* 14, p. 33, 1-55.

Houthakker and Magee (1969), "Prices and Income Demand Elasticities both for Imports and Exports for Developed Countries". *Review of Economics and Statistic,* No. 51, pp. 111-125.

Houthakker, H. S. (1960). "Additive Preferences", *Econometrica,* No.28:pp.244-57.

Johanson, Stanley R., Zuhair A. Hassan, and Richard D. Green (1984). "Demand Systems Estimation: Methods and Applications". Ames*: Iowa University Press.*

Johanson, S.(1988)."Statistical Analysis of Cointegrating Vectors". *Journal of Economic Dynamics and Control* 12:p. 231-254.

Johansen, S. And Juselius (1990), "Maximum Likelihood Estimation and inference on Cointegration-With Application to the Demand for Money", *Oxford Bulletin of Economics and Statistics,* 52, p. 169-210.

Johansen, S. (1991)."Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models" .*Econometrica* 59:p.1551-1580.

Johansen, S. (1992), "Determination of Cointegration Rank in the Presence of a Linear Trend", *Oxford Bulletin of Economics and Statistics*, 54, 3, p. 383-397.

Johansen, S. and K. Juselius (1992), "Testing Structural Hypothesis in A Multivariate Cointegration Analysis of the PPP and the UIP for UK", *Journal of Econometrics*, 53, p.211-224.

Johansen, S. (1989), "Likelihood Based Inference on Cointegration. Theory and Applications", *Cento Interuniversitario Di Econometria* (CIDE), Bologna.

Karagiannis, Giannis and K. Velentzas (1997), "Explained Food Consumption Patterns in Greece", *Journal of Agricultural Economics*, Vol. 48, No 1.pp. 83-92.

Karagiannis, Giannis and K. Velentzas (2000). "An error correction Almost Ideal Demand System for meat in Greece", *Agricultural Economics*, 22:pp. 29-35.

Khan, Mohsen (1975a), "Import and Export Demand Functions for Developing Countries", *IMF Staff Paper*, No. 21, pp. 678- 93.

Klein, L. R. and H. Rubin (1947), "A Constant Utility Index of the Cost of Living" *The Review of Economic Studies*, 15(2), No. 38, pp. 84-87.

Lilien, and Gopalakrishna , (1994),"A Dynamic model of Business Trade Show Effectiveness", *ISBM Report*, 3.

Lipsky, George A. (1959), Saudi Arabia: Its People, Its Society, and Its Culture, New Haven:Hraf Press.

Maddala,G.S. (1992),Introduction to Econometrics, New York: Macmillan.

Maddala,G.S. and Kim (1998), Unit Root Cointegration and Structural Change. *Cambridge University Press*, Cambridge, UK.

Mackinnon,J.G.(1991) "Critical values for integration and cointegration tests", in Long-run Economic Relationships: Readings in Cointegration..R.F.Engle and C.W.J. Granger. *Oxford University Press*, New York, p.267-276.

Maradoi, Hutasuhut, Hui-Shung Chang, Garry Griffith and Howard Doran (2002), "The Demand for Beef in Indonesia", *Agribusiness Review*, Vol. 10.p.217-229.

Martyn, Duffy (2001), "Integrating demand system for food in the United Kingdom", *Manchester School of Management.*

McLaren, K. R. and Fry T. L. (1995),"A Simple Nested Test of the Almost Ideal Demand System.", *Empirical Economics*, 20, pp.149-61.

Ministry of Planning, *Central Department of Statistics, Foreign Trade, 1975-1999.*

Ministry of Agricultural and Water, *A view on the Agricultural Development in the Kingdom of Saudi Arabia*, 1970- 1999.

Ministry of Agricultural and Water, *Agriculture Statistical Year Book*, 1999.

Miller, S.M. and F..Russek (1990) "Cointegration and Error- Correction Model: Temporal Causality between Government Taxes and Spending" *Southern Economic Journal*, 57, p.221-229.

Ministry of Finance and National Economy, *Export Statistical Yearbook*, various issues. Riyadh, Saudi Arabia

Ministry of Finance and National Economy, *Foreign Trade Statistics in Saudi Arabia*, Various issues. Riyadh, Saudi Arabia

Ministry of Hajj, Islamic Studies, Riyadh, Saudi Arabia, 1998.

Ministry of Planning, Import Statistics in Saudi Arabia, various issues. Riyadh, Saudi Arabia.

Moosa, I. (1994): "Testing Proportionality, Symmetry and Exclusiveness in Long-run PPP", *Journal of Economic Studies*, 21, 3-21.

Mustapha, Nik, Abdul Aziz Abdul Rahman, Alias Radam and Ahmad Baharumshah (1999), "Demand and Prospects for Food in Malaysia", *Department of Agribusiness and Information System*, Serdang, Malaysia.

Muscatelli, V.and Hurn (1992). "Cointegration and Dynamic Time Series Models", *Journal of Economic Surveys*, 6(1).

Murray, J. (1984), "Retail Demand for Meat in Australia: A Utility Theory Approach." *Economic Record*, 60, pp. 45-56.

Moschini, G. (1995), "Units of measurement and the Stone index in demand system estimation", *American Journal of Agricultural Economics*, 77, pp.63-68.

Nelson, C.R. & Plosser, C. (1982) "Trends and random walks in macroeconomic time series: Some evidence and implication" *Journal of Monetary Economics*, 10, pp.139-162.

