COMPLETE FOOD COMMODITY DEMAND SYSTEMS FOR SAUDI ARABIA WITH COMMODITY PROJECTIONS AND POLICY APPLICATIONS FOR WHEAT

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FOR WHEAT

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CHAPTER I

INTRODUCTION

Problem Statement

Saudi Arabia is considered 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 sectors) 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 development of bond markets. Consequently, in the 1984/85 budget, oil and non-oil revenues contributed 40 and 60 percent, respectively, of government receipts compared to 65 and 35 percent in the 1979/80 budget which indicates Saudi Arabia has taken steps to diversify its economy.

Since the start of diversification, the agricultural sector has been one of the fastest growing sectors. 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 1970's to 8.7 percent in the 1980 to 1985 period. This growth rate lead to agriculture's contribution of about 5 percent in non-oil GDP for 1985.

Saudi Arabia has achieved self-sufficiency in wheat, eggs, and dates. In fact, it currently exceeds the domestic demand for these commodities. Also,

there has been success in expanding production in broilers, dairy products, vegetables, and fruits. The rapid expansion in dairy products and broilers has permitted meeting about 40 percent of domestic demand.

Self-sufficiency in wheat was achieved in 1984 in response to the government's procurement price of $1,030 per metric ton (mt). Farmers increased their production from 85,435 metric tons in 1980 to 1.3 million metric tons in 1984. Having achieved self-sufficiency in wheat, the government reduced the subsidy to $571 a metric ton (four times higher than the world market price) for the 1985 crop year. The larger, more efficient farmers can still make a profit from wheat production at the lower subsidy.

Wheat self-sufficiency was gained at the expense of other cereal crops such as barley, sorghum, and millet. Production of the other cereal crops has declined but demand, especially for barley used for cattle feed, has been increasing, thereby increasing imports. Barley, sorghum, and millet could be the next crops targeted for subsidy in Saudi Arabia.

Even though agricultural output has increased because of heavy subsidies (the area under cultivation expanded from 150,000 acres in 1974 to about 2.3 million acres in 1984), Saudi Arabia still imports about 70 percent of its agricultural commodities from international markets, estimated to be one of the world's highest per capita import levels.

The Saudi government policy goals include a high level of self-sufficiency in foodstuffs and stable prices of the basic food commodities. Those groups included in the agricultural and food subsidy system are producers and consumers. Producer subsidies include commodity price supports; free land grants; 45 percent subsidy on major farm implements; 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 (Gardner).

During the last decade, the demand for basic food commodities increased dramatically in Saudi Arabia. There are several social and economic factors causing this rapid increase in consumption of basic food commodities including population growth, up from 6 million in 1970 to about 11 million in 1985. Because of high wages and a high increase in the number of development projects launched by the government, there are many guest workers in the Kingdom drawn from all over the world. The census (International Trade Center, UNCTAD/GATT) shows the number of guest workers at about 1.5 million from the Middle East and East African countries; between 2 and 2.5 million from India, Sri Lanka, Pakistan, Bangladesh, Thailand, the Philippines, Malaysia, the Republic of Korea, and Turkey; 100,000 from the North African Arab countries; and about one million from North America and Europe. In addition to the guest workers, the number of religious pilgrims who come to the Holy City (Mekka) 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 risen 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 income, have improved standards of living and changed significantly the structure and pattern of consumption.

Residents have increasingly adopted technology for storing frozen and chilled foodstuffs, thus keeping foods for longer periods of time, yet maintaining a high nutritional value. This has caused consumption patterns to change and consumption to increase. Even though the Saudi people are more aware of, and 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 direct consumer subsidy was estimated to be about $6.619 billion from 1980-1985 (MOFNE). Because water, electricity, and gasoline are also heavily subsidized by the Saudi government, this has led to an indirect impact on consumer subsidies.

Even with the decrease in oil revenues the last few years, Saudi Arabia is likely to continue providing government services and subsidies to maintain high standards of living for people in the Kingdom.

Importance of the Study

There has been a sharp increase in food consumption and significant changes in the composition of the food basket for Saudi Arabia over the past two decades. This result has continued during the recent past even though oil revenues have decreased per capita GDP significantly. The major factors that have contributed to increased food demand and a change in the composition of the food basket are:

1) Growth in population (Table 1). The large growth in infrastructure and development projects during the 1970's resulted in increased demand

TABLE I

POPULATION, POPULATION GROWTH RATE, AND NOMINAL AND REAL GROSS DOMESTIC PRODUCT PER CAPITA, SAUDI ARABIA, 1971-1986

Year	Population	Population Growth Rate	Nominal GDP Per Capita	GDP Deflator	Real GDP Per Capita	Real GDP Growth Rate
	(1,000)	(Percent)	(SR)	(base 1980)	(SR)	(Percent)
1971	6,470	2.89	3,539	14.7	24,059	10.00
1972	6,660	2.89	4,249	15.7	26,951	10.77
1973	6,860	2.96	5,918	18.9	31,326	13.97
1974	7,067	2.97	14,051	40.2	34,993	10.48
1975	7,282	3.00	19,171	56.7	34,042	-2.80
1976	7,734	6.02	21,399	61.1	34,820	2.23
1977	8,277	6.79	24,780	66.2	37,453	7.03
1978	8,742	5.47	25,601	68.6	37,565	0.30
1979	9,082	3.82	27,351	71.2	38,581	2.63
1980	9,420	3.65	40,955	100.0	40,955	5.80
1981	9,759	3.54	53,346	125.0	42,668	4.01
1982	10,099	3.42	51,956	124.0	41,915	-1.80
1983	10,433	3.35	39,759	109.9	36,177	-15.86
1984	10,794	3.31	35,353	98.6	35,325	-2.41
1985	10,650	-1.34	31,925	93.7	33,962	-4.01
1986	10,600	-0.47	23,871	88.9	26,858	-26.45

Source: USDA, Economic Research Service, Data User Service for Saudi Arabia. International Montary Fund (IMF), International Financial Statistics (IFS), Washington, D. C., 1987.

for guest workers. The population growth rate averaged under 3 percent during the first half of the 1970's. The latter part of the 1970's and the first part of the 1980's had higher annual growth rates with a peak rate of 6.8 percent in 1977. The growth rate in population turned negative in 1985 as the demand for guest workers decreased.

2) Growth in nominal and real per capita GDP (Table 1). In the 1970's, GDP per capita increased because of increased oil prices and exports. Growth in real per capita GDP increased during this period at an annual rate of 6 percent. Real per capita GDP has subsequently decreased from SR 42,668 in 1981 to SR 26,858 in 1986.

3) Change in standards of living and consumption preferences.

4) Food subsidies.

Growth in food demand for the future, however, may be very different from the past for the following reasons:

1) Growth in population may slow and the composition of the population between nationals and guest workers may change. As large infrastructure and development projects come to completion and as the growth in energy demand takes on a more stable long run equilibrium rate, the demand for guest workers will decrease and population growth will become closer to the natural rate of increase.

2) Growth in per capita income may slow and the income elasticities of demand may decrease as incomes reach higher levels. Growth in aggregate food demand will more nearly approach the levels of industrialized countries.

3) Effects of changes in consumer preferences may slow and those preferences may increasingly take on those of the developed industrialized countries.

4) Government policies of the future may be considerably different from the past. There undoubtedly will be reduced consumer and producer subsidies and more market oriented policies directed towards investments, imports, exports, and pricing. Other government policies towards distribution of wealth may be employed with emphasis on policies of income maintenance, manpower training, and progressive taxation.

It is important that the government of Saudi Arabia anticipate the effects of these changes on growth of food demand and to focus on food policies that contribute to the overall development goals of 1) a measure of food self-sufficiency, 2) equitable distribution of the benefits of economic development, and 3) private sector orientation to market development.

However, the analytical and empirical research base in Saudi Arabia is limited in providing policy makers an understanding of the potential impacts of these changes. There is no consistent framework for analyzing the empirical effects of changes in the factors affecting demand for food commodities. Similarly, there is no consistent framework for analyzing effects of a more private sector orientation to market development. Analysis of individual commodity markets in isolation is generally misleading because of interdependencies of consumption, production, and government policies. The availability of a complete food demand system and a general equilibrium framework for analyzing market interdependencies would be helpful tools in providing information to policy makers for formulating and evaluating economic

plans and government policies. Making available information on expected food demand and food production will facilitate government policy formulation to reduce the potential of a food shortage crisis. This information not only helps match supply with demand, but it also contributes to the efficient allocation of resources and increased economic development in the various economic sectors.

A complete demand system has not been estimated for the Saudi Arabia economy nor has a policy framework been established to analyze the effects of changes in government policy upon the food system. These tools need to be developed and tested in evaluating the effects of changes in the food demand system.

Objectives of the Study

The overall objective of this research is to develop and apply a framework for analyzing the Saudi Arabia food commodity demand and supply effects from adjustments in selected government policies of consumer price subsidies, producer support prices, input price subsidies, and selected macroeconomic government policies such as income transfers and limiting the expatriate labor force. Specific objectives of the research include:

1. Specification and review of the theoretical models for analysis of the effects of Saudi Arabia government policies on food commodity markets. This objective will include a selected review of past studies on the analysis of agricultural commodity markets for Saudi Arabia.
2. Estimation of a complete food demand system for Saudi Arabia at different levels of commodity aggregation including the estimation of direct and cross price elasticities and income elasticities of demand.

3. Establishment of a partial equilibrium framework for analysis of adjustments in selected government policies on food commodity demand utilizing the systems estimated in objective two.
4. Analysis of the overall policy implications of adjustments in government policies on food commodity demand and supply, government costs, and social welfare.

Background Information

The increase in the price and production of oil in 1972-73 was a welcome shock to the Saudi economy but caused a certain amount of instability among the various economic sectors in the country. The GDP increased by 20 percent in 1972-73 and 15 percent in 1973-74 primarily because of increased price and production of oil.

Prior to 1940 the agricultural sector was the cornerstone of the Saudi economy and was the principal occupation of most of the population. Because most of the basic food was produced domestically, the country was considered to be self-sufficient. Before 1962 it was estimated that about 60 percent of the Saudi population derived their living from agriculture and livestock production. By 1974 this percentage had dropped to 37 (Quotah).

Agriculture's contribution to Gross Domestic Product (GDP) decreased from 11 percent in 1960 to 5.7 percent in 1970, and to 1.07 percent in 1981, but then started increasing in 1982 (Table II). Growth in the agricultural sector GDP in the latter years is because of generous subsidies. In contrast, the number employed in the agricultural sector fell from 40 percent in 1975 to about 25 percent in 1980 (Abdul-Ghani). The decline in the total agricultural labor force is, in part, because of capital substitutions. The elasticity of substitution

TABLE II

AGRICULTURE SHARE IN GROSS DOMESTIC PRODUCT (GDP), 1970-1985 (MILLION SAUDI RIYALS IN CONSTANT PRICES)

Year	Total GDP	Oil GDP	Non-Oil GDP	Agriculture GDP	Agriculture GDP as Percentage of Total GDP	Agriculture GDP as Percentage of Non-Oil GDP
1970	135,960	76,687	59,273	7,688	5.70	13.00
1971	155,600	99,457	56,143	6,912	4.44	12.30
1972	179,500	121,009	58,491	6,745	3.76	11.53
1973	214,900	154,567	60,333	6,026	2.80	9.99
1974	247,300	208,917	38,383	3,090	1.25	8.05
1975	247,900	197,948	49,952	2,473	1.00	4.95
1976	269,300	191,848	77,452	2,596	0.96	3.35
1977	310,000	207,745	102,255	2,819	0.91	2.76
1978	328,400	197,375	131,025	5,697	1.73	4.35
1979	350,400	199,785	150,615	5,892	1.68	3.91
1980	385,800	254,916	130,884	4,648	1.20	3.55
1981	416,400	290,598	125,802	4,457	1.07	3.50
1982	423,300	274,677	148,623	5,436	1.28	3.66
1983	377,800	190,861	186,939	7,939	2.10	4.25
1984	381,300	156,973	224,327	10,470	2.80	4.70
1985	361,700	131,574	230,126	11,286	3.50	4.90

Source: Kingdom of Saudi Arabia, Ministry of Planning, Achievement of the Development Plans, 1970 - 1990.

between capital and labor is estimated to be 1.5 which indicates a high potential for substituting capital intensive technologies for labor (Al-Homoudi).

The domestic demand for basic foodstuff has increased dramatically since 1970 because of increases in per capita incomes, changes in consumption patterns, a population growth rate of 3 percent, rapid urbanization, increased levels of education, and growth in the number of guest workers.

To accomplish the goals of increased food self-sufficiency, economic diversification, and national economic security, growth and development in the agricultural sector was needed. Therefore, policy makers in Saudi Arabia developed and implemented four continuous economic development plans, each having a five-year span (1970 to 1990), with emphasis on agriculture.

Generally, the overall objectives of these plans were to expand domestic output to meet shortages in demand (achieving self-sufficiency policy), to improve standards of living, and to increase growth of employment. In accomplishing these objectives, care was exercised so there would be minimal misallocation of resources or instability in the economy which would lead to undesirable economic results such as a high rate of inflation and/or increased inequality of income distribution. These development plans were designed to spread the benefits of increased oil revenue to other sectors in the country and to diversify the sources of national income. Because of important constraints in the agricultural sector, such as availability of water and the need to adopt new technologies requiring investments in infrastructure, the time-span for each development plan might not be long enough to accomplish the expected goals.

The first plan was introduced in 1970 and focused on diversification of the sources of national income to reduce the dependency on the oil sector and to decrease the reliance on importing basic foodstuffs from international markets by expanding domestic output. The overall aim of the first plan was to

increase GDP, sustain growth of employment, train the available human resources to contribute and participate more efficiently in the country, and increase government services. The growth rate in the agricultural sector during the first development plan was slower than desired for achieving self-sufficiency in cereal products. Meanwhile, the demand for basic foodstuffs continued to increase.

The second development plan (1975-1980) was designed to eliminate some of the problems that occurred in the first development plan (1970-1975). The food self-sufficiency goal was considered essential to national economic security. Therefore, increasing the growth rate of the agricultural sector and obtaining high levels of productivity were emphasized in the second development plan. The overall goals in this plan were to increase food self-sufficiency, increase employment opportunities, improve living standards, encourage private investments, expand physical and social infrastructure, and reduce the inflation rate. The country made considerable progress towards these goals during the second development plan. Favorable economic sector growth rates, a reduction in the rate of inflation, and improvement in the infrastructure were obtained (Looney and Frederiksen).

The main objective of the third development plan (1980-1985) was to reduce the government GDP share by diversifying the economic base in Saudi Arabia. The specific goals were to: rapidly increase the rate of growth in economic development, which lead the government to import more laborers from other countries; sustain price stabilization; increase production efficiency; and encourage private enterprise.

Many goals were extended into the fourth development plan (1985-1990) because the government's macroeconomic targets were not completely met by the end of the third development plan. The specific objectives for the fourth

development plan were to: reduce the foreign labor force because the large infrastructure and development projects were being completed; extend and develop the agricultural, manufacturing, and financial sectors that were driving the economic diversification program; use natural resources more efficiently; and promote more private investment in the agricultural and non-agricultural sectors.

In conclusion, the agricultural growth rate improved because of facilities and services provided to the sector. As a result of these facilities, services, and incentives, private investors and corporations were attracted to invest in the agricultural sector. Traditional farms were labor intensive, while commercial farms were capital intensive in the production process. Even though commercial farms did not exist until the 1980s, by 1983 the 101 commercial farms accounted for 20 percent of the total cultivated wheat area (Al-Abrahem).

Commercial farms, using large scale production systems, high-yielding varieties, and large quantities of fertilizer, took advantage of price supports and import subsidies to increase agricultural and livestock production. In fact, Saudi Arabia declared self-sufficiency in wheat production in 1984 and with increases in other grain and livestock products.

Increased growth in agricultural production and attaining a certain amount of self-sufficiency in food products achieved one of the primary goals. It also resulted in wheat surpluses and a high cost subsidy program for wheat production. It also raises the question of who receives the real benefits from such a subsidy program. The benefits and costs of such a program, including the risk and uncertainty associated with importing food supplies, has been a topic for extensive investigation.

Organization of the Study

A review of food commodity markets is presented in Chapter II. Three different complete food commodity demand systems for Saudi Arabia are presented and estimated in Chapter III. Simulations of alternative scenarios for growth in food demand are presented in Chapter IV. Analysis of government policies for wheat producers and consumers is presented in Chapter V. Summary and conclusions are presented in Chapter VI.

CHAPTER II

COMMODITY MARKETS IN SAUDI ARABIA

Policy goals of the Saudi Arabia government are to encourage and promote the private sector for purposes of increasing domestic food production and thus decrease reliance on imports. In addition, the government tries to keep consumer prices relatively low by subsidizing and controlling prices for both domestic and imported food commodities. The purpose of this chapter is to identify and analyze market structure for selected food commodities in Saudi Arabia.

Commodity Market Analysis

The marketing function is considered an effective tool of economic development. It helps producers and consumers to maximize their utility by providing them with accurate and complete information. It allows producers to produce marketable commodities and offers consumers goods that satisfy their needs.

Market structure is characterized by pure competition, monopolistic competition, oligoploy, or monopoly. The following discussion focuses on marketing structure under perfect competition and imperfect competition from the impact of government intervention.

Market Structure Under Perfect Competition

A market is perfectly competitive when the following primary features are met:

(1) There are many sellers and buyers of the commodity relative to the market size. This condition or feature ensures that the actions of any individual seller or buyer can not affect the commodity's price.

(2) All commodities sold in the market are entirely homogeneous.

(3) There are no artificial restrictions. This condition ensures that prices are free to move in response to changes in demand and supply and that there is no government interference in the market.

(4) Resources are free to seek the location of highest return. Therefore, it is easy to enter and exit from any factor market.

(5) Producers and consumers have perfect knowledge about prices and sources of supply.

Figure 2.1 shows the standard marketing structure under autarchy perfect competition. Slopes and positions of the supply and demand curves are subject to an earlier history of prices and price policy (Timmer).

The supply and the demand curves intersect at the equilibrium price P_e and the equilibrium quantity q_e. The social marginal costs of producing each level of output and the marginal value gains to consumers at each level of consumption are reflected by the supply and demand curves, respectively. When the market operates under equilibrium it results in social marginal costs equal to marginal benefits leading to Pareto optimality for the existing income distribution.