NG, Serena (1995), "Testing for Homogeneity in Demand System when the repressors are Nonstationary", *Journal of Applied Economics*, vol. 10, pp. 147-163.

Osman, Mohammed (1987), "An Economic Analysis of the Demand for Wheat in Saudi Arabia". *King Saud University*, Saudi Arabia, Riyadh.

Patterson, Kerry (2000), *An Introduction to Applied Econometrics: A Time Series Approach,* Palgrave, New York. Macmillan Press Ltd.

Park, John, Rodney B. Holcomb, Kellie Curry Raper, and Oral Capps (1996), "The Demand Systems Analysis of Food Commodities", *American Journal Agricultural Economics,* pp. 290-300.

Parikh, Ashok (1986)."The Estimation and Forecasting of Trade Shares", *United Nations Economic and Social Commission for Asia and the Pacific.*

Pashardes, P. (1993), "Bias in estimating the almost ideal demand system with the Stone index approximation", *Economic Journal*. 103, pp.908-915.

Peseran, H. and Peseran, B. (1997) Microfit 4.0: An Interactive Econometric Software Package (User Manual), *Oxford University Press*, Oxford.

Perron, P.P. (1989), "The Great Crash, the Oil Price *Shock and the Unit Root* Hypothesis", *Econometrica*, Vol. 57, pp.1361-1401.

Presley, John and Westaway, A.J. (1989), A Guide to the Saudi Arabian Economy, Second edition, *London: Macmillan.*

Presley, John (1996), *Sixth Development Plan*, The Saudi British Bank, Saudi Arabia, Riyadh.

Phillips. L. (1983)."Applied Consumption Analysis". *Revised and Enlarged Edition, North-Holland Publishing Company*, Amsterdam.

Pollak, R., and Wales, Terence J. (1969). "Estimation of Linear Expenditure System". *Econometrica*, No.37:629-50.

Phillips, Peter C.B.,and Pierre Perron (1988).Testing for a Unit Root in Time Series Regression, .*Econometrica*, 75: p.335-346.

Phillips,P.C.B. (1986), Understanding Spurious Regression in Econometrics, *Journal of Econometric*, 33: p.311-340.

Phillips, Peter C.B.,and Pierre Perron (1998).Testing for a Unit Root in Time Series Regression. *Econometrica*, 75: p.335-346.

Rao, B., Bhaskara (1994).Cointegration for Applied Economist, *The Macmillan Press.*

Ray, Ranjan (1982)."The Testing and Estimation of Complete Demand System on Household Budget Survey: An Application of AIDS". *European economic Review*, No. 17:p. 349-69.

Rinaldi, R. and R. Tedeschi, (1996), *Money Demand in Italy: A System Approach,* Temi di Discussione, No. 267, Banca d'Italia, May.

Robertson, D. and M. Wickens, (1994), VAR Modelling, in S.G. Hall, Applied Economic Forecasting Techniques, London: Harvester,Wheatshea.

Ronnie, Pillips and Cutler, Harvey (1998).Domestic exchange rates and regional economic growth in the United States. *The Journal of Economic History* 58:1010-1026.

Saudi Arabian Monetary Agency (SAMA), *Annual Report, 1970-2000, Saudi Arabia, Riyadh..*

Sawyer, Charles and Richard l. Sprinkle (1997), "Demand for Imports and Exports in Japan", *Journal of Japanese and International Economies*, pp. 247-259.

Sinha, D.(1997), "Determinants of Import Demand in Thailand", *International Economics Journal*, vol:11, No. 4, pp. 73-82.

Silberberg, E. (1992), "The Structure of Economics: A Mathematical Analysis, 2nd ed. *McGraw-Hill Publication.* Co, New York.

Singh, B. and B. S. Sahni (1984), "Causality between public expenditure and national income", *Review of Economics and Statistics* 66, pp.630-644.

Stone, J.R.N. (1954). "Linear Expenditure System and Demand Analysis: An Application to the Pattern of British Demand". *Economic Journal*, No. 64:pp.511-27.

Sung (1996), "Beef Import Demand and Impacts of Exchange Rate Changes in Korea", *American Journal Agricultural Economics*, pp. 542-556.

The Saudi British Bank, *Trade and Saudi Arabia, 2001.*

The Saudi British Bank, *Saudi Arabian and Membership of WTO, 1999.*

Theil, H.(1980). "System-Wide Approach to Micro-economic" Chicago: *University of Chicago Press.*

Theil, H, and K.W. Clements.(1987), " Applied Demand Analysis." Series on Econometrics and Management Sciences, Vol.7., Cambridge, Massachusetts: Ballinger, 1987.

Timothy A. Deyak, W. Charles and Richard L Sprinkle (1991), "Comparison of the Demand for Imports and Exports in Japan and United States", *Journal of World Trade*, pp. 64-72 .

Varian, H.R. (1984), "Microeconomic Analysis, Second Edition, New York.

Watson, A, and S. Sturgess (1978), "Oligopoly Pricing in the World Wheat Market". *American Journal of Agricultural Economics* 60 (2). Pp.137-85.

Watsham, T. and Parramore, K. (1997) "*Quantitative Methods in Finance*". Thomson Business Press.

Walter, Veandaele (1983), "*Applied Time series and Box-Jenkins Model*", Jersey, Channel Islands: A GJP Publication.

Wilson, Rodney (1979), *The Economies of the Middle East*, London: Macmillan.

Wilson, Rodney and Presley, John (1991), *Banking in the Arab Gulf*, London: Macmillan.