If market clearing equilibrium is effected by any implicit or explicit factor such as government intervention (controlling prices, export tax, subsidy) then

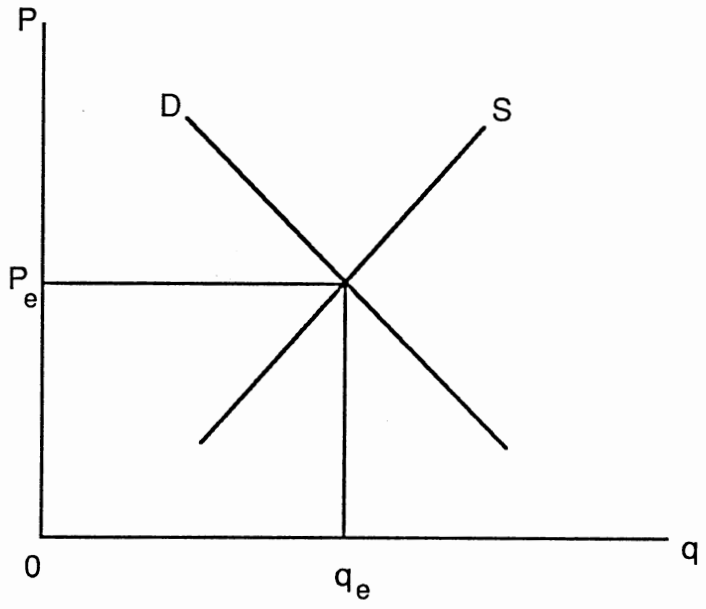


Figure 2.1. Marketing Structure Under Conditions of Perfect Competition

social marginal costs will not equal marginal benefits and the result is inefficient resource allocation.

Figure 2.2 shows the results when free-trade is possible or permitted. World (c.i.f) price, P_w, is below the domestic market-clearing price and the quantity produced is different than without trade. Quantity demanded is increased to q_d while quantity supplied is reduced to q_s, thus equilibrium quantities produced domestically and consumed are no longer equal. Imports from the world market at price P_w are used to fill the gap between q_d and q_s. The direct expenditure of foreign exchange is required to purchase needed imports which corresponds to the area bcq_dq_s, or $P_w (q_d - q_s)$. The big country assumption effects world price, whereas the small country assumption will not effect world price. Compared to autarchy, consumers gain the area P_eacP_w whereas producers lose the area P_eabP_w.

Market Structure Under Government Intervention

Government intervenes directly or indirectly in marketing structure depending on current economic or political objectives. Government intervenes through different means and options.

Government may reduce food prices to improve nutritional status and urban income distribution in the short-run as shown in Figure 2.3. Retail price, P_r, is below world price causing the import gap to increase and thus increasing direct expenditure of foreign exchange. The difference between the world price and the retail price is the consumer subsidy paid by the government. Compared to autarchy, consumers gain the area P_eaeP_r whereas producers lose the area P_eabP_w.

Government may increase farm level prices to protect domestic producers from foreign competition and/or low consumer prices. Support price

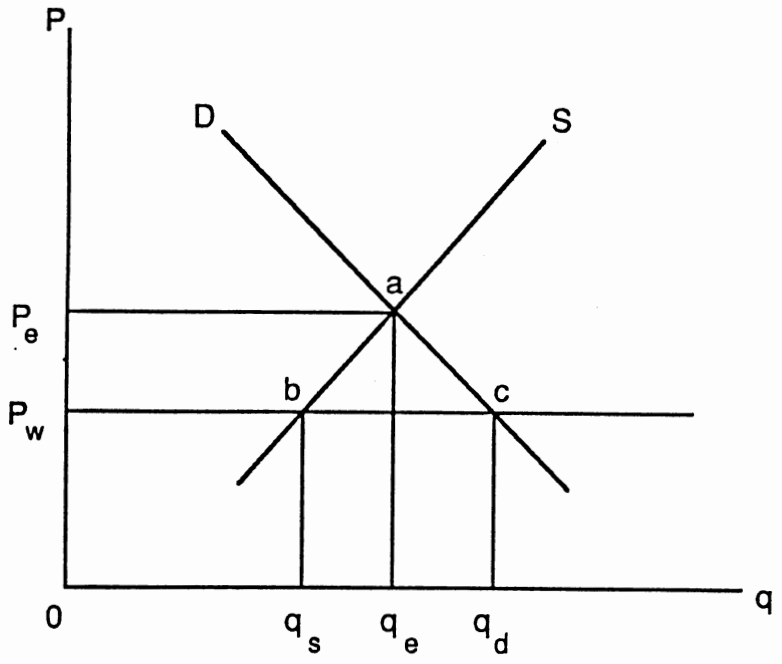


Figure 2.2. Marketing Structure Under Free-Trade

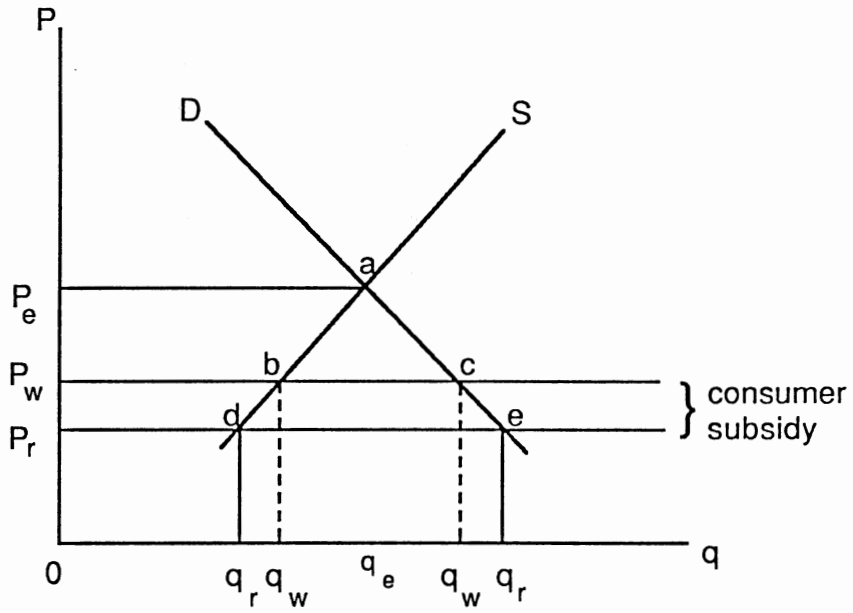


Figure 2.3. Marketing Structure Under Consumer Price Subsidy

is presented in Figure 2.4 as P_s. Price support is higher than autarchy market-clearing price, thus quantity produced increases to q_s. To clear the market, consumer price will need to be lowered to P_r, which is below the autarchy equilibrium price. If world price is below the autarchy equilibrium price, the result of producer support price reduces the import gap and direct foreign exchange requirement. Compared to autarchy, producers gain the area P_eP_sba.

Government may lower consumer prices and raise farm prices at the same time. If consumer price is reduced to P_r and producer price is raised to P_s, compared to autarchy consumers gain the area P_eacP_r and producers gain the area P_eP_sba. Dead weight loss is abc and the public cost is equal to the rectangle P_sbcP_r. However, P_r may be determined according to the world price and the importance of the country in the world market. If consumer price is set higher than the world price and the support price is set to eliminate imports at the world price, the excess of production over consumption will be exported to clear the market.

Marketing Structure for Selected Food Commodities

Although Saudi markets are becoming more competitive for some commodities, there are certain food commodities with controlled prices or consumer subsidies such as wheat, rice, and dairy products. Most basic food stuffs are subsidized to keep prices low to consumers. Subsidies paid on basic food commodities and cattle feed for the period 1974-1985 are shown in Table III. Food commodity subsidies amounted to SR 10,512 million for the 12-year period. Cattle feed subsidies for the six-year period 1980-1985 amounted to SR 10,877 million. The quantities and subsidies for specific commodities are shown in Table IV.

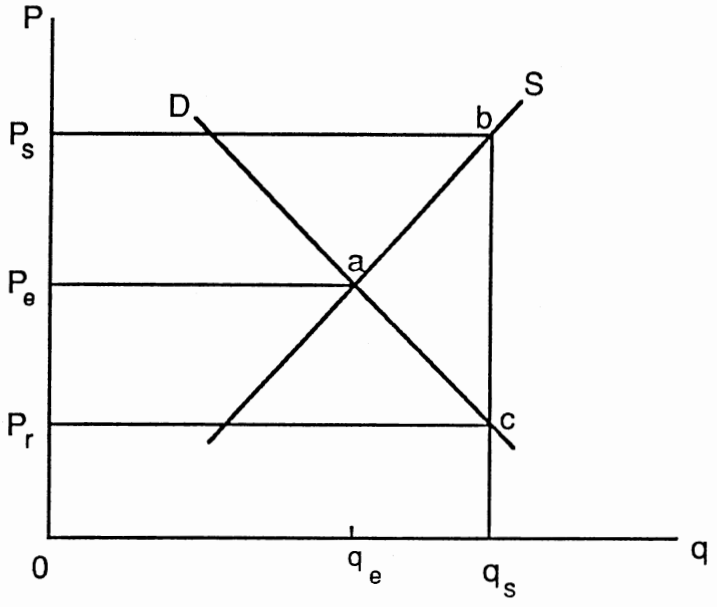


Figure 2.4. Marketing Structure Under Both Consumer and Producer Price Support

TABLE III

SUBSIDIES PAID ON BASIC FOOD COMMODITIES AND CATTLE FEED 1974-1985, SAUDI ARABIA (MILLION S.R.)

Year	Food Commodities	Cattle Feed	Total
1974	300	-	300
1975	750	-	750
1976	700	-	700
1977	600	-	600
1978	700	-	700
1979	843	-	843
1980	930	396	1,326
1981	1,589	1,392	2,981
1982	1,727	3,000	4,727
1983	966	3,249	4,215
1984	733	881	1,614
1985	674	1,959	2,633
TOTAL	10,512	10,877	21,389

Source: Ministry of Finance and National Economy (MOFNE), "Loans and Subsidies, 1980-1985." Riyadh. Saudi Arabia.

TABLE IV

QUANTITY AND VALUE OF INDIVIDUAL COMMODITY SUBSIDIES, 1980-1985, SAUDI ARABIA

	BASIC FOOD COMMODITIES											CATTLE FEED					
	Flour		Rice		Sugar		Meats		Vegetable Oil and Milk		Total	Barley		Corn		Total	
Year	1,000 MT	Million S.R.	1,000 MT	Million S.R.	1,000 MT	Million S.R.	1,000 MT	Million S.R.	1,000 MT	Million S.R.	Million S.R.	1,000 MT	Million S.R.	1,000 MT	Million S.R.	1,000 MT	Million S.R.
1980	362	504	86	80	66	25	11	24	NA	297	930	337	284	182	112	519	396
1981	353	554	410	123	246	409	17	43	NA	457	1589	1364	1024	497	368	1861	1392
1982	180	248	431	273	505	930	22	61	NA	215	1727	2977	2529	482	873	3459	3000
1983	136	164	190	136	263	141	22	60	NA	465	966	3799	2653	882	595	3681	3248
1984	149	154	124	70	313	48	9	24	NA	437	733	2580	777	341	104	2921	881
1985	167	140	8	5	48	8	2	5	NA	516	674	6260	1865	332	94	6592	1959

Source: Ministry of Finance and National Economy (MOFNE), "Loans and Subsidies, 1980-1985." Riyadh, Saudi Arabia.

NA = Not Available

Direct payment subsidy on basic foodstuffs did not start until 1974. The subsidy included imported vegetable oil, milk products, flour, rice, and sugar. In 1975, imported meats were subsidized. In 1980, barley and corn as cattle feed were included in the subsidy program. The subsidies were removed or reduced on meats, rice, and sugar in 1984 because of decreasing world prices for these commodities. The marketing structure for selected food items are discussed.

Cereals

Cereals consumption increased from 575,000 mt in 1971 to 2,300 thousand mt in 1986. Per capita consumption increased from 88.9 kg to 217 kg for the same period. The increased cereals consumption was due to increased population, greater purchasing power, and the subsidy program. The International Trade Center, UNCTAD/GATT (1984, pg. 33) stated that "...there is no tax on food imports and the main purposes of government policies for cereals in Saudi Arabia is to ensure continuity of supply at reasonable prices. GSFMO (Grain Silos and Flour Mills Organization) is the institution responsible for carrying out the general food policy directive of the Department of Supplies of the Ministry of Commerce. GSFMO's functions include setting price levels, procuring and formulating import regulations for all cereals and ensuring that they are adhered to. The criteria followed in price setting and adjustment are not known. Target levels are said to have been raised recently".

Rice and wheat are the most important staple foods in Saudi Arabia. Rice and wheat, however, are important substitutes, and relatively large quantities are consumed. Wheat is the traditional cereal consumed but during the last three decades the consumption of rice has increased. However, the demand for wheat and wheat products has increased from 80 kg per capita in

the 1970's to about 125 kg per capita in the 1980's as a result of the increased consumption of the traditional Arab bread, the Western-style bread, and pastry products. Other cereal products are less important in the Saudi diet and are used principally for cattle feed. Focus now turns to the marketing structure of wheat and rice.

Wheat. Wheat production was largely for subsistence and any excess was sold in the local market. Shortages in the urban markets were imported. In the late 1960's and 70's, wheat production decreased because of the high cost of production and wheat imports increased.

The government introduced the wheat subsidy program in late 1973 with a payment of SR 0.25 per kg. However, the government neither bought the wheat production from farmers nor controlled consumer price. Farmers sold their excess production in the open market and received the prevailing market price plus the subsidy. After establishing the Grain Silos and Flour Mills Organization (GSFMO) in 1977, the government began purchasing wheat from farmers. In 1978, the government purchased 3 percent of total wheat production.

The support price increased to SR 3.5 per kg in 1979 and remained at that level until 1984 when self-sufficiency in wheat was achieved. The percentage of wheat delivered to the GSFMO increased to 96 percent of total production by 1984. Wheat not purchased by the government was sold in the open market. Thus Al-Abrahem (1987, pg. 15) stated that...."in essence there were two wheat prices during the 1978-84 period--the open market price and the government price." In 1985 the government lowered the wheat price support to SR 2.00 per kg and purchased almost all the wheat produced domestically. It is expected that the support price will remain at this level

through the fourth development plan. Wheat import share of total supply decreased from a record high of 96 percent in 1973 to 3.5 percent in 1986.

Wheat market structure is illustrated in Figure 2.5 to present the impact of government price policy on producers, consumers, public cost, and social cost. D is the demand curve and S is the supply curve for wheat. Producers supply q_e quantity in response to price P_e under autarchy perfect competition (no government interference). With government supporting the wheat price at P_s, producers supply q_s quantity. The government purchases wheat and resells it to consumers at P_r to clear the market. The costs and benefits of the price support through government purchases at price P_s and resale to consumers at P_r are shown in Figure 2.5 as follows: (1) consumers gain the area P_ecbP_r, (2) producers gain the area P_sacP_e, (3) public cost is the area P_sabP_r, and (4) net loss to society (dead weight loss) is the area acb.

Price support is not the only producer benefit from producing wheat in Saudi Arabia. There are also input subsidies and free government services. Because of these other generous programs, wheat production increases through shifts in the supply curve from S to S'. Producers supply q'_s in response to input subsidies and price support. The government purchases q'_s quantity of wheat and stores it at the GSFMO. To clear the market, the government resells wheat to consumers at P'_r which is lower than P_r. The increased costs and benefits of the input subsidies and price supports over autarchy are shown in Figure 2.5 as follows: (1) consumer gains increase by the area $P_ecb'P'_r$, (2) producer gains increase by the difference between the areas $P_sa'd'$ and P_ecd, (3) public cost is the area $P_sa'b'P'_r$ plus the input subsidy cost, (4) net society cost is the area a'c'b', and (5) government storage and administrative cost for the larger volume of wheat q'_s compared to q_e.

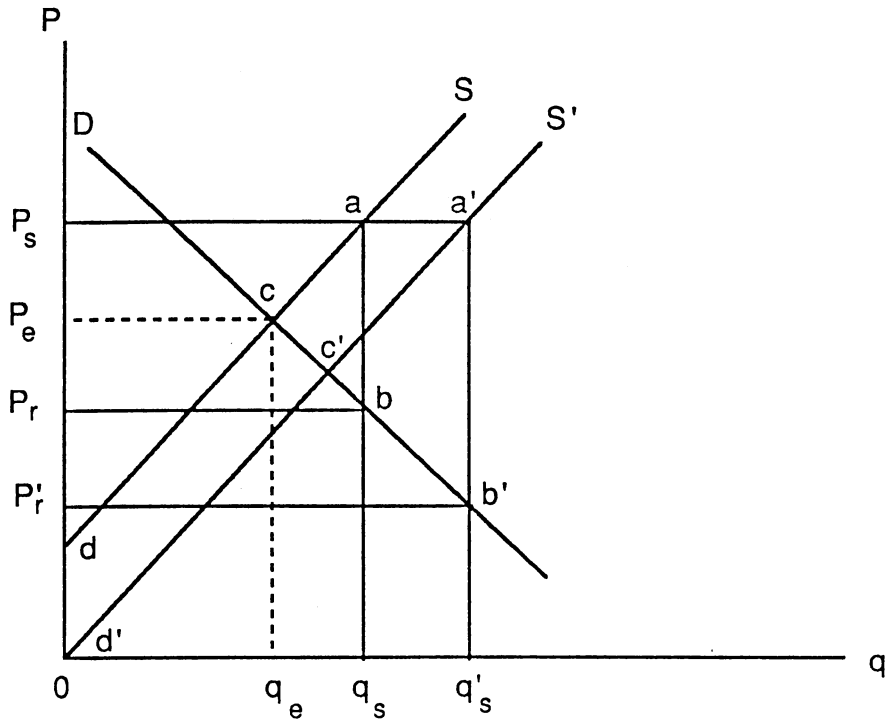


Figure 2.5. Wheat Marketing Structure Under Consumers and Producers Price Support in Saudi Arabia

Rice. Rice production in Saudi Arabia is insignificant and estimated to be about 2,000 mt in 1986 (USDA), thus, most rice consumed is imported. Total imports increased by 140 percent in 1986 compared to 1971 while production decreased by 50 percent over the same period. Per capita consumption has increased from 50.2 kg in the 1970's to 116.5 kg in 1986 (USDA).

Rice is sold in the free market where competition is strong among the various brands. However, government exempts importers from tax, tariff, or tariff barriers on imports of rice to ensure continuity of supplies at reasonable prices. The government intervention in the rice market is to set a ceiling price fixed by the Ministry of Commerce as shown in Table V. The government pays a direct subsidy to major importers when the c.i.f. price is higher than the local ceiling price. The subsidy is equal to the difference between the c.i.f. price and the ceiling price plus allowances for port and internal transport charges and a 10 percent profit margin. The retail price of rice is within a 10 percent profit margin for distributors as required for the import subsidy (International Trade Center, UNCTAD/GATT).

The marketing structure for rice is illustrated in Figure 2.6. DD is the demand for rice and q_d is the quantity consumed at the world price P_w. The government lowers the price to P_r since the price of imports converted at the current effective exchange rate is higher than the desired market price so that a subsidy is paid to importers by the government to close the gap between the world price and the desired domestic price. Quantity consumed increases to q_r in response to the decrease in price to P_r. The costs and benefits from the reduced world price to the desired domestic price are; (1) consumers gain the area P_wabP_r, (2) importers are compensated by the area P_wkbP_r, (3)

TABLE V

CEILING PRICE FOR RICE, SAUDI ARABIA, 1982

Type	Region (Riyals/Kg)		
	Jeddah	Dammam	Riyadh
American brand Abou Siouf	110	110	111
Other American Varieties	107	108	110
Basmati, Anberbo, Peshwari	175	175	180
Sela Basmati, Mazri Indian	90	90	92.5
Sela Basmati, Mazri Indian	175	175	180
Thailand Varieties	120	120	122

Source: International Trade Center, UNCATAD/GATT. "Rice: A survey of selected markets in the Middle East." Geneva, 1984, pg. 48.

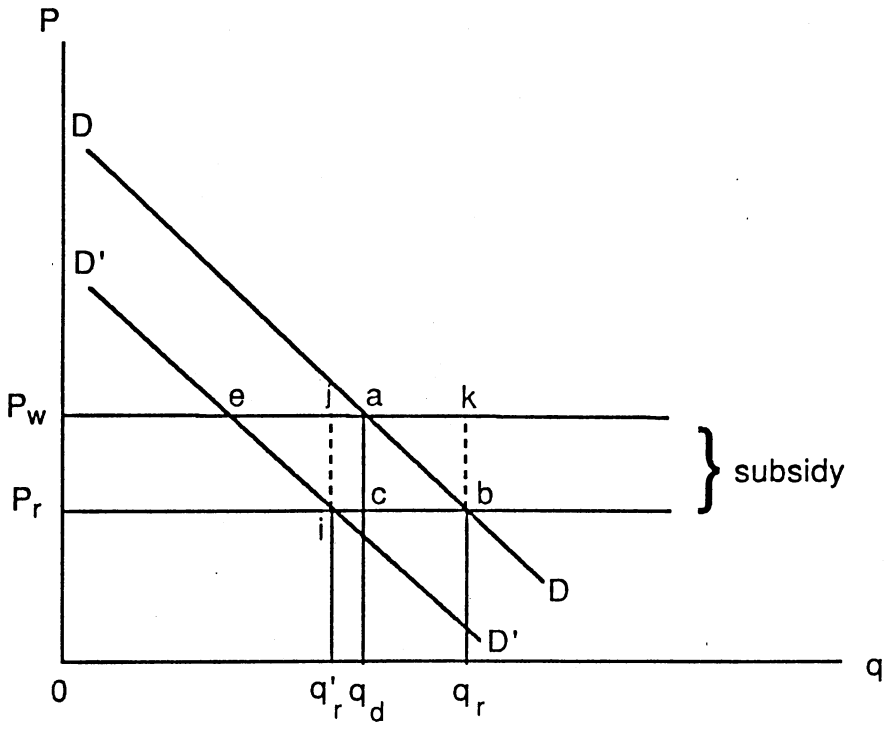


Figure 2.6 Rice Marketing Structure With Price Subsidy on Imports for Saudi Arabia

government cost is equal to the area P_wkbP_r, and (4) net loss to society is the area akb.

Because rice and wheat are substitute goods, wheat will substitute for rice because of the subsidized wheat price and the subsequent increase in consumption. As a result the demand for rice shifts to the left from DD to D'D'. Quantity consumed decreases to q'_r. Therefore, government costs decrease by the area jkbi and net loss to society is the area eji.

Vegetables

General consumption of vegetables has steadily increased due to the change in consumption patterns. Most fresh vegetables are produced and consumed domestically. However, recent production of fresh vegetables has increased as a result of using the most advanced irrigation and greenhouse technologies. Vegetables are sold in the open market. However, government does pay input subsidies to farmers which shifts supply, hence decreasing retail prices.

Until recently vegetable markets were seasonal which caused large price fluctuations or importing of the market shortages. However, with improved marketing services and better storage and refrigeration facilities, surpluses of seasonal supplies are better utilized to decrease price fluctuations and meet year-round domestic demand.

The marketing structure of vegetables under input subsidy is illustrated in Figure 2.7. q_e is the quantity consumed at price P_e under free market and no input subsidy. Input subsidy shifts the supply curve to the right, thus quantity consumed increases to q_r and price decreases to P_r. Consumers gain the areas a, b, and c. Producers lose the area a and gain the areas b, c, e, and f. Government costs are the input subsidies and net loss to society is the area d.

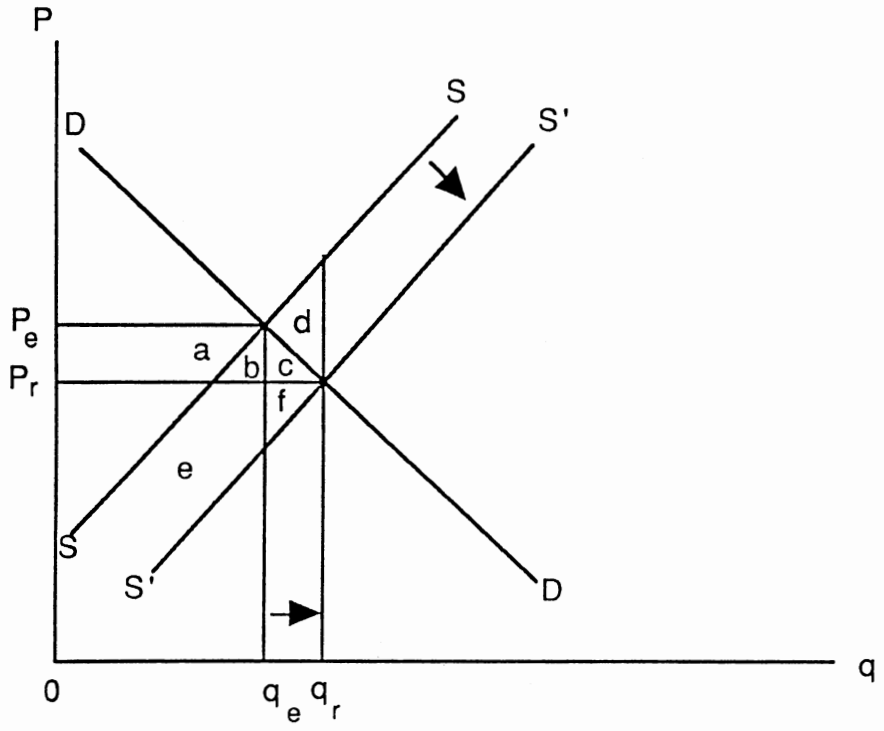


Figure 2.7. Vegetables Marketing Structure with Input Subsidy, Saudi Arabia

Other Food Commodity Groups

Marketing structure of other food commodity groups such as meats, fruits, and dates are identical to the vegetable marketing structure because government intervention is limited to input subsidies. Sugar and tea are imported goods and their marketing structure is similar to the rice marketing structure.

CHAPTER III

COMMODITY DEMAND SYSTEMS FOR SAUDI ARABIA

This chapter discusses the analytical models and empirical results for estimating complete commodity demand systems at aggregated and disaggregated levels. The estimated parameters are used in succeeding chapters for projecting commodity demand and analysis of government policy. The concept of Marshallian demand theory and separability of utility is utilized to estimate the complete demand systems.

Consumer Demand Theory

The work of Cournot and Dupuit during the middle of the nineteenth century, and popularized by Marshall, is the basis for demand theory. However, the concept of Marshallian demand, which is derived from the classical theory of individual consumer behavior, focuses on the relationship between the quantity and the price for a single commodity, holding the consumer's income and other prices constant. Hence, the Marshallian demand provides only the uncompensated demand for income effects. The work by Hicks and Slutsky, however, distinguishes between compensated and uncompensated demand for an income change and between income and substitution effects for a price change (George and King).

Classical consumer demand theory allocates the consumer's income to purchases of various commodities to obtain the maximum level of utility. The consumer's behavior is assumed to be rational, and hence the most preferred

bundle of goods will always be chosen from the set of feasible alternatives (Varian). The consumer is assumed to have preference among commodity bundles; thus, the consumer's preference is assumed to satisfy certain axioms represented by a utility function. These axioms, as stated in Varian, are completeness, reflexivity, transitivity, continuity, strong monotonicity, local nonsatiation, and strict convexity. The consumer's utility function is also assumed to be strictly quasiconcave and twice continuously differentiable through these preference axioms. The utility maximization problem is as follows:

$$\text{maximize } (q): \; u(q) \tag{3.1}$$

$$\text{subject to: } P' q \leq Y \tag{3.2}$$

where

$u(q)$ is a utility function,

q is an n-coordinate column vector of quantities of commodities demanded,

P is an n-coordinate column vector of commodity prices, and

$P' q \leq Y$ is the consumer's expenditure constraint.

The utility maximization problem is represented by an inequality form which can be transferred to an equality form by applying the Lagrangian multiplier (λ):

$$L(q, \lambda) = u(q) + \lambda (Y - P' q). \tag{3.3}$$

The first order condition, which is the necessary condition, can be obtained by taking the partial derivatives to equation (3.3) with respect to the decision variables and setting all equations equal to zero:

$$\frac{\partial L}{\partial q} = \frac{\partial U(q)}{\partial q} - \lambda P' = 0 \tag{3.4}$$

$$\frac{\partial L}{\partial \lambda} = Y - P'q = 0. \tag{3.5}$$

The second order conditions for a maximum can be written as

$$q'Uq \leq 0 \text{ for all } q \text{ such that } p'q \geq 0 \tag{3.6}$$

where U is called the Hessian matrix.

The second order condition, which is the sufficient condition, must be satisfied to ensure that a maximum is reached (Henderson and Quandt). Assuming the second order condition is satisfied and solving the (n + 1) equations for the (n + 1) unknowns results in a set of demand functions. The demand functions are homogeneous of degree zero in prices and income. The quantity demanded for each commodity is expressed as a function of all commodity prices and expenditures:

$$q_i = q_i (P_i, \ldots, P_n, Y). \tag{3.7}$$

The relationships of homogeneity, Engel aggregation, Cournot aggregation, and Slutsky symmetry must be satisfied by the demand functions (George and King). These conditions are:

$$\sum_j e_{ij} + e_{iy} = 0 \qquad \text{(homogeneity)}$$

$$\sum_j e_{iy} w_i = 1 \qquad \text{(Engle aggregation)}$$

$$\sum_j e_{ij} w_j = -w_i \qquad \text{(Cournot aggregation)}$$

$$e_{ji} = \frac{w_i}{w_j} e_{ij} + (e_{iy} - e_{jy}) w_i \qquad \text{(Slutskey symmetry)}$$

$$(i, j = 1, 2, \ldots n)$$

where

e_{ij} = price elasticities,

e_{iy} = income elasticities, and

$w_i = \frac{P_i q_i}{Y}$ = budget shares.

Elasticity

The elasticity concept is a useful analytical tool for economic analysis; thus, the estimation of elasticities provide information for determining the degree of responsiveness of quantities demanded to changes in the consumer's income and all commodity prices. Three types of elasticities are defined:

1. The own-price elasticity is the ratio of the percentage change in the quantity demanded of a commodity to the percentage change in the commodity price. The inverse relationship between the quantity demanded and the commodity price causes the expected negative sign of the own-price elasticity. $e_{ii} = \frac{\partial q_i}{\partial p_i} \cdot \frac{p_i}{q_i}$.

2. Cross-price elasticity is the ratio of the percentage change in the quantity demanded of a commodity to the percentage change in any other commodity price. It provides a measure of the extent to which the demands for commodities are related to each other.

The positive sign of the cross-elasticity coefficient indicates substitutions among commodities, while the negative sign indicates complementarity among commodities. $e_{ij} = \frac{\partial q_i}{\partial p_j} \cdot \frac{p_j}{q_i}$.

3. An income elasticity is defined as the proportionate change in quantity demanded to the proportionate change in income. The sign of the income elasticity coefficient can be positive, negative, or zero. The commodity is normal when the income elasticity coefficient has a positive sign, while a negative sign indicates an inferior good. However, a positive sign is normally assumed (Henderson and Quandt). $e_{iy} = \frac{\partial q_i}{\partial Y} \cdot \frac{Y}{q_i}$.

Estimated elasticities are sensitive to data used (either cross section or time series data), functional form, and statistical estimation procedure such as single or simultaneous equation. Therefore, estimated elasticities should be interpreted carefully.

Complete Demand Systems

The concept of separability is used for commodity aggregations in producer and consumer theory to facilitate estimation of a set of n commodity groups as complete demand systems. Leontief (1947) and Sono (1960) assumed that the set of n commodities available to consumers can be partitioned into G mutually exclusive and collectively exhaustive different groups (subsets), $\{g_1, g_2, \ldots, g_G\}$. Each group contains g_m commodities where $m = 1, 2, \ldots, M_i$ and the total number of commodities is $n = \sum_{i=1}^{G} \sum_{m=1}^{M_i} g_{mi}$. Within each group some common characteristics are assumed.

Strotz and Gorman used the separability property such that the consumer decision for allocating budget over all commodity groups occurs in two stages. In the first stage, the consumer budgets income to be allocated between subsets of commodity groups ($g_1, \ldots, g_G$). In the second stage, the expenditures determined in the first stage are allocated to the individual items in each group thus determining the consumption within a commodity group.

The first stage equations are as follows:

$$Y_g = Y_g (P_1, \ldots, P_G, Y) \tag{3.8}$$

$$\text{subject to } \sum_{g=1}^{G} Y_g = Y.$$

Y = total expenditure,

Y_g = expenditure in each group g,

and $g = 1, \ldots, G$ and $P_g = P_g (P_{g1}, \ldots, P_{gM_i})$. The P's are price indices for the g commodity groups.

The second stage demand equations are:

$$q_m = q_m (P_1, \ldots, P_{M_i}, Y_g) \tag{3.9}$$

$$\text{subject to } \sum_{m=1}^{M_i} P_m q_m = Y_g.$$

The system of equations is block recursive because the first stage is predetermined and independent of the second stage. Therefore, the second stage demand equations are estimated independently and provide the independency of the disturbance terms of the two decision problem (Bieri and de Janvry). The separable utility function under two stage maximization

provides the same equilibrium solutions as direct maximization (George and King).

Several types of separability have been defined such as strong, weak, and Pearce separability and can be utilized for grouping of commodities (Goldman and Uzawa, 1964). Strong and weak separability were pioneered by Strotz (1959), and Pearce separability was introduced by Pearce (1964).

The utility function U(q) is strongly separable when the marginal rate of substitution between any two commodities such as i and j from groups I and J, respectively, are unaffected by quantity consumed of commodity k belonging to K commodity group. In mathematical notation:

$$\frac{\partial \frac{U_i}{U_j}}{\partial q_K} = 0 \tag{3.10}$$

for all $i \in I$, $j \in J$, $I \neq J$, and $K \notin I, J$. Strong separability allows additivity preferences (Philips, 1974) and results in the block additive utility function as follows:

$$U(q) = U_1(q_1) + U_1(q_2) + \ldots + U_g(q_g). \tag{3.11}$$

A special case of strong separability is when the g groups of n commodities each contain only one commodity. This type of utility form is called pointwise strong separability. It implies that the marginal rate of substitution between any two commodities is independent of all other commodities. Thus, if the utility function is pointwise separable, then the utility function is directly additive or want independent which can be written as:

$$U(q) = U_1(q_1) + \ldots + U_n(q_n) \tag{3.12}$$

where there is a total of n commodities.

The utility function U(q) is weakly separable when the marginal rate of substitution between any two commodities i and j from the same group is independent of the quantity consumed from any other commodity group. This is written as:

$$\frac{\partial \frac{U_i}{U_j}}{\partial q_k} = 0 \qquad (3.13)$$

for all i, j ε I, and k $\notin$ I.

The utility function under weak separability is a necessary and sufficient condition for the second stage of the two stage budget allocation process (Deaton and Muellbauer, 1980). If the utility is weakly separable, then the utility function assumes a nonadditive form (Goldman and Uzawa) expressed as:

$$U(q_1, \ldots, q_n) = F[U_1(q_1), \ldots, U_G(q_G)]. \qquad (3.14)$$

The utility function U(q) is said to be Pearce separable if the marginal rate of substitution between any two commodities i and j belonging to the same group I is independent of the quantity consumed of all other commodities, including other commodities within the same group:

$$\partial \frac{\frac{U_i}{U_j}}{\partial q_k} = 0 \qquad (3.15)$$

for all i, j ε I, and k $\neq$ i, j.

The utility function under Pearce separability takes the form:

$$U(q_1, \ldots, q_n) = F\{U_1[f_1(q_1) + \ldots + f_n(q_n)], \ldots, U_g[f_g(q_g) + \ldots f_n(q_n)]\}. \qquad (3.16)$$

It is important to specify the utility forms since the invariance of the want elasticities and the flexibility of money does not hold under the various transformations of utility (Pyles).

Procedure and Empirical Results for the Social Accounts Aggregated Demand System

The complete demand system for the aggregated social accounts is estimated using the Frisch model. The aggregated level is for the 11 commodity groups contained in the Saudi Arabia Social Accounting Matrix (MOFNE). Frisch assumed commodity groups want independent while assuming dependency within a commodity group. There are 11 commodity groups (sectors) and each group is considered to be only one commodity. Thus, the form of the utility function is pointwise separable which means the utility by group is directly additive.

The first order conditions presented earlier for maximizing utility included the following result:

$$U_j (q_1, \ldots, q_n) - \lambda P_j = 0 \qquad (3.17)$$

$$Y - (P_1 q_1 + \ldots + P_n q_n) = 0 \qquad (3.18)$$

where:

U_j = the marginal utility of commodity j,

P_j = the price of commodity j,

q_j = the quantity consumed of commodity j,

Y = total consumer income or expenditure, and

λ = the marginal utility of income.

Rearranging equation (3.17) gives the marginal utility of money income λ, which is defined as a common ratio:

$$\lambda = \frac{U_j (q_1, \ldots, q_n)}{P_j}. \tag{3.19}$$

The marginal utility of commodity j is

$$U_j = \frac{\partial U_j (q_1, \ldots, q_n)}{\partial q_j}. \tag{3.20}$$

Considering the marginal utility as a function of quantities consumed,

$$U_j = U_j (q_1, \ldots, q_n). \tag{3.21}$$

Then the inverse function of (3.21) can be written as:

$$q_j = q_j (U_1, \ldots, U_n). \tag{3.22}$$

Utility accelerations, want elasticity, and money flexibility are defined by Frisch as follows:

$$U_{ij} = \frac{\partial U_i (q_1, \ldots, q_n)}{\partial q_j} \cdot \frac{q_j}{U_i(q_1, \ldots, q_n)} \quad \text{(utility accelerations)} \tag{3.23}$$

$$\sigma_{ij} = \frac{\partial q_i (U_1, \ldots, U_n)}{\partial U_j} \cdot \frac{U_j}{q_i} \quad \text{(want elasticity)} \tag{3.24}$$

$$\gamma = \frac{\partial \lambda}{\partial Y} \cdot \frac{Y}{\lambda} \quad \text{(money flexibility)} \tag{3.25}$$

The Frisch (1959) relationship is the same as the Slutsky equation derived from first order conditions and expresses the price elasticities (e_{ij}) as functions of the want elasticities (σ_{ij}), budget proportions (w_i), income elasticities (e_{iy}), and the flexibility of the marginal utility of income with respect to income (γ):

$$e_{ij} = \sigma_{ij} - w_j e_{iy} - \frac{1}{\gamma} w_j e_{jy}\, e_{iy}. \qquad \text{(Slutsky equation)} \quad (3.26)$$

The Frisch statement in terms of want elasticities and the money flexibility coefficient as defined in George and King is

$$e_{iy} = \gamma \sum_j \sigma_{ij}. \qquad (3.27)$$

Under want independence the money flexibility, own price elasticity, and cross price elasticity can be derived from equation (3.26) as follows:

$$\gamma = \frac{e_{iy}\,(1 - w_i\, e_{iy})}{(e_{ii} + w_i\, e_{iy})} \qquad \text{(money flexibility)} \quad (3.28)$$

$$e_{ii} = -e_{iy}\left[w_i - \left(\frac{1 - w_i\, e_{iy}}{\gamma}\right)\right] \qquad \text{(own-price elasticity)} \quad (3.29)$$

and

$$e_{ij} = -e_{iy}\, w_j \left(1 + \frac{e_{iy}}{\gamma}\right) \qquad \text{(cross-price elasticity)} \quad (3.30)$$

where

$$\sigma_{ij} = 0 \text{ for all } i \neq j.$$

Using the Frisch method the following information has to be known to construct an entire demand matrix:

(1) all commodity income elasticities,

(2) all commodity expenditure weights and must sum to unity, and

(3) a single commodity own-price elasticity.

Having this information available, the Engel aggregation property can be imposed to estimate the demand matrix. The Frisch parameter is calculated

from equation (3.28) and involves the income elasticity, budget share, and direct elasticity of any single commodity. However, estimation of the money flexibility from various commodities or commodity groups should provide similar values as long as the want independent assumption is valid (George and King). The rest of the parameters are estimated using equations (3.29) and (3.30). The resulting estimates of the demand matrix automatically hold for the Slutsky symmetry, homogeneity, and Cournot conditions.

The data used to estimate the parameters of the entire aggregated demand system were obtained from different sources. Income elasticities and the own-price elasticity for agriculture, forestry, and fishing were obtained from Al-Ali and Jammal and the expenditure weights were obtained from the 1980/81 Saudi Arabia Social Accounting Matrix. The results of estimating the complete aggregated demand system are presented in Table VI.

The estimated money flexibility coefficient is -0.862 and is consistent with the Frisch categories (1959). All income elasticities have positive signs indicating normal goods. The positive relation means that as household income increases the consumption of that commodity increases. All own-price elasticities of demand are negative implying an inverse relationship between quantity consumed and its price. The demand parameters as presented in Table VI satisfy the Engel aggregation, Cournot aggregation, homogeneity, and Slutsky symmetry conditions.

Procedure and Empirical Results for the Aggregated Food and Nonfood Demand System

The demand system for aggregated food and nonfood is divided into n + 1 commodities: n food commodities and one nonfood (other expenditures)

TABLE VI

SOCIAL ACCOUNTS AGGREGATED DEMAND SYSTEM FOR SAUDI ARABIA

Sectors	Budget Shares	Income Elasticities	Budget Share Times Income Elasticity	Price Elasticities 1	2	3	4	5	6	7	8	9	10	11	Sum of Price Elasticities
1. Agriculture, forestry, and fishing	0.13816	0.7656	0.10578	-0.90000	0	0	-0.00452	0.13160	-0.00182	0	-0.00289	0.00999	-0.01628	0.01832	-0.7656
2. Crude petroleum and natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Other mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Pretroleum refining	0.04024	0.7355	0.02960	-0.01136	0	0	-0.85760	0.12642	-0.00175	0	-0.00278	0.00960	-0.01560	0.01760	-0.7355
5. Other manufacturing	0.54957	1.1316	0.62190	-0.01748	0	0	-0.00668	-1.11826	-0.00269	0	-0.00427	0.01477	-0.02407	0.02708	-1.1316
6. Electricity, gas, and water	0.01039	0.6648	0.00691	-0.01027	0	0	-0.00393	0.11426	-0.77276	0	-0.00251	0.00868	-0.01414	0.01591	-0.6648
7. Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8. Wholesale and retail trade, restaurants, and hotels	0.02073	0.7049	0.01461	-0.01089	0	0	0	0.12117	-0.00168	0	-0.82042	0.00920	-0.01499	0.01687	-0.7049
9. Transport, storage, and communication	0.03888	1.1514	0.04477	-0.01779	0	0	-0.00416	0.19791	-0.00274	0	-0.00435	-1.32071	-0.02449	0.02756	-1.1514
10. Finance, insurance, real estate, and business services	0.11670	0.7049	0.00823	-0.01089	0	0	-0.00680	0.12117	-0.00168	0	-0.00266	0.00920	-0.83275	0.01687	-0.7049
11. Community social and personal services	0.08532	1.1038	0.09418	-0.01705	0	0	-0.00652	0.18973	-0.00262	0	-0.00417	0.01441	-0.02348	-1.25410	-1.1038

Frisch Parameter -0.862

Sources: Saudi Arabia Social Accounting Matrix 1980-81, Ministry of Finance and National Economy (MOFNE), Central Department of Statistics (CDS), Riyadh, Saudi Arabia. Al-Ali and Jammal, The Arab Gulf Journal, nd.

commodity. The n food commodities are partitioned into G groups. Thus, the elasticity matrix for the aggregated food and nonfood demand system is a block diagonal of the complete demand system presented later. The food commodities are divided into six groups depending on the homogeneity within each group and data availability for quantities consumed and the corresponding retail prices for individual items. The food commodity groups are designated as follows: (1) cereals, (2) meats, (3) vegetables, (4) fruits, (5) beverages and sugar, and (6) dates. Table VII shows the individual food commodities classified by commodity group.

Expenditure weights by individual commodities and commodity groups are given in Table VII. Expenditure weights are as follows:

$$E_i = \frac{1}{T} \sum_{t=1}^{T} P_{it}\, q_{it} \tag{3.31}$$

$$E = \frac{1}{T} \sum_{t=1}^{T} E_t \tag{3.32}$$

$$\delta_i = \frac{E_i}{E} \tag{3.33}$$

$$\gamma_g = \sum_{j=1}^{K_g} \frac{E_{gi}}{E} \tag{3.34}$$

where

t = 1,....., T (1971 - 1985),

T = 15,

i = 1,....., 27,

E_i = average per capita real expenditure for commodity i (over the period 1971-1985),

P_{it} = real price for commodity i in time t,

TABLE VII

EXPENDITURE WEIGHTS BY INDIVIDUAL COMMODITIES AND COMMODITY GROUP FOR SAUDI ARABIA

Commodity Group	Individual Commodity		Individual Commodity Weight	Commodity Group Weight
I - Cereals	1 -	Rice	0.014494	.033241
	2 -	Wheat flour	0.014790	
	3 -	Corn	0.002096	
	4 -	Millet	0.000581	
	5 -	Sorghum	0.001280	
II - Meats	6 -	Beef	0.009848	.058611
	7 -	Camel	0.004464	
	8 -	Fish	0.010780	
	9 -	Mutton	0.011970	
	10 -	Poultry	0.021549	
III - Vegetables	11 -	Carrot	0.000350	.029246
	12 -	Eggplant	0.001596	
	13 -	Garlic	0.000531	
	14 -	Okra	0.002214	
	15 -	Tomato	0.016541	
	16 -	Potato	0.003021	
	17 -	Onion	0.004993	
IV - Fruits	18 -	Banana	0.004814	.037593
	19 -	Grapes	0.006419	
	20 -	Watermelon	0.008449	
	21 -	Citrus	0.012942	
	22 -	Apple	0.004969	
V - Beverages and Sugar	23 -	Coffee	0.004549	.013107
	24 -	Sugar	0.004571	
	25 -	Tea	0.003987	
VI - Dates	26 -	Dates	0.037345	.037345
VII - Nonfood			0.790859	.790859
			1.000000	1.000000

Source: International Monetary Fund (IMF), International Financial Statistics (IFS), Washington D.C., 1987. Ministry of Agriculture and Water, Department of Economic Studies and Statistics, "Saudi Arabian Food Balance Sheets, 1974-1984." Riyadh, Saudi Arabia. Ministry of Finance and National Economy (MOFNE), Central Department of Statistics (CDS), Statistical Year Book, Riyadh, Saudi Arabia, 1971-1985.

q_{it} = per capita consumption for commodity i in time t,

E = average per capita total real expenditure (income) over the period 1971-1985,

δ_i = expenditure weight for commodity i,

E_{gj} = average per capita real expenditure for commodity j in commodity group g, where

$g = 1, \ldots, G$

$j = 1, \ldots, K_g$,

K_g = number of commodities in commodity group g, and

γ_g = expenditure weight for commodity group g.

Meats, fruits, dates, cereals, vegetables, and beverages and sugar is the ranking of the food commodity groups with expenditure weights of 0.058611, 0.037593, 0.037345, 0.033241, 0.029246, and 0.013107, respectively. The total food commodity expenditure weight is 0.209143 and the nonfood expenditure weight is 0.790859.

Expenditure weights (in percent) of more than one percent for individual food items are: dates (3.73), poultry (2.15), tomato (1.65), wheat (1.48), rice (1.45), citrus (1.29), mutton (1.20), and fish (1.08). The composite food demand system was estimated using the procedures explained above. Income elasticities for commodity groups were estimated. The data required to estimate income elasticities are per capita consumption, real price for the corresponding commodity, and per capita income. Real prices were obtained from the Saudi Arabia Statistical Year Book (MOFNE), per capita consumption was obtained from the Saudi Arabian Food Balance Sheets (MOAW), and per capita income was obtained from the Saudi National Accounts (IFS). Data are annual observations for the years 1971 to 1985.

Aggregate price and quantity variables were constructed for the commodity group analysis using an index procedure. The Laspeyres index was used as follows:

$$Q_{gt} = \sum_{j=1}^{Kq} \left(\frac{q_{jt}}{q_{j0}} \right) w_{j0} \tag{3.35}$$

$$P_{gt} = \sum_{j=1}^{Kg} \left(\frac{p_{jt}}{p_{j0}} \right) w_{j0} \tag{3.36}$$

where Q_{gt} and P_{gt} are the aggregate commodity group quantity and price indexes at year t, q_{jt} and p_{jt} are disaggregated quantity and price indexes for the jth commodity in group g at year t, w_{j0} is the expenditure weight of the jth commodity in the base year, and the subscript "$_0$" indicates base year 1980.

Having the aggregate quantity and price indexes, the composite food income elasticities were estimated. To estimate the composite food income elasticities, aggregate price and aggregate expenditure are exogenous variables and aggregate quantity is the endogenous variable. Thus, the demand for composite food is a function of aggregate price and aggregate expenditure (income) expressed in logs. However, the demand function is not homogeneous of degree zero in prices and income. But because the purpose is to compute income elasticities for estimating point wise utility the demand function is the following:

$$\text{Log } Q_{gt} = a + b \text{ Log } P_{gt} + c \text{ Log } I_t + e_t. \tag{3.37}$$

Statistical results of the single composite demand equations are presented in Table VIII. All income elasticities are positive except dates which indicate the latter is an inferior good. The regression coefficients for income are

TABLE VIII

STATISTICAL RESULTS OF SINGLE COMPOSITE FOOD DEMAND EQUATIONS FOR SAUDI ARABIA

Commodity Group		Income Elasticities	Std. Error of the Coefficient	t - Statistic	Adjusted $\bar{R}^2$
I -	Cereals	0.21	0.023	9.20	.94
II -	Meats	0.52	0.076	6.83	.90
III -	Vegetables	0.24	0.125	2.04	.60
IV -	Fruits	0.39	0.036	10.78	.92
V -	Beverages and Sugar	0.27	0.130	2.40	.78
VI -	Dates	-0.13	-0.140	-0.93	.86

all significantly different from zero at the 10 percent probability level except for dates.

The composite nonfood income elasticity is calculated using the Engle aggregation and budget share properties. The weighted sum of all income elasticities is unity thus the nonfood income elasticity is estimated as follows:

$$w_{nf}\, e_{nfy} + w_f\, e_{fy} = 1 \qquad (3.38)$$

where

w_{nf} = expenditure weight for nonfood commodity,

w_f = expenditure weight for the sum of the food commodities,

e_{nfy} = nonfood income elasticity, and

e_{fy} = all food income elasticity.

The e_{fy} is the sum of the product of the income elasticities times the expenditure weights for all of the food commodities divided by the sum of all the food expenditure weights:

$$e_{fy} = \frac{w_1 e_{1y} + w_2 e_{2y} + \ldots + w_i e_{iy} + \ldots w_n e_{ny}}{w_1 + \ldots + w_i + \ldots w_n}. \qquad (3.39)$$

Thus:

$$e_{nfy} = \frac{1 - w_f e_{fy}}{w_{nf}}. \qquad (3.40)$$

The calculated nonfood income elasticity (e_{nfy}) is 1.19.

Using the information on commodity group income elasticities, budget shares, and one commodity group direct price elasticity (the estimated direct elasticity of beverages and sugar), the Frisch model was applied to estimate the composite demand matrix. Results of the ordinary and compensated aggregate

demand systems for food and nonfood commodities are presented in Table IX. The results give information on income elasticities, direct price elasticities, and cross-price elasticities for each commodity group. The direct price elasticities by commodity group shown in the diagonal entries are all negative except dates. The positive sign of own-price elasticity of dates may be due to the significant change in the consumption pattern of dates over the period estimated. Dates used to be considered a basic food commodity while currently dates are considered a delicacy. With improved quality of dates, the price has increased significantly and consumption has increased. The demand parameters satisfy the Engel aggregation, Cournot aggregation, homogeneity, and symmetry conditions.

Procedure and Empirical Results for the Disaggregated Food and Nonfood Demand Subsystems

The disaggregate demand system was estimated in two steps. The first step was to estimate within group parameters. The second step was to estimate cross group parameters. The between commodity groups are assumed want independent, while want dependency is assumed among commodities within a group. Then the utility function is assumed strongly separable and takes on the additive-block form.

The Seemingly Unrelated Regression (SUR) model was used to estimate the within group parameters. The demand subsystem structure used in the estimation procedure for group g with n_g commodities is the following:

$$\text{Log } q_i = f(\log P_{ij}, \log Y) \tag{3.41}$$

hence

TABLE IX

ORDINARY AND COMPENSATED AGGREGATED DEMAND SYSTEM FOR FOOD AND NONFOOD COMMODITY GROUPS, SAUDI ARABIA

Commodity	Budget Shares	Income Elasticities	Budget Share Times Income Elasticity	Price Elasticities						
				Cereals	Meats	Vegetables	Fruits	Beverages and Sugar	Dates	Nonfood
Ordinary Demand										
I - Cereals	0.033241	0.21	0.006981	-0.368531	-0.001169	-0.003638	-0.002584	-0.001464	-0.009605	0.176991
II - Meats	0.058611	0.52	0.030595	-0.011034	-0.907933	-0.009044	-0.006423	-0.003639	-0.023876	0.439949
III - Vegetables	0.029246	0.23	0.006876	-0.004970	-0.001309	-0.411682	-0.002893	-0.001639	-0.010753	0.198145
IV - Fruits	0.037593	0.39	0.014586	-0.005707	-0.002160	-0.006722	-0.677477	-0.002705	-0.017747	0.327012
V - Beverages and Sugar	0.013107	0.27	0.003538	-0.002740	-0.001503	-0.004678	-0.003322	-0.470000	-0.012350	0.227560
VI - Dates	0.037345	-0.13	-0.004841	0.002740	0.000722	0.002246	0.001595	0.000904	0.230695	-0.109262
VII - Nonfood	0.790857	1.19	0.942265	-0.025185	-0.006632	-0.020642	-0.014660	-0.023823	-0.019918	-1.061528
Compensated Demand										
I - Cereals				-0.361550	0.011139	0.002503	0.005311	0.001289	-0.001763	0.343071
II - Meats				0.006318	-0.877338	0.006223	0.013201	0.003203	-0.004382	0.852776
III - Vegetables				0.002845	0.012471	-0.404807	0.005945	0.001443	-0.001973	0.384076
IV - Fruits				0.004696	0.020581	0.004625	-0.662890	0.002381	-0.003257	0.633864
V - Beverages & Sugar				0.003268	0.014322	0.003219	0.006828	-0.466461	-0.002266	0.441091
VI - Dates				-0.001569	-0.006877	-0.001545	-0.003278	-0.000795	0.225854	-0.211789
VII - Nonfood				0.014428	0.063200	0.014203	0.030130	-0.008207	0.024577	-0.119263

$$q_i^* = \sum_{j \in I} e_{ij} P_j^* + e_{iy} Y^* \qquad (3.42)$$

where $i = 1, 2, \ldots, n_g$; q_i^* is the natural log of per capita consumption for the ith commodity in group g; P_j^* is the natural log of the real price indexes; and Y^* is the natural log of real per capita income. The estimated parameters e_{ij} are direct and cross-price elasticities and the e_{iy} are income elasticities. Based on equation (3.42), the stochastic demand system for commodities within group g for T sample observations is written as:

$$\begin{bmatrix} q_{11}^* \\ \vdots \\ q_{iT}^* \\ \cdots \\ q_{n1}^* \\ \vdots \\ q_{nT}^* \end{bmatrix} = \begin{bmatrix} P_{11}^* \cdots P_{n1}^* \; Y_1^* & & 0 \\ P_{iT}^* \cdots P_{nT}^* \; Y_T^* & & \\ & & \\ 0 & & P_{11}^* \cdots P_{n1}^* \; Y_1^* \\ & & P_{iT}^* \cdots P_{nT}^* \; Y_T^* \end{bmatrix} \begin{bmatrix} e_{11} \\ \vdots \\ e_{in} \\ e_{iy} \\ \cdots \\ e_{n1} \\ \vdots \\ e_{nn} \\ e_{ny} \end{bmatrix} + \begin{bmatrix} u_{11} \\ \vdots \\ u_{iT} \\ \cdots \\ u_{n1} \\ \vdots \\ u_{nT} \end{bmatrix} . \qquad (3.43)$$

Using matrix notation, the demand equation (3.43) is:

$$Z^* = X^* \beta^* + U^* \qquad (3.44)$$

where:

Z^* = column vector of nT observations on per capita quantity consumption on all commodities in group g,

X^* = nT * (n + 1) n matrix containing the observations of all prices for all commodities in group g and per capita incomes,

β^* = vector of n (n + 1) parameters, and

U^* = column vector of nT random disturbances.

SUR is used to estimate $\hat{\beta}^*$. The random disturbances in equation (3.44) are assumed to be multivariate normal (0, Σ). Then $\hat{\beta}^*$ is written as:

$$\hat{\beta}^* = [\ X^{*'}\ (\hat{\Sigma}^{-1} \otimes I)\ \ X^*]^{-1}\ \ X^{*'}\ (\hat{\Sigma}^{-1} \otimes I)\ \ Z^* \qquad (3.45)$$

where

$$\Sigma = \begin{bmatrix} \sigma_{11} & \cdots\cdots & \sigma_{1n} \\ \sigma_{1n} & \cdots\cdots & \sigma_{nn} \end{bmatrix}.$$

The Slutsky symmetry condition is imposed within each commodity group. Therefore, it provides n(n - 1) /2 independent linear constraints on the parameters of equation (3.42). In mathematical notation the Slutsky symmetry is:

$$e_{ji}\, w_j - e_{ij}\, w_i - w_i\, w_j\, e_{iy} + w_i\, w_j\, e_{jy} = 0 \qquad (3.46)$$

$$i = 1, \ldots, n-1$$

$$j = 2, \ldots, n$$

where w_i is the expenditure weight for the ith commodity. After imposing the Slutsky symmetry condition, equation (3.45) becomes:

$$\tilde{\hat{\beta}} = \hat{\beta}^* - [\ X^{*'}(\hat{\Sigma}^{-1} \otimes I)\, X^*\ ]^{-1} \cdot R'[R(\ X^{*'}(\hat{\Sigma}^{-1} \otimes I)\, X^*)^{-1}\ R']^{-1} \cdot R\,\hat{\beta}^* \qquad (3.47)$$

where R = n (n - 1) /2 * n(n + 1) matrix of constraints.

The interdependence relationships, price responses, and expenditure responses are important in the disaggregated demand system. The substitution or complementary effects depend on the sign of the compensated cross-price elasticity. The compensated elasticities are calculated as follows:

$$e^*_{ij} = e_{ij} + e_{iy}\, w_j. \qquad (3.48)$$

The value of $e_{iy}\ w_j$ is generally negligible because the budget shares are relatively small. Therefore, the signs of the compensated elasticities (e^*_{ij}) are generally consistent with the signs of the ordinary demand elasticities (e_{ij}). Positive cross-price elasticities indicate substitutes while negative cross-price elasticities indicate complements. The individual commodity groups are presented and discussed.

Cereals

The estimated direct and cross-price elasticities for the disaggregated cereal group, ordinary and compensated demand, are presented in Table X. The table also shows the estimated income elasticities. All income elasticities are positive, implying normal goods. Income elasticities are statistically significant at the 10 percent probability level for rice and wheat and not statistically significant at the 10 percent level for the other commodities. All direct price elasticities are negative, indicating an inverse relationship between consumption and price. The direct elasticities show that rice (-0.43449) is comparatively more elastic than wheat flour equivalent (-0.14791), and corn, millet, and sorghum (-0.24242). This may be due to minor consumption of the latter commodities compared to rice. The estimated cross price elasticities show significant substitution among commodities in the cereal group. The quantity demanded (compensated) for rice is expected to increase by 0.23 percent for a one percent increase in the price of wheat flour and by 0.06 percent for a similar increase for millet, sorghum, and corn, respectively. On the other hand, an increase (decrease) of one percent in the rice price is expected to increase (decrease) the quantity demanded for wheat flour by 0.22 percent and for millet, sorghum, and corn by 0.22 percent.

TABLE X

ORDINARY AND COMPENSATED DEMAND ELASTICITIES FOR CEREALS, SAUDI ARABIA

	Rice	Wheat flour	Corn	Millet	Sorghum	Income
			Ordinary Demand			
Rice	-0.43449 (-1.022)	0.22722 (.864)	0.05849 (-.35)	0.05849 (-.35)	0.05849 (-.35)	0.13428 (1.62)*
Wheat flour	0.21914 (.854)	-0.14791 (.521)	-0.01429 (-.111)	-0.01429 (-.111)	-0.01429 (-.111)	0.37794 (6.403)*
Corn	0.21565 (.353)	-0.04839 (-.101)	-0.24242 (-.566)	-0.24242 (-.566)	-0.24242 (-.566)	0.03678 (.238)
Millet	0.21565 (.353)	-0.04839 (-.101)	-0.24242 (-.566)	-0.24242 (-.566)	-0.24242 (-.566)	0.03678 (.238)
Sorghum	0.21565 (.353)	-0.04839 (-.101)	-0.24242 (-.566)	-0.24242 (-.566)	-0.24242 (-.566)	0.03678 (.238)

t- statistics are given in parenthesis below the coefficients and * indicates at least a 10 percent probability level.

Compensated Demand

	Rice	Wheat flour	Corn	Millet	Sorghum
Rice	-0.43254	0.22920	0.05902	0.05902	0.05902
Wheat flour	0.22462	-0.14232	-0.01280	-0.01280	-0.01280
Corn	0.21618	-0.04785	-0.24227	-0.24227	-0.24227
Millet	0.21618	-0.04785	-0.24227	-0.24227	-0.24227
Sorghum	0.21618	-0.04785	-0.24227	-0.24227	-0.24227

Meats

Meats account for 28 percent of food expenditures and 5.9 percent of total expenditures which is the highest share among the food commodity groups. Results of the estimated subsystem demand for meat is presented in Table XI. Income elasticities indicate beef, fish, mutton, and poultry are normal goods, while camel is an inferior good.

All direct price elasticities are negative, implying an inverse relationship between consumption and price. Thus, the quantity demanded (compensated) for beef, camel, fish, mutton, and poultry are expected to increase by 0.33, 0.48, 0.45, 1.50, and 1.63 percent, respectively, when the price of an individual meat falls by one percent (other meat prices held constant). The estimated cross-price elasticities for beef show significant substitution with fish and mutton. It also shows complementary relationships with camel and poultry but the results are not statistically significant. The quantity demanded for beef is expected to increase by 1.08 and 1.05 percent for a one percent increase in the price of fish and mutton, respectively. The quantity demanded for fish and mutton would increase by 0.99 and 0.87 percent, respectively, for a one percent increase in beef prices.

Vegetables

The estimated demand subsystem for vegetables is presented in Table XII. All income elasticities are positive and statistically significant at the 10 percent probability level. All direct price elasticities are negative. The price responses of tomatos, carrots, eggplant, garlic, and potatoes are less elastic than okra with direct price elasticities of -0.50777, -0.03518, -0.34214, -0.35375, -0.46219, and -1.13002, respectively.

TABLE XI

ORDINARY AND COMPENSATED DEMAND ELASTICITIES FOR MEATS, SAUDI ARABIA

	Beef	Camel	Fish	Mutton	Poultry	Income
			Ordinary Demand			
Beef	-0.33598	-0.13477	1.08051	1.04643	-0.26454	0.44452
	(-0.718)	(-0.667)	(2.430)*	(1.472)*	(-0.499)	(2.385)*
Camel	-0.28812	-0.47957	0.55338	0.23252	-0.46304	-0.48854
	(-0.645)	(-1.314)	(1.475)*	(0.271)	(-1.252)	(-3.597)*
Fish	0.98924	0.22596	-0.45672	-0.74279	-0.27591	0.22648
	(2.437)*	(1.456)*	(-0.588)	(-1.155)	(.429)	(1.033)
Mutton	0.86272	0.08337	-0.66932	-1.49875	-0.35827	0.26123
	(1.473)*	(0.261)	(-1.155)	(-1.261)	(-0.594)	(1.269)
Poultry	-0.11943	-0.09942	0.13728	-0.19942	-1.63949	0.29580
	(-0.490)	-1.290)	(0.423)	(-0.592)	(2.253)*	(1.196)

t - statistics are given in parenthesis below the coefficients and * indicates at least a 10 percent probability level.

Compensated Demand

	Beef	Camel	Fish	Mutton	Poultry
Beef	-0.33161	-0.13278	1.08530	1.05175	-0.25496
Camel	-0.29294	-0.48175	0.54811	0.22667	-0.47357
Fish	0.99147	0.22697	-0.45428	-0.74008	0.28079
Mutton	0.86530	0.08453	-0.66650	-1.49562	-0.35264
Poultry	-0.11652	-0.09810	0.14046	-0.19588	-1.63312

TABLE XII

ORDINARY AND COMPENSATED DEMAND ELASTICITIES
FOR VEGETABLES, SAUDI ARABIA

	Carrot	Eggplant	Garlic	Okra	Tomato	Potato	Onion	Income
				Ordinary Demand				
Carrot	-0.03534	0.02132	0.43125	0.59293	-0.81521	-1.22913	-0.46665	0.45228
	(-0.150)	(0.069)	(1.830)*	(2.195)*	(-1.469)*	(-1.577)*	(-1.427)*	(2.348)*
Eggplant	0.00476	-0.34246	-0.06367	-1.24887	-0.24252	0.86216	-0.34537	0.19818
	(0.070)	(-0.962)	(-0.322)	(-5.015)*	(-0.504)	(1.329)	(-0.973)	(1.837)*
Garlic	0.28419	-0.19206	-0.35408	-1.58912	1.35279	-0.08776	1.61938	0.62509
	(1.830)*	(-0.323)	(-0.542)	(-2.582)*	(0.993)	(-0.054)	(2.070)*	(2.314)*
Okra	0.09373	-0.90070	-0.38104	-1.13131	-1.50721	-1.32401	0.54787	0.46724
	(2.194)*	(-5.017)*	(-2.581)*	(-3.272)*	(-2.980)*	(-2.693)*	(1.476)*	(4.476)*
Tomato	-0.01715	-0.02336	0.04366	-0.20109	-0.51069	0.05635	-0.51734	0.17620
	(1.467)*	(-0.504)	(1.001)	(-2.978)*	(-2.347)*	(0.446)	(-4.515)*	(4.373)*
Potato	-0.14241	0.45499	-0.01536	-0.97040	-.30316	-0.46371	0.76678	0.50304
	(-1.579)*	(1.327)	(-0.054)	(-2.695)*	(0.437)	(-0.407)	(1.717)*	(3.256)*
Onion	-0.03270	-0.11080	0.17231	0.24297	-1.71844	0.46409	-0.81054	0.45148
	(-1.428)*	(-0.977)	(2.071)*	(1.476)*	(-4.517)*	(1.717)*	(-1.955)*	(5.019)*

t - statistics are given in parenthesis below the coefficients and * indicates at least a 10 percent probability level.

				Compensated Demand			
Carrot	-0.03518	0.02205	0.43149	0.59393	-0.80773	-1.22776	-0.46528
Eggplant	0.00483	-0.34214	-0.06356	-1.24843	-0.23924	0.86276	-0.34770
Garlic	0.28441	-0.19106	-0.35375	-1.58774	1.36313	-0.08587	1.62127
Okra	0.09389	-0.89995	-0.3808	-1.13002	-1.49948	-1.32259	0.54928
Tomato	-0.01709	-0.02308	0.04376	-0.20070	-0.50777	0.05689	-0.51681
Potato	-0.14224	0.45580	-0.01509	-0.96929	0.31148	-0.46219	0.76830
Onion	-0.03255	-0.11008	0.17255	0.24397	-1.71098	0.46546	-0.80918

Tomato is the major vegetable commodity with an expenditure share of 56.6 percent of the vegetable group. Per capita consumption expenditures of tomatos increased from 6.1 percent in 1971 to 8 percent in 1985 of total food expenditures. The estimated cross-price elasticities indicate that tomato is a complement with carrots, eggplant, okra, and onions, while it is a substitute for garlic and potatoes. In general, per capita consumption of vegetables has increased. Using the expenditure index with base year of 1980, vegetable consumption increased from 3.6 percent in 1971 to 10 percent in 1985.

Fruits

The estimated parameters of the demand subsystem for fruits are presented in Table XIII. Fruit consumption, using the expenditure index with base year 1980, increased from 3 percent in 1971 to 11 percent in 1985. All income elasticities are positive, implying normal goods. All direct price elasticities are negative and range from -0.21 to -0.60. The price responses for banana and citrus are more elastic than for grapes, watermelon, and apple, with direct price elasticities of -0.60, -0.47, -0.21, -0.26, and -0.37, respectively. The estimated cross price responses indicate that watermelon is a substitute for all other fruits. A complementary relationship is found among banana, grapes, citrus, and apple.

Beverages and Sugar

The empirical results for the beverages and sugar subsystem are given in Table XIV. Income elasticities of coffee and sugar are positive but only sugar is statistically significant. The income elasticity for tea is negative but not statistically significant. Tea is comparatively less price elastic than coffee and

TABLE XIII

ORDINARY AND COMPENSATED DEMAND ELASTICITIES FOR FRUITS, SAUDI ARABIA

	Banana	Grapes	Watermelon	Citrus	Apple	Income
			Ordinary Demand			
Banana	-0.59967	-0.05349	0.25593	0.49832	-0.10471	0.43219
	(-0.846)	(-0.142)	(1.508)*	(0.996)	(-0.150)	(3.096)*
Grapes	-0.03887	-0.21346	0.11457	-0.08433	-0.39627	0.17323
	(-.138)	(-0.669)	(0.805)	(-0.222)	(-1.068)	(1.977)*
Watermelon	0.14738	0.08746	-0.25919	0.15694	0.16547	0.10898
	(1.522)*	(0.807)	(-0.668)	(0.649)	(1.178)	(0.973)
Citrus	0.18524	-0.04364	0.09952	-0.47821	-0.34423	0.45627
	(0.996)	(-0.231)	(0.630)	(-1.055)	(-1.255)	(6.748)*
Apple	-0.10235	-0.51478	0.27703	-0.89868	-0.37047	0.61966
	(-0.151)	(-1.072)	(1.161)	(-1.258)	(-0.320)	(3.870)*

t - statistics are given in parenthesis below the coefficients and * indicates at least a 10 percent probability level.

	Banana	Grapes	Watermelon	Citrus	Apple
			Compensated Demand		
Banana	-0.59751	-0.05141	0.25958	0.50392	-0.10257
Grapes	-0.03800	-0.21263	0.11604	-0.08209	-0.39541
Watermelon	0.14792	0.08798	-0.25821	0.15835	0.16601
Citrus	0.18752	-0.04144	0.10337	-0.47231	-0.34196
Apple	-0.09926	-0.51179	0.28227	-0.89066	-0.36739

TABLE XIV

ORDINARY AND COMPENSATED DEMAND ELASTICITIES FOR BEVERAGES AND SUGAR, SAUDI ARABIA

	Coffee	Sugar	Tea	Income
		Ordinary Demand		
Coffee	-1.44249 (-2.155)*	-0.89914 (-2.520)*	0.35177 (0.683)	0.03525 (0.520)
Sugar	-0.89541 (-2.521)*	-3.31561 (-7.746)*	-0.27175 (-0.872)	0.16626 (1.784)*
Tea	0.40153 (0.683)	-0.31078 (-0.870)	-0.72517 (-0.976)	-0.00293 (-0.058)

t - statistics are given in parenthesis below the coefficients and * indicates at least a 10 percent probability level.

Compensated Demand

	Coffee	Sugar	Tea
Coffee	-1.44233	-0.89898	0.35191
Sugar	-0.89466	-3.31485	-0.27109
Tea	0.40154	-0.31077	-0.72516

sugar. The estimated cross-price elasticities show that sugar is a complement with coffee and tea, while coffee is a substitute for tea.

Dates

Ordinary least squares (OLS) is applied to obtain the income and direct price elasticity for dates. The empirical results for dates are given in Table XV. The results indicate that dates are an inferior good but the income coefficient is not statistically significant.

Nonfood

The nonfood income elasticity was calculated using equation (3.40), while the nonfood direct price elasticity was computed utilizing the Frisch method in equation (3.29). The calculated nonfood income elasticity is 1.21394 and the nonfood direct price elasticity is -1.18749.

Procedure and Empirical Results for the Complete Disaggregated Commodity Demand System

After estimating demand elasticities within each commodity group, which forms the block diagonal of the complete demand matrix, the demand elasticities across groups are computed to complete the entire demand matrix. The information needed to estimate cross group elasticities include: (1) a complete set of income elasticities, (2) the money flexibility parameter, and (3) a full set of expenditure shares.

Income elasticities and expenditure shares are the same as those computed for within groups. Thus, the money flexibility parameter remains to be

TABLE XV

ORDINARY AND COMPENSATED DEMAND ELASTICITIES FOR DATES, SAUDI ARABIA

	Dates	Income
Ordinary Demand		
Dates	-0.14431 (-0.930)	-0.12964 (-0.740)

t - statistics are given in parenthesis below the coefficients and * indicates at least a 10 percent probability level.

	Dates
Compensated Demand	
Dates	-0.14915

calculated. Utility maximization implies the following property in the demand function (Pyles):

$$e_{ij} = \frac{\phi_{ij} - w_j e_{iy} e_{jy}}{\gamma} - w_j e_{iy} \qquad i, j \in I \tag{3.49}$$

where ϕ_{ij} are the want elasticities and all other parameters are as previously defined. The utility is assumed to be strongly separable, then under the block-additive representation the matrix of utility accelerators ϕ is block-diagonal. There are g groups of commodities so there are g blocks, each corresponding to a commodity group. Under block-additive, the elasticity of the marginal utility of a commodity in one group with respect to any commodity in any other group is equal to zero. Expressed mathematically:

$$\phi_{ij} = 0. \qquad i \in I, j \notin I$$

The inverse of a block diagonal can be obtained by inverting each block, so Φ^{-1} is also block-diagonal with elements satisfying (Pyles):

$$\phi^{ij} = 0. \qquad i \in I, j \notin I$$

Then equation (3.49) becomes:

$$e_{ij} = - \frac{w_j e_{iy} e_{jy}}{\gamma_i} - w_j e_{iy}. \qquad i \in I, j \notin I \quad \text{(cross elasticities)} \tag{3.50}$$

Money flexibility can be calculated from equation (3.50) and defined as follows:

$$\gamma_i = \frac{e_{iy} (1 - e^g)}{\sum_{j \in g} e_{ij} + w^g e_{iy}} \qquad i \in g, \tag{3.51}$$

where

$$w^g = \sum_{i \in g} w_i. \qquad g = 1, 2, \ldots, G$$

$$e^g = \sum_{i \in g} w_i \cdot e_{iy}. \qquad g = 1, 2, \ldots, G$$

By imposing the Slutsky symmetry property on the estimators of the within group and imposing the Engle aggregation property on the estimators for the income elasticities, the γ_i for each row is calculated such that the homogeneity property is satisfied. Thus, the complete disaggregated demand system satisfies all properties (Pyles).

Equation (3.50) is applied to complete the entire disaggregated demand matrix. The estimated parameters for the ordinary complete disaggregated demand system are presented in Table XVI. The results provide essential information regarding the interdependent relationships, price responses, and expenditure responses among commodity groups and within groups. The demand parameters satisfy the Slutsky symmetry, homogeneity, Cournot aggregation, and Engle aggregation conditions.

Evaluation of the Alternative Disaggregated Demand Systems

Evaluation of the alternative demand systems is based on theoretical and statistical support for the estimated parameters such as signs and magnitude of the coefficients, goodness-of-fit of the sample data, and the ability and accuracy of the forecasting performance of the models.

The signs of estimated parameters are consistent with demand theory. Income elasticities for 23 of the 26 food commodities are positive, implying normal goods. The three commodities with negative income elasticities are camel, tea, and dates, implying these commodities are inferior goods. All food commodity income elasticities in absolute value are less than unity. In the

TABLE XVI

COMPLETE DISAGGREGATED ORDINARY DEMAND SYSTEM FOR 26 FOOD COMMODITIES AND 1 NONFOOD COMMODITY, SAUDI ARABIA

Commodity	Budget Share	Income Elasticities	Budget Share Times Income Elasticities	Direct and Cross Price Elasticities						
				Rice	Wheat flour	Corn	Millet	Sorghum	Beef	Camel
I -Cereals:										
1 - Rice	0.01449	0.13428	0.00195	-0.43449	0.22722	0.05849	0.05849	0.05849	-0.00120	-0.00065
2 - Wheat flour	0.01479	0.33793	0.00559	0.21914	-0.14791	-0.01429	-0.01429	-0.01429	-0.00390	-0.00159
3 - Corn	0.00210	0.03675	0.00008	0.21565	-0.04839	-0.24242	-0.24242	-0.24242	0.00211	-0.00139
4 - Millet	0.00058	0.03675	0.00002	0.21565	-0.04839	-0.24242	-0.24242	-0.24242	-0.00712	0.00321
5 - Sorghum	0.00128	0.03675	0.00005	0.21565	-0.04839	-0.24242	-0.24242	-0.24242	-0.00983	0.00455
II -Meats:										
6 - Beef	0.00984	0.44452	0.00437	-0.00924	-0.01461	-0.00104	-0.00028	-0.00063	-0.33598	-0.13477
7 - Camel	0.00446	-0.48854	-0.00218	0.00802	0.00991	0.00106	0.00029	0.00065	-0.28812	-0.47957
8 - Fish	0.01078	0.22648	0.00244	-0.00388	-0.00507	-0.00049	-0.00013	-0.00030	0.98924	0.22596
9 - Mutton	0.01197	0.26123	0.00313	-0.00069	0.00501	-0.00042	-0.00011	-0.00025	0.86273	0.08337
10 - Poultry	0.02155	0.29581	0.00637	-0.00053	0.00642	-0.00047	-0.00013	-0.00028	-0.11943	-0.09942
III - Vegetables:										
11 - Carrot	0.00035	0.45228	0.00016	-0.00363	0.00170	-0.00083	-0.00023	-0.00050	0.00211	-0.00529
12 - Eggplant	0.00160	0.19818	0.00032	-0.00018	0.00479	-0.00030	-0.00008	-0.00018	0.00410	-0.00389
13 - Garlic	0.00053	0.62509	0.00033	-0.01112	-0.01517	-0.00139	-0.00038	-0.00085	-0.01079	-0.00047
14 - Okra	0.00221	0.46724	0.00103	0.00224	0.01896	-0.00062	-0.00017	-0.00038	0.01566	-0.01217
15 - Tomato	0.01654	0.17620	0.00291	-0.00026	0.00396	-0.00027	-0.00007	-0.00017	0.00341	-0.00334
16 - Potato	0.00302	0.50304	0.00152	-0.00718	-0.00714	-0.00105	-0.00029	-0.00064	-0.00472	-0.00236
17 - Onion	0.00499	0.45149	0.00225	-0.00304	0.00336	-0.00080	-0.00022	-0.00049	0.00341	-0.00593
IV - Fruits:										
18 - Banana	0.00481	0.43219	0.00208	-0.00628	-0.00646	-0.00090	-0.00025	-0.00055	-0.00431	-0.00190
19 - Grapes	0.00642	0.17322	0.00111	-0.00130	0.00090	-0.00031	-0.00008	-0.00019	0.00101	-0.00212
20 - Watermelon	0.00845	0.10898	0.00092	-0.00217	-0.00332	-0.00025	-0.00006	-0.00015	-0.00241	0.00018
21 - Citrus	0.01294	0.45627	0.00591	-0.00550	-0.00355	-0.00091	-0.00025	-0.00055	-0.00199	-0.00328
22 - Apple	0.00497	0.61966	0.00308	-0.00585	-0.00018	-0.00117	-0.00032	-0.00071	0.00093	-0.00627
V - Beverages & Sugar:										
23 - Coffee	0.00455	0.03525	0.00016	0.00336	0.01061	0.00008	0.00002	0.00005	0.00837	-0.00449
24 - Sugar	0.00457	0.16626	0.00076	0.00632	0.02261	-0.00000	-0.00000	-0.00000	0.01800	-0.01052
25 - Tea	0.00399	-0.00293	-0.00001	0.00128	0.00359	0.00006	0.00002	0.00003	0.00281	-0.00137
VI - 26 - Dates	0.03735	-0.12964	-0.00484	0.00217	0.00275	0.00028	0.00008	0.00017	0.00193	0.00026
VII - Nonfood	0.79086	1.21394	0.96006	-0.06516	0.01387	-0.00210	-0.00058	-0.00128	0.01297	-0.01783

TABLE XVI (Continued)

Commodity	Direct and Cross Price Elasticities									
	Fish	Mutton	Poultry	Carrot	Eggplant	Garlic	Okra	Tomato	Potato	Onion
I - Cereals:										
1 - Rice	-0.00138	-0.00152	-0.00271	-0.00004	-0.00020	-0.00006	-0.00026	-0.00214	-0.00036	-0.00060
2 - Wheat	-0.00417	-0.00465	-0.00840	-0.00013	-0.00061	-0.00021	-0.00087	-0.00637	-0.00120	-0.00197
3 - Corn	0.00098	0.00132	0.00280	0.00008	0.00012	0.00017	0.00050	0.00103	0.00074	0.00109
4 - Millet	-0.00417	-0.00527	-0.01064	-0.00025	-0.00054	-0.00053	-0.00168	-0.00511	-0.00245	-0.00366
5 - Sorghum	-0.00567	-0.00720	-0.01458	-0.00035	-0.00074	-0.00073	-0.00231	-0.00691	-0.00339	-0.00505
II - Meats:										
6 - Beef	1.08051	1.04643	-0.26454	-0.00038	-0.00116	-0.00071	-0.00247	-0.01154	-0.00352	-0.00546
7 - Camel	0.55338	0.23252	-0.46304	0.00025	0.00093	0.00042	0.00158	0.00948	0.00221	0.00352
8 - Fish	-0.45672	-0.74279	-0.27591	-0.00012	-0.00045	-0.00022	-0.00082	-0.00464	-0.00115	-0.00182
9 - Mutton	-0.66932	-1.49875	-0.35827	0.00016	0.00009	0.00039	0.00106	0.00031	0.00162	0.00227
10 - Poultry	0.13728	-0.19942	-1.63949	0.00020	0.00014	0.00048	0.00134	0.00073	0.00204	0.00287
III - Vegetables:										
11 - Carrot	-0.00121	-0.00072	-0.00018	-0.03534	0.02132	0.43125	0.59293	-0.81521	-1.22913	-0.46665
12 - Eggplant	0.00124	0.00195	0.00454	0.00477	-0.34246	-0.06367	-1.24887	-0.24252	0.86216	-0.34537
13 - Garlic	-0.00932	-0.01079	-0.02023	0.28419	-0.19206	-0.35408	-1.58912	1.35279	-0.08776	1.61938
14 - Okra	0.00626	0.00888	0.01943	0.09373	-0.90070	-0.38104	-1.13106	-1.50721	-1.32401	0.54787
15 - Tomato	0.00097	0.00156	0.00369	-0.01715	-0.02336	0.04367	-0.20109	-0.51069	0.05635	-0.51734
16 - Potato	-0.00529	-0.00585	-0.01050	-0.14241	0.45499	-0.01536	-0.97040	-0.30316	-0.46371	0.76678
17 - Onion	-0.00048	0.00021	0.00171	-0.03271	-0.11080	0.17231	0.24297	-1.71844	0.46409	-0.81054
IV - Fruits:										
18 - Banana	-0.00469	-0.00521	-0.00939	-0.00015	-0.00069	-0.00023	-0.00097	-0.00718	-0.00132	-0.00218
19 - Grapes	-0.00035	-0.00013	0.00022	0.00004	-0.00008	0.00011	0.00026	-0.00105	0.00042	0.00053
20 - Watermelon	-0.00192	-0.00226	-0.00430	-0.00008	-0.00027	-0.00015	-0.00055	-0.00269	-0.00079	-0.00123
21 - Citrus	-0.00352	-0.00367	-0.00618	-0.00006	-0.00054	-0.00005	-0.00041	-0.00588	-0.00050	-0.00098
22 - Apple	-0.00275	-0.00239	-0.00310	0.00004	-0.00048	0.00020	0.00029	-0.00556	0.00057	0.00053
V - Beverages & Sugar:										
23 - Coffee	0.00448	0.00580	0.01193	0.00030	0.00057	0.00064	0.00198	0.00522	0.00292	0.00431
24 - Sugar	0.00916	0.01203	0.02500	0.00065	0.00115	0.00140	0.00427	0.01032	0.00631	0.00928
25 - Tea	0.00158	0.00202	0.00411	0.00010	0.00021	0.00021	0.00066	0.00190	0.00097	0.00145
VI - 26 - Dates	0.00176	0.00202	0.00374	0.00007	0.00025	0.00012	0.00044	0.00258	0.00062	0.00098
VII - Nonfood	0.00082	0.00327	0.01014	0.00048	-0.00013	0.00125	0.00320	-0.00348	0.00499	0.00677

TABLE XVI (Continued)

Commodity	Direct and Cross Price Elasticities									
	Banana	Grapes	Watermelon	Citrus	Apple	Coffee	Sugar	Tea	Dates	Nonfood
I - Cereals:										
1 - Rice	-0.00058	-0.00083	-0.00110	-0.00157	-0.00058	-0.00060	-0.00059	-0.00053	-0.00514	-0.07973
2 - Wheat	-0.00190	-0.00247	-0.00323	-0.00513	-0.00200	-0.00172	-0.00175	-0.00150	-0.01391	-0.33845
3 - Corn	0.00099	0.00039	0.00021	0.00285	0.00155	-0.00007	0.00026	-0.00015	-0.00409	0.51156
4 - Millet	-0.00339	-0.00195	-0.00173	-0.00960	-0.00494	-0.00041	-0.00134	-0.00012	0.00611	-1.51302
5 - Sorghum	-0.00467	-0.00264	-0.00230	-0.01324	-0.00684	-0.00051	-0.00181	-0.00012	0.00910	-2.10583
II - Meats:										
6 - Beef	-0.00513	-0.00445	-0.00507	-0.01424	-0.00663	-0.00225	-0.00312	-0.00175	-0.00963	-1.73213
7 - Camel	0.00335	0.00367	0.00457	0.00916	0.00391	0.00230	0.00260	0.00194	0.01592	0.84776
8 - Fish	-0.00173	-0.00179	-0.00219	-0.00475	-0.00207	-0.00107	-0.00127	-0.00089	-0.00696	-0.47600
9 - Mutton	0.00205	0.00009	-0.00074	0.00599	0.00359	-0.00093	0.00001	-0.00106	-0.01744	1.31739
10 - Poultry	0.00259	0.00025	-0.00072	0.00757	0.00447	-0.00103	0.00011	-0.00120	-0.02040	1.61942
III - Vegetables:										
11 - Carrot	0.00094	-0.00123	-0.00243	0.00301	0.00237	-0.00181	-0.00092	-0.00182	-0.02415	1.08279
12 - Eggplant	0.00192	0.00026	-0.00040	0.00560	0.00327	-0.00067	0.00014	-0.00080	-0.01409	1.17004
13 - Garlic	-0.00521	-0.00519	-0.00625	-0.01435	-0.00637	-0.00301	-0.00366	-0.00247	-0.01820	-1.51264
14 - Okra	0.00738	0.00215	0.00031	0.02128	0.01193	-0.00138	0.00138	-0.00191	-0.03985	4.07386
15 - Tomato	0.00160	0.00017	-0.00040	0.00466	0.00274	-0.00061	0.00009	-0.00071	-0.01226	0.98824
16 - Potato	-0.00231	-0.00317	-0.00420	-0.00619	-0.00233	-0.00227	-0.00225	-0.00200	-0.01904	-0.34722
17 - Onion	0.00156	0.00090	-0.00216	0.00476	0.00328	-0.00176	-0.00069	-0.00182	-0.02555	1.36647
IV - Fruits:										
18 - Banana	-0.59967	-0.05349	0.25593	0.49832	-0.10471	-0.00196	-0.00198	-0.00172	-0.01607	-0.35407
19 - Grapes	-0.03887	-0.21346	0.11457	-0.08433	-0.39627	-0.00068	-0.00032	-0.00069	-0.00947	0.45822
20 - Watermelon	0.14738	0.08746	-0.25919	0.15694	0.16547	-0.00054	-0.00073	-0.00043	-0.00258	-0.38017
21 - Citrus	0.18524	-0.04364	0.09952	-0.47821	-0.34423	-0.00198	-0.00165	-0.00182	-0.01980	0.18799
22 - Apple	-0.10235	-0.51478	0.27703	-0.89868	-0.37047	-0.00256	-0.00161	-0.00248	-0.03092	1.05275
V - Beverages & Sugar:										
23 - Coffee	0.00397	0.00199	0.00153	0.01130	0.00596	-1.44249	-0.89914	0.35177	-0.01095	1.88381
24 - Sugar	0.00853	0.00392	0.00272	0.02433	0.01298	-0.89541	-3.31561	-0.27175	-0.02792	4.17406
25 - Tea	0.00134	0.00072	0.00061	0.00379	0.00197	0.40153	-0.31078	-0.72517	0.00296	0.61200
VI- 26 - Dates	0.00093	0.00100	0.00123	0.00255	0.00110	0.00061	0.00071	0.00052	-0.14431	0.24503
VI - Nonfood	0.00600	-0.00146	-0.00501	0.01791	0.01150	-0.00460	-0.00122	-0.00490	-0.07290	-1.18749

cereal group, rice is more sensitive to changes in own-price. Mutton and poultry are very sensitive to own-price changes and less sensitive to changes in prices of substitutes and complements. Okra, in the vegetable group, is very sensitive to own price changes. Banana, in the fruit group, is the most sensitive to own-price changes. Coffee and sugar are very sensitive to own-price changes. The results of the aggregated and disaggregated demand systems in terms of signs and magnitudes appear to be consistent.

Statistical tests of the subsystem demand models are presented in Table XVII. The basic assumptions of the absence of multicollinearity and autocorrelation, small mean square errors, and high coefficients of determination ($\bar{R}^2$) are necessary in linear models to produce best estimators.

Multicollinearity may exist in the demand systems because prices and income move together over time. SUR was used to estimate the subsystems simultaneously which tends to reduce multicollinearity. In addition, aggregating the 26 commodities to 5 groups also reduces multicollinear problems.

Autocorrelation may not be important because of the limited number of observations. However, the Durbin-Watson (D. W.) test was applied to test if serial correlation exists in the demand subsystem models. Results of the D. W. test presented in Table XVII indicate that five commodities out of the 26 do not have serial correlation and the rest of the commodities lie in the inconclusive range. Each Commodity group has a different inconclusive range depending on the degrees of freedom. The significance of the first order autocorrelation coefficient ($\hat{\rho}$) indicates whether serial correlation exists for those commodities in the inconclusive range. The t statistic shows that none of the first order autocorrelation coefficients is statistically significant at the 10 percent level implying no serial correlation in the time series data used for the subsystem models.

TABLE XVII

STATISTICAL TESTS OF THE SUBSYSTEM DEMAND MODEL

Commodity	Mean Square Error	$\bar{R}^2$	D. W.	$\hat{\rho}$	t-Statistic	Autocorrelation Test	Correlation Coefficient r_Q	Test of Normality
1 - Rice	.0091	.81	2.33	-.17	-1.07	Inconclusive	.9560	Normal*
2 - Wheat flour	.0109	.95	2.97	-.59	-1.52	Inconclusive	.9378	Normal*
3 - Corn	.0778	.73	1.67	.09	0.08	Inconclusive	.9190	Normal*
4 - Millet	.0870	.94	2.41	-.28	-0.68	Inconclusive	.8632	Normal
5 - Sorghum	.1220	.50	1.61	.10	0.20	Inconclusive	.9696	Normal*
6 - Beef	.0409	.90	2.43	-.27	-1.55	Inconclusive	.9455	Normal*
7 - Camel	.0059	.95	2.64	-.33	-0.29	Inconclusive	.9375	Normal*
8 - Fish	.0032	.98	2.21	-.12	-0.37	Inconclusive	.8756	Normal*
9 - Mutton	.0138	.95	2.39	-.22	-0.98	Inconclusive	.9279	Normal*
10 - Poultry	.0351	.96	2.65	-.36	-1.45	Inconclusive	.9650	Normal*
11 - Carrot	.0028	.78	1.94	-.02	-1.28	No Correlation	.9621	Normal*
12 - Eggplant	.0544	.86	2.50	-.26	-0.52	Inconclusive	.8847	Normal
13 - Garlic	.0035	.91	1.86	.04	-1.23	Inconclusive	.9516	Normal*
14 - Okra	.0275	.75	2.03	-.04	0.39	No Correlation	.9182	Normal*
15 - Tomato	.1518	.74	1.86	-.01	0.09	Inconclusive	.9587	Normal*
16 - Potato	.2137	.97	3.24	-.63	-1.55	Inconclusive	.9333	Normal*
17 - Onion	.1833	.86	2.24	-.14	-1.54	Inconclusive	.9502	Normal*
18 - Banana	.0271	.90	2.21	-.14	-0.50	Inconclusive	.9152	Normal*
19 - Grapes	.0127	.68	1.63	-.08	-0.21	Inconclusive	.9734	Normal*
20 - Watermelon	.0052	.88	2.30	-.25	0.67	Inconclusive	.9325	Normal*
21 - Citrus	.0294	.88	1.68	.14	0.18	Inconclusive	.9393	Normal*
22 - Apple	.0478	.89	1.44	.27	1.39	Inconclusive	.9686	Normal*
23 - Coffee	.0897	.32	2.23	-.15	-0.15	No Correlation	.9677	Normal*
24 - Sugar	.2965	.83	2.45	-.26	-1.37	Inconclusive	.9529	Normal*
25 - Tea	.0338	.61	1.91	-.10	-0.57	No Correlation	.9844	Normal*
26 - Dates	.0019	.86	1.93	.50	1.58	No Correlation	.9606	Normal*

* indicates that the Correlation Coefficient (r_Q) is significant at 1 percent level.

The mean square errors are small and the coefficients of determination ($\bar{R}^2$) are relatively high. The statistical tests indicate that the subsystem demand models are significant and good estimators. The complete demand system is calculated using the subsystem demand models as the matrix diagonal and completing the remaining parts of the demand matrix on the basis of the assumptions of the theoretical demand properties of Engle aggregation, homogeneity conditions, and Slutsky symmetry.

The assumption of normality in the disturbance errors implies that the dependent variables are distributed multivariate normally. The test of dependent variables using correlation coefficient (r_Q) shows all the dependent variables are statistically significant at the 1 percent level, indicating all the dependent variable data are distributed multivariate normal (Table XVII).

Theil's inequality coefficient (U) was used to measure the ability and the accuracy of forecasting for the subsystem demand models and the complete demand system model. The U statistic is defined as:

$$U = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(\hat{q}_{tj} - q_{tj})^2}}{\sqrt{\frac{1}{T}(q_{tj})^2 + \frac{1}{T}\sum_{t=1}^{T}(q_{tj})^2}} \qquad (3.52)$$

where

$\hat{q}_{tj}$ = estimated value for the jth commodity in time t,

q_{tj} = actual value for the jth commodity in time t, and

T = number of observations.

The U value will always fall between zero and one. When U = 0, which means estimated values equal actual values for all t, a perfect fit occurs. The performance of the model is at its worst when the U value is equal to one. Thus, the closer the U value is to zero the more accurate is the model's forecast (Pindyck and Rubinfeld).

In the subsystem demand models and complete demand system model, the estimated values were calculated using the following equations, respectively:

$$\hat{q}_{tig} = \alpha_{ig} + \sum_{j=1}^{m_g} e_{ij}\, p_j + e_{iy}\, y \qquad (i = 1, 2, \ldots, n) \qquad (3.53)$$

$$(j = 1, 2, \ldots, m_g)$$

$$(g = 1, 2, \ldots, 7)$$

$$\hat{q}_{ti} = \alpha_i + \sum_{j=1}^{n} e_{ij}\, p_j + e_{iy}\, y \qquad (i, j = 1, 2, \ldots, n) \qquad (3.54)$$

where

α_{ig} and α_i are constant terms,

m is number of commodities in each group, and

n is the total number of commodities.

A nonfood price index was calculated and used for estimating $\hat{q}_{ti}$ in equation (3.54) for the complete demand system. The nonfood price index was calculated using the following procedure:

$$q_f = \alpha_f \frac{P_g}{P_f} q_g \qquad (3.55)$$

$$q_{nf} = q_g - q_f \qquad (3.56)$$

$$P_{nf} = \alpha_{nf} \frac{q_g}{q_{nf}} P_g \quad (3.57)$$

where

q_g = per capita general quantity index,
α_f = food share,
P_g = general price index,
P_f = all food price index,
q_f = food quantity index
q_{nf} = nonfood quantity index,
α_{nf} = nonfood share, and
P_{nf} = nonfood price index.

Results of computing the nonfood price index are presented in Table XVIII.

The Theil inequality coefficients (U) for the demand subsystems and the complete demand system are presented in Table XIX. The calculated U values for the subsystem demand models are smaller than the calculated U values for the complete demand system, implying that the subsystem demand models are more accurate in forecasting than is the complete demand system. However, the results of the calculated U values for both systems are small indicating both systems perform well.

TABLE XVIII

ESTIMATING THE NONFOOD PRICE INDEX

Year	Real GDP (Billion S.R.)	Population (1,000)	Per Capita Real GDP (S. R.)	Per Capita Quantity Index (1971 =100) q_g	Food Share α_f	General Price Index 1983=100 P_g	All Food Price Index 1983=100 P_f	P_g/P_f	Food Quantity Index q_f	Nonfood Quantity Index q_{nf}	q_g/q_{nf}	Nonfood Share α_{nf}	Nonfood Price Index P_{nf}	Real Non-Food Price Index P_{nf}/P_g
1971	155.6	6,470	24,049	1.0000	0.5009	28.0	35.3	0.7932	0.3973	0.6027	1.6592	0.4991	23.1881	0.8281
1972	179.5	6,660	26,951	1.1207	0.5499	29.2	35.9	0.8134	0.5013	0.6194	1.8093	0.4501	23.7778	0.8143
1973	214.9	6,860	31,326	1.3026	0.6308	33.9	41.6	0.8149	0.6696	0.6330	2.0577	0.3692	25.7558	0.7598
1974	247.3	7,067	34,993	1.4551	0.6196	41.2	49.0	0.8408	0.7580	0.6970	2.0875	0.3804	32.7177	0.7941
1975	247.9	7,282	34,042	1.4155	0.3228	55.5	58.7	0.9455	0.4320	0.9836	1.4392	0.6772	54.0944	0.9747
1976	269.3	7,734	34,820	1.4479	0.3316	73.0	72.3	1.0097	0.4847	0.9632	1.5033	0.6684	73.3521	1.0048
1977	310.0	8,277	37,453	1.5574	0.3426	81.2	87.6	0.9269	0.4946	1.0628	1.4654	0.6574	78.2214	0.9633
1978	328.4	8,742	37,565	1.5620	0.2175	90.3	84.5	1.0686	0.3631	1.1989	1.3029	0.7825	92.0563	1.0194
1979	350.4	9,082	38,581	1.6043	0.2206	92.0	87.0	1.0575	0.3742	1.2301	1.3042	0.7794	93.5208	1.0165
1980	385.8	9,420	40,955	1.7030	0.1690	95.3	92.5	1.0303	0.2965	1.4065	1.2108	0.8310	95.8901	1.0062
1981	416.4	9,759	42,668	1.7742	0.1593	98.1	98.5	0.9959	0.2815	1.4927	1.1886	0.8407	98.0245	0.9992
1982	423.3	10,099	41,915	1.7429	0.1665	99.2	99.8	0.9940	0.2885	1.4544	1.1984	0.8335	99.0808	0.9988
1983	377.8	10,443	36,177	1.5043	0.1938	100.0	100.0	1.0000	0.2915	1.2128	1.2404	0.8062	99.9999	1.0000
1984	381.3	10,794	35,325	1.4689	0.1952	98.8	100.7	0.9811	0.2814	1.1875	1.2369	0.8048	98.3497	0.9954
1985	361.7	10,650	33,962	1.4122	0.2361	95.6	97.4	0.9815	0.3273	1.0849	1.3017	0.7639	95.0568	0.9943

Source: Real GDP and population are obtained from USDA, General and All Food Price Index are obtained from the Statistical Indicator, Ministry of Finance National Economy, Saudi Arabia.

TABLE XIX

THEIL'S INEQUALITY COEFFICIENTS FOR THE DEMAND SUBSYSTEMS AND THE COMPLETE DEMAND SYSTEM

Commodities	Subsystems U	Complete System U
1 - Rice	.0400	.0409
2 - Wheat flour	.0340	.0387
3 - Corn	.1200	.1162
4 - Millet	.0780	.2959
5 - Sorghum	.1658	.2495
6 - Beef	.0973	.1262
7 - Camel	.0378	.0501
8 - Fish	.0789	.0780
9 - Mutton	.0825	.0827
10 - Poultry	.0597	.0799
11 - Carrot	.0586	.0729
12 - Eggplant	.0841	.0983
13 - Garlic	.1489	.1417
14 - Okra	.0816	.1675
15 - Tomato	.1042	.0756
16 - Potato	.0553	.0893
17 - Onion	.1377	.1042
18 - Banana	.0779	.0648
19 - Grapes	.0636	.0632
20 - Mellon	.0631	.1024
21 - Citrus	.0569	.0630
22 - Apple	.0747	.0872
23 - Coffee	.1551	.1757
24 - Sugar	.1478	.1796
25 - Tea	.0909	.0985
26 - Dates	.0525	.0902

CHAPTER IV

FOOD COMMODITY DEMAND SIMULATIONS

The preceding chapters presented alternative empirical demand systems for Saudi Arabia utilizing analytical and statistical estimation procedures. Growth in per capita income and total population may slow so that future development plans may differ from past results. Therefore, making available information on expected food demand and food production should facilitate government policy formulation to reduce the potential for food shortages and excesses. The purpose of this chapter is to present alternative simulations analyzing the impacts on quantity demanded of food commodities under variations of commodity prices, growth in per capita income, and growth in population. The effects of changes in supply due to changes in government policies are analyzed in the following chapter. Results of these analyses should help decision makers design better development plans.

Evaluation of Exogenous Demand Factors

There are several individual and joint exogenous demand variables that cause per capita consumption of the various food and nonfood commodities to change in the long-run including relative prices, income, changes in tastes and preferences, introduction of new products, changes in occupation, urbanization, and changes in age composition of the population. In the short-run, the socioeconomic factors other 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.

Prices

The variation in food commodity prices depends mainly on supply conditions such as production cycles, seasonal variations, weather conditions, and technological changes. Thus forecasting changes in food commodity prices is considered to be the most crucial element in demand projections. Two alternative assumptions are modeled about food commodity prices for purposes of estimating per capita consumption: (1) no relative price changes for food commodities and (2) the trend in food commodity prices will continue to some stable level. Projecting future prices based on historical data does not mean those will be the actual prices but simply indicate what would happen if past observed trends continue. However, government policies such as price controls can change observed trends.

Relative Prices Unchanged. This scenario projects per capita food commodity consumption to 1995 based on the assumption of constant 1985 real prices. The rational for assuming 1985 relative prices is for purposes of providing a base point projection. The assumption of no relative price changes is realistic if the government values highly stable food prices as stated in the 1970 to 1990 development plans for Saudi Arabia.

Continuation of Price Trends. The alternative to no relative price changes among commodities in the food groups is to allow price adjustments based on individual commodity price trends. Time series data are available for the 15 year period 1971 to 1985 for the individual food commodities. It

becomes important now to choose the appropriate time series model that produces the best unbiased prediction of prices for the period 1986 to 1995.

There are two major steps to determine the best time series model. The first step is to check whether the data are stationary or nonstationary. If the data are nonstationary, differencing may be used to transform the data to the stationary state. The reason for transforming the data is that most statistical theory of time series is based on stationary processes. The periodogram or the autocorrelation plot is used to determine whether the data are stationary or nonstationary.

The TIMESLAB program was used in analyzing the data for stationarity and to choose the best time series model for projecting prices. The periodogram plot of prices for all individual commodities indicates that the data are stationary. The small number of observations, however, may cause one to accept stationarity even though the data may not be stationary. Hence, further testing such as the spectral window generator is applied to verify the periodogram plot. Results of the spectral window generator also indicate stationarity of the data. Therefore, all food commodity prices are considered as stationary data.

The next step is to choose the best time series process for explaining the data. Time series processes considered include moving average, MA (q); autoregressive, AR (p); mixed moving average and autoregressive, ARMA (p,q); random walk; and white noise. The TIMESLAB program suggests the best time series model for projecting prices is the first order autoregressive process, AR (1). The length of time series data may have influenced selection of the AR (1) result. However, the most frequently selected time series model in practice is the autoregressive process (Newton). To verify whether the time series data follow the AR (1) process is to see if the error can be transformed to white noise

by a filter of length 1. Another test to verify if the data follow AR (1) is to determine if the zeros of the characteristic polynomial of the stochastic difference equation are all greater than unity in modulus and if the correlogram decays exponentially to zero.

The procedures for transforming the autoregressive process to white noise through filtering the data of length p is presented. The autoregressive model of order p with coefficients a_1,....., a_p and white noise variance σ^2 is as follows:

$$X(t) + a_1 X(t-1) + \ldots\ldots\ldots + a_p X(t-p) = \varepsilon(t), \qquad t \in z, \tag{4.1}$$

where $\varepsilon \sim wn(\sigma^2)$, wn is white noise, and z is an integer number.

Time series is said to be a white noise process with variance σ^2 if:

$$E(X(t)) = 0, \qquad t \in z$$

$$R(v) = \text{cov}(X(t), X(t+v)) = \begin{cases} \sigma^2; & v = 0 \\ 0; & v \neq 0 \end{cases}$$

The filter process for X(t) is defined by Newton as the new time series Y with filter coefficients $\{a_j, j \in z\}$ and written as follows:

$$Y(t) = \sum_{j=0}^{p} a_j X(t-j), \; t \in z. \tag{4.2}$$

For AR (1), the model is

$$X(t) + a_1 X(t-1) = \varepsilon(t) \tag{4.3}$$

$$a_0 X(t-0) + a_1 X(t-1) = Y(t) \tag{4.4}$$

where a_0 is equal to one by assumption, then by equating (4.3) and (4.4) the result is:

$$Y(t) = \varepsilon(t)$$

implying AR (1) is white noise.

The characteristic polynomial of the stochastic difference equation is defined as follows:

$$g(z) = \sum_{j=0}^{p} a_j Z^j \qquad (4.5)$$

with $a_0 = 1$, and $E \sim wn(\sigma^2)$.

Then AR (1) is :

$$g(Z) = a_0 + a_1 Z^1$$

$$g(Z) = 1 + a_1 Z^1 \qquad (4.6)$$

where $(g(Z)) = 0$ by definition.

Then equation (4.6) will be:

$$0 = 1 + a_1 Z^1, \text{ implying}$$

$$Z = \left|\frac{-1}{a_1}\right| > 1.$$

The first order autoregressive process provides evidence that all price series can be transformed to white noise by a filter of length 1.

Figure (4.1) illustrates white noise series for the price of rice of filter length 1 where none of the errors cross the boundary lines for AR (1). The Correlogram is the plot of at the autocorrelation function $\rho(v)$ versus v for v = 0, 1, ..., M for some maximum lag M. The cummulative periodogram is the plot of the sample spectral distribution function $\hat{F}(\omega_k)$ versus ω_k and the ω_k are the frequencies between 0 and 0.5. Correlograms and cumulative periodograms for white noise series for the other food commodities of filter length 1 show that none of the errors cross the boundary lines for AR (1). Therefore, autoregressive of order one is applied to predict commodity prices to the year 1995.

Table XX shows actual and predicted prices from year 1971 to 1995 for the cereals group. The predicted real prices for rice and wheat decrease while corn, millet, and sorghum prices increase gradually over the period 1986-95. Predicted prices for other food commodity groups are presented in Tables XXI through XXIV.

Incomes

The Saudi Arabia Gross National Product (GNP) increased dramatically in the 1970's but started to decrease in 1984 as a result of decreasing oil prices. Growth in real per capita income follows closely growth in real GNP. The overall rate of growth in per capita real GNP was estimated using the following exponential form:

$$Y = a * e^{gt} \qquad (4.7)$$

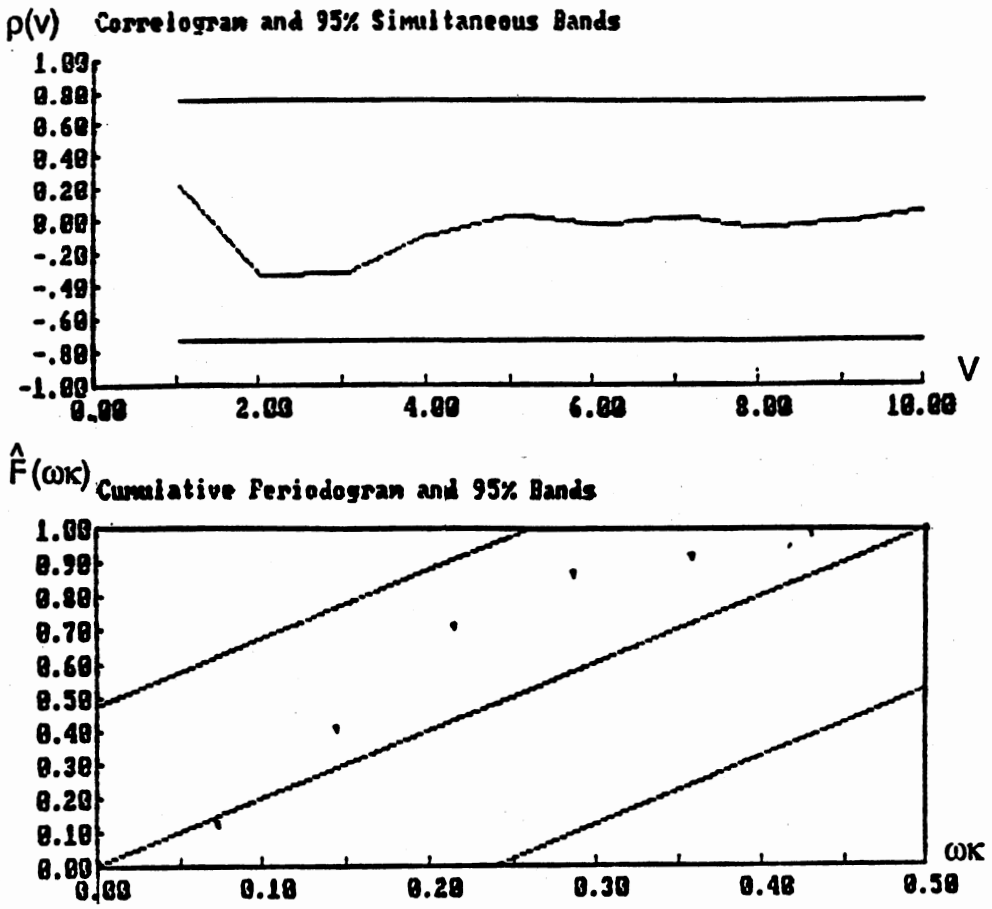


Figure 4.1. Correlogram and Cumulative Periodogram for White Noise in Rice Price Data, 1971-1985.

where

$$\rho(v) = \frac{R(v)}{R(o)} \qquad v = 0, 1, ..., M$$

$$\hat{F}(\omega_k) = \frac{\sum_{j=1}^{k} \hat{f}(\omega j)}{\sum_{j=1}^{q} \hat{f}(\omega j)} \qquad k = 1,....,q$$

$$\omega_j \ (j - 1) / Q, j = 1 ,...., Q, q = [Q/2] + 1,$$

and

$$\hat{f}(\omega) = \begin{cases} \frac{1}{n} \left| \sum_{t=1}^{n} X(t) e^{2\Pi i(t-1)\omega} \right|^2 & ,\omega\varepsilon[0,\ 0.5] \\ \hat{f}\ (1-\omega) & ,\omega\varepsilon[0.5,\ 1] \end{cases}$$

TABLE XX

CEREALS: ACTUAL AND PREDICTED REAL PRICES, 1971-1995, SAUDI ARABIA

	Rice (SR/Kg)		Wheat flour (SR/Kg)		Corn (SR/Kg)		Millet (SR/Kg)		Sorghum (SR/Kg)	
Year	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
1971	4.58		2.45		2.27		2.42		2.06	
1972	4.26	4.28	2.12	2.33	2.17	2.48	2.55	2.80	2.32	2.30
1973	4.98	4.05	2.59	2.27	2.24	2.64	2.98	3.11	2.36	2.43
1974	5.12	3.86	2.97	2.24	2.25	2.75	2.99	3.40	2.01	2.54
1975	3.98	3.72	2.64	2.23	2.29	2.84	3.05	3.64	1.98	2.63
1976	3.30	3.60	2.01	2.22	1.84	2.90	3.24	3.86	2.08	2.70
1977	2.88	3.51	1.89	2.22	1.77	2.94	3.01	4.06	2.39	2.74
1978	3.10	3.44	1.95	2.22	1.67	2.98	4.17	4.23	2.32	2.77
1979	3.04	3.38	1.94	2.22	3.84	3.00	4.15	4.40	3.42	2.79
1980	3.17	3.34	1.87	2.22	3.90	3.02	4.10	4.51	3.30	2.81
1981	3.16	3.31	2.27	2.22	4.09	3.04	4.06	4.63	3.41	2.83
1982	3.16	3.30	2.05	2.22	3.47	3.05	5.15	4.73	2.89	2.84
1983	3.19	3.25	1.98	2.22	3.63	3.06	4.48	4.82	3.06	2.84
1984	3.23	3.24	1.93	2.22	3.47	3.06	5.30	4.90	3.09	2.85
1985	3.14	3.22	2.66	2.22	3.36	3.10	5.53	4.96	2.96	2.85
1986		3.21		2.22		3.07		5.03		2.86
1987		3.21		2.22		3.07		5.08		2.86
1988		3.20		2.22		3.07		5.13		2.86
1989		3.19		2.22		3.07		5.18		2.86
1990		3.19		2.22		3.07		5.21		2.86
1991		3.18		2.22		3.08		5.25		2.86
1992		3.18		2.22		3.08		5.27		2.86
1993		3.18		2.22		3.08		5.30		2.86
1994		3.18		2.22		3.08		5.32		2.86
1995		3.18		2.22		3.08		5.34		2.86

Source: Ministry of Finance and National Economy, Central Department of Statistics. Statistical Yearbook. Riyadh, Saudi Arabia, various issues, 1971-85.

TABLE XXI

MEATS: ACTUAL AND PREDICTED REAL PRICES, 1971-1995, SAUDI ARABIA

	Beef (SR/Kg)		Camel (SR/Kg)		Fish (SR/Kg)		Mutton (SR/Kg)		Poultry (SR/Kg)	
Year	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
1971	11.52		7.58		13.64		17.58		18.88	
1972	11.59	12.41	7.83	7.10	13.94	14.86	17.39	16.90	18.17	16.99
1973	11.19	13.14	8.08	7.40	13.78	15.91	16.17	16.62	16.08	15.37
1974	10.92	13.74	8.20	7.71	15.86	16.82	16.67	16.50	14.14	13.97
1975	12.96	14.23	8.22	8.02	17.07	17.60	17.62	16.45	12.04	12.76
1976	12.50	14.64	8.22	8.33	18.28	18.27	15.91	16.43	11.42	11.73
1977	12.47	14.97	8.32	8.64	17.41	17.41	15.95	16.43	10.86	10.84
1978	12.64	15.24	8.45	8.96	17.04	18.11	15.84	16.42	9.24	10.10
1979	12.45	15.46	8.30	9.30	17.99	18.71	15.56	16.42	9.08	9.41
1980	12.00	15.64	8.50	9.60	18.84	19.22	15.00	16.42	8.75	8.85
1981	19.29	15.80	8.93	9.90	23.13	19.67	17.84	16.42	8.52	8.36
1982	20.01	15.91	9.63	10.20	20.90	20.10	18.30	16.42	7.71	7.94
1983	19.44	16.01	10.01	10.51	21.01	20.38	17.98	16.42	6.69	7.57
1984	19.42	16.10	10.73	10.82	21.12	20.66	16.46	16.42	6.99	7.27
1985	17.39	16.16	14.15	11.13	22.76	20.90	14.98	16.42	6.92	6.99
1986		16.21		11.44		21.11		16.42		6.77
1987		16.26		11.75		21.30		16.42		6.60
1988		16.30		12.10		21.45		16.42		6.40
1989		16.33		12.38		21.58		16.42		6.25
1990		16.35		12.69		21.69		16.42		6.13
1991		16.37		13.00		21.79		16.42		6.02
1992		16.39		13.31		21.87		16.42		5.90
1993		16.40		13.62		21.95		16.42		5.84
1994		16.41		13.93		22.00		16.42		5.77
1995		16.42		14.24		22.10		16.42		5.72

Source: Ministry of Finance and National Economy, Central Department of Statistics. Statistical Yearbook. Riyadh, Saudi Arabia, various issues, 1971-85.

TABLE XXII

VEGETABLES: ACTUAL AND PREDICTED REAL PRICES, 1971-1995, SAUDI ARABIA

	Carrot (SR/Kg)		Eggplant (SR/Kg)		Garlic (SR/Kg)		Okra (SR/Kg)		Tomato (SR/Kg)		Potato (SR/Kg)		Onion (SR/Kg)	
Year	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
1971	23.64		3.54		7.45		9.24		3.30		3.10		2.97	
1972	22.40	19.94	3.30	3.75	9.91	9.51	9.94	10.10	2.96	3.51	3.70	3.46	2.64	2.85
1973	18.66	16.92	3.23	3.87	10.67	9.83	9.95	10.71	3.63	3.68	3.36	3.65	2.29	2.79
1974	14.96	14.44	2.97	3.95	9.86	9.87	9.34	11.25	3.56	3.81	3.22	3.75	1.95	2.76
1975	10.52	12.42	3.32	3.99	5.52	9.88	11.92	11.68	3.22	3.92	3.40	3.80	2.20	2.74
1976	7.87	10.76	3.03	4.02	8.67	9.88	12.50	12.03	3.22	4.00	4.10	3.83	2.82	2.73
1977	6.96	9.41	4.43	4.03	8.00	9.88	16.04	12.31	3.23	4.10	3.90	3.84	3.66	2.73
1978	7.02	8.30	4.36	4.04	12.62	9.88	16.93	12.54	4.12	4.12	4.00	3.85	2.99	2.73
1979	6.85	7.39	3.98	4.05	10.96	9.88	16.70	12.73	4.72	4.21	4.18	3.85	3.10	2.72
1980	6.40	6.65	3.65	4.05	10.42	9.88	15.86	12.88	4.27	4.24	4.20	3.85	3.12	2.72
1981	6.32	6.05	5.04	4.06	10.34	9.88	14.79	13.00	4.59	4.26	4.10	3.85	3.05	2.72
1982	5.52	5.55	4.75	4.06	11.13	9.88	13.93	13.10	4.60	4.28	3.86	3.85	2.84	2.72
1983	5.01	5.14	5.03	4.06	9.77	9.88	11.66	13.17	4.68	4.29	3.81	3.85	2.91	2.72
1984	5.66	4.81	5.26	4.06	9.35	9.88	11.60	13.24	4.35	4.31	3.87	3.85	3.04	2.72
1985	4.77	4.54	3.91	4.06	10.59	9.88	10.92	13.29	4.62	4.31	3.66	3.85	2.28	2.72
1986		4.32		4.06		9.88		13.33		4.32		3.85		2.72
1987		4.13		4.06		9.88		13.37		4.33		3.85		2.72
1988		3.99		4.06		9.88		13.39		4.33		3.85		2.72
1989		3.86		4.10		9.88		13.42		4.34		3.85		2.72
1990		3.76		4.10		9.88		13.43		4.34		3.85		2.72
1991		3.68		4.10		9.88		13.45		4.34		3.85		2.72
1992		3.62		4.10		9.88		13.46		4.34		3.85		2.72
1993		3.56		4.10		9.88		13.47		4.34		3.85		2.72
1994		3.52		4.10		9.88		13.48		4.35		3.85		2.72
1995		3.48		4.10		9.88		13.48		4.35		3.85		2.72

Source: Ministry of Finance and National Economy, Central Department of Statistics. Statistical Yearbook. Riyadh, Saudi Arabia, various issues, 1971-85.

TABLE XXIII

FRUITS: ACTUAL AND PREDICTED REAL PRICES, 1971-1995, SAUDI ARABIA

	Banana (SR/Kg)		Grape (SR/Kg)		Mellon (SR/Kg)		Citrus (SR/Kg)		Apple (SR/Kg)	
Year	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
1971	5.91		6.21		1.60		5.76		5.61	
1972	5.42	5.25	5.77	6.56	1.83	1.98	5.42	5.18	5.42	5.31
1973	5.07	4.83	5.97	6.84	1.99	2.13	5.40	4.87	5.40	5.18
1974	4.47	4.57	5.36	7.10	1.65	2.18	4.51	4.71	5.94	5.13
1975	4.25	4.40	5.61	7.25	1.32	2.20	4.74	4.63	5.20	5.11
1976	4.90	4.30	6.41	7.45	1.64	2.21	4.17	4.59	4.76	5.11
1977	4.39	4.23	5.90	7.59	2.24	2.21	4.16	4.56	4.67	5.10
1978	4.17	4.19	6.22	7.70	2.27	2.21	4.33	4.55	5.10	5.10
1979	4.48	4.16	7.30	7.79	1.74	2.21	4.67	4.54	5.21	5.10
1980	4.00	4.15	7.20	7.87	1.70	2.21	4.60	4.54	5.01	5.10
1981	3.99	4.14	10.04	7.94	2.37	2.21	5.10	4.54	5.46	5.10
1982	3.93	4.13	9.08	7.99	2.35	2.21	4.84	4.54	4.93	5.10
1983	4.13	4.13	10.40	8.04	2.30	2.21	4.16	4.54	4.89	5.10
1984	3.87	4.12	9.59	8.08	4.35	2.21	4.44	4.54	4.92	5.10
1985	3.93	4.12	8.70	8.11	2.61	2.21	4.43	4.54	4.94	5.10
1986		4.12		8.13		2.21		4.54		5.10
1987		4.12		8.16		2.21		4.54		5.10
1988		4.12		8.17		2.21		4.54		5.10
1989		4.12		8.19		2.21		4.54		5.10
1990		4.12		8.20		2.21		4.54		5.10
1991		4.12		8.21		2.21		4.54		5.10
1992		4.12		8.22		2.21		4.54		5.10
1993		4.12		8.23		2.21		4.54		5.10
1994		4.12		8.23		2.21		4.54		5.10
1985		4.12		8.24		2.21		4.54		5.10

Source: Ministry of Finance and National Economy, Central Department of Statistics. Statistical Yearbook. Riyadh, Saudi Arabia, various issues, 1971-85.

TABLE XXIV

BEVERAGES, SUGAR, AND DATES: ACTUAL AND PREDICTED REAL PRICES,1971-1995, SAUDI ARABIA

	Coffee (SR/Kg)		Sugar (SR/Kg)		Tea (SR/Kg)		Dates (SR/Kg)	
Year	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted
1971	21.45		2.91		28.85		5.70	
1972	19.79	21.10	3.33	2.71	28.84	24.52	6.38	7.69
1973	16.92	20.94	3.51	2.54	21.22	22.27	5.57	7.49
1974	16.21	20.87	2.97	2.39	19.53	21.10	9.55	7.50
1975	16.96	20.83	2.28	2.25	19.65	20.48	6.98	7.50
1976	17.62	20.82	1.73	2.13	19.22	20.16	8.10	7.50
1977	28.89	20.81	1.56	2.02	20.78	19.99	8.32	7.50
1978	28.94	20.81	1.58	1.93	26.75	19.91	7.43	7.50
1979	22.71	20.81	1.56	1.84	21.31	19.87	9.54	7.50
1980	24.61	20.81	1.50	1.77	18.86	19.84	9.60	7.50
1981	18.83	20.81	1.46	1.70	19.44	19.83	5.16	7.50
1982	22.63	20.81	1.44	1.64	18.11	19.82	6.24	7.50
1983	18.60	20.81	1.43	1.59	17.67	19.82	6.91	7.50
1984	18.79	20.81	1.45	1.54	18.32	19.82	6.59	7.50
1985	20.69	20.81	1.48	1.50	18.69	19.82	8.60	7.50
1986		20.81		1.46		19.82		7.50
1987		20.81		1.43		19.82		7.50
1988		20.81		1.40		19.82		7.50
1989		20.81		1.38		19.82		7.50
1990		20.81		1.36		19.82		7.50
1991		20.81		1.34		19.89		7.50
1992		20.81		1.32		19.82		7.50
1993		20.81		1.30		19.82		7.50
1994		20.81		1.29		19.82		7.50
1995		20.81		1.28		19.82		7.50

Source: Ministry of Finance and National Economy, Central Department of Statistics. Statistical Yearbook. Riyadh, Saudi Arabia. Various issues 1971-85.

where

Y = per capita real GNP from 1971-1985,

g = growth rate in per capita GNP, and

t = time.

Equation (4.7) yields a growth rate in real per capita GNP of 1.6 percent.

Figure 4.2 shows the result of two alternative procedures for projecting per capita GNP over the period 1986-95. The first procedure is to project per capita GNP based on past growth and assumed rates for future periods. Using this procedure, three alternative rates are assumed for growth over the period 1986-1995. The first is an optimistic alternative which assumes growth in per capita income will be at the same rate as growth in per capita real GNP for the 1971-1985 period. This is the 1.6 percent rate estimated from equation (4.7). The second is an intermediate rate which assumes growth of 1 percent annually over the period 1985-95. The third is a low alternative which assumes growth of 0.5 percent annually over the same period.

The second procedure is to predict GNP per capita using the first order autoregressive process. This result gives the same end year value as the assumption of per capita GNP growth of one percent starting from the 1985 base. The first procedure of assuming a high, intermediate, and low rate of growth will be used in projecting consumption of food commodities over the 1985 to 1995 period.

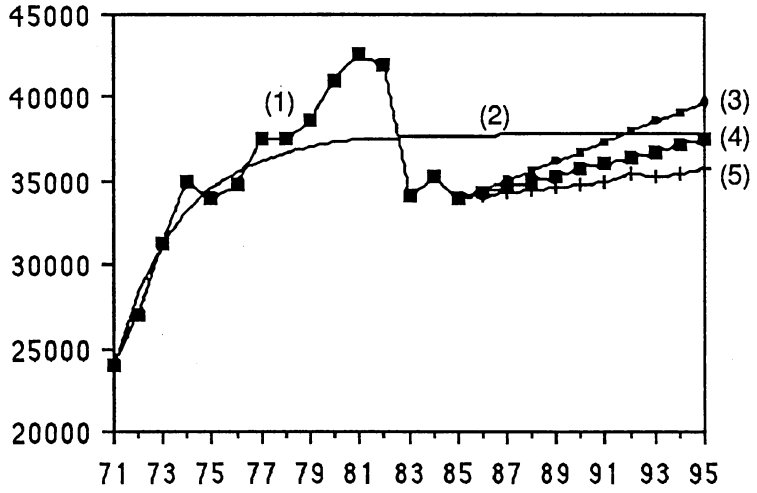


Figure 4.2. Alternative Assumptions For Projected Growth in Per Capita Income, Saudi Arabia, 1985-1995

(1) Actual per capita real GNP 1971-1985

(2) Predicted per capita GNP using first order autoregressive model 1971-1995

(3) Projected per capita GNP 1986-1995 assuming 1.6 percent annual growth

(4) Projected per capita GNP 1986-1995 assuming 1.0 percent annual growth

(5) Projected per capita GNP 1986-1995 assuming 0.5 percent annual growth

Population

Population increased at about three percent annually until 1975 when the annual rate increased to more than six percent as the result of increased numbers of guest workers (Table XXV). The first column in Table XXV shows the actual population estimate through 1985. The second column shows the results of applying the first order autoregressive model to column one and projecting the population to 1995. The third column shows population projections at a constant 3 percent annual growth beginning from the base year of 1971.

Column (4) is consistent with a decrease in guest workers from 2.66 million in the third development plan to 2.06 million in the fourth development plan (1986/1990). After 1989 the number of guest workers is assumed constant at 2.06 million while the Saudi population is assumed to increase at the natural growth rate of three percent annually. The alternative population projections are illustrated in Figure 4.3.

Projected Per Capita Consumption

The estimated complete demand system for the disaggregated food commodity groups presented in Chapter III is used to predict consumption for the twenty-six food commodities. The real nonfood price index is used as the price vector for the nonfood commodity expenditure. In Chapter III, the complete disaggregated demand system is the following:

$$q_i = \alpha_i + \sum_j e_{ij} P_j + e_{iy} Y \qquad (4.8)$$

TABLE XXV

ESTIMATES OF POPULATION GROWTH 1971-1985 WITH PROJECTIONS TO 1995, SAUDI ARABIA (1,000)

Year	Population Estimates (1)	Population Projections Using First Order Autoregressive (2)	Population Projections Assuming 3% Growth Rate (3)	Population Projections Assuming 3% Growth Rate Beginning in 1989 (4)
1971	6,470	6,470	6,470	6,470
1972	6,660	6,660	6,664	6,660
1973	6,860	6,860	6,864	6,860
1974	7,067	7,067	7,070	7,067
1975	7,282	7,282	7,282	7,282
1976	7,734	7,734	7,500	7,734
1977	8,277	8,277	7,725	8,277
1978	8,742	8,742	7,957	8,742
1979	9,082	9,082	8,196	9,082
1980	9,420	9,420	8,442	9,420
1981	9,759	9,759	8,695	9,759
1982	10,099	10,099	8,956	10,099
1983	10,443	10,443	9,225	10,443
1984	10,794	10,794	9,502	10,794
1985	10,650	10,650	9,787	10,650
1986		10,600	10,089	10,600
1987		10,734	10,392	10,734
1988		10,861	10,704	10,861
1989		10,979	11,025	10,979
1990		11,090	11,356	11,249
1991		11,194	11,697	11,526
1992		11,291	12,048	11,812
1993		11,382	12,409	12,106
1994		11,467	12,781	12,409
1995		11,547	13,164	12,721

Source: USDA, Economic Research Service (ERS), Data User Service for Saudi Arabia.

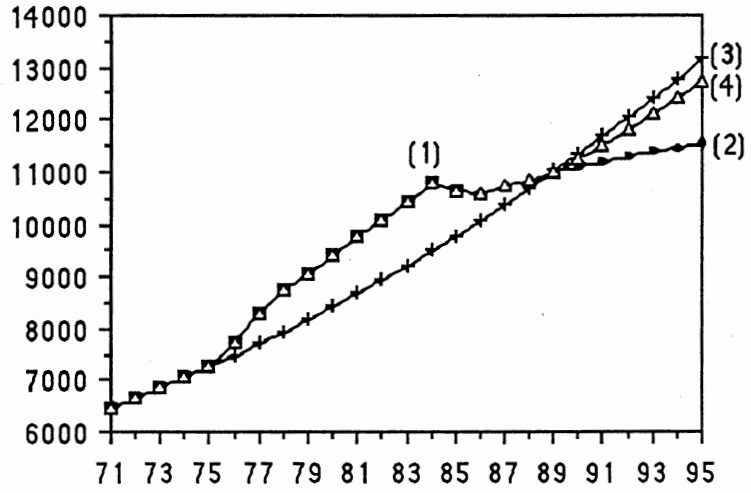


Figure 4.3. Population Estimates 1971-1989
With Alternative Projections
To 1995, Saudi Arabia

(1) Population estimates to 1985

(2) Predicted population using first order autoregressive model 1971-1995

(3) Projected population assuming constant 3 percent growth from base year 1971

(4) Decrease in guest workers to 2.06 million in 1989 and constant 3 percent growth in Saudi population to 1995.

where

q_i = per capita consumption of food commodity i expressed in logs,

α_i = constant term (computed from the log averages of q_i, P_j, and Y),

e_{ij} = own and cross price elasticities,

e_{iy} = income elasticity,

P_j = price of food commodity j expressed in logs, and

Y = total per capita expenditure expressed in logs.

When estimates of prices and total per capita expenditure are available for future periods, per capita consumption can be estimated from applying equation (4.8) under the assumption of constant demand elasticities. Eight different scenarios are used to compare results of projected per capita consumption to 1995 for the 26 food commodities. These scenarios include four levels of income growth with constant relative prices and four levels of income growth with price trends as calculated in the previous section. Results of the projected per capita consumption levels are discussed by commodity grouping. The scenario of constant relative prices and zero income growth is equal to the base year 1985 and thus the results of the other seven scenarios can be compared to the base year. The results of projected per capita consumption over the period 1985-1995 are presented in Appendix B.

Cereals

Projected per capita consumption by 1995 for the cereal group is presented in Table XXVI. Per capita consumption of rice, wheat, corn, millet, and sorghum in the base year 1985 equalled 42.2, 109.5, 2.3, 0.5, and 1.8 kilograms, respectively. With constant relative prices and 1.0 percent income

TABLE XXVI

CEREALS: PROJECTED PER CAPITA CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE AND INCOME GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	Kg/Person			
Constant Relative Prices				
Rice	42.2	42.5	42.8	43.1
Wheat flour	109.5	111.6	113.7	116.3
Corn	2.3	2.3	2.4	2.4
Millet	0.5	0.5	0.5	0.5
Sorghum	1.8	1.8	1.8	1.8
Total	156.3	158.7	161.2	164.1
Price Trends				
Rice	42.6	42.9	43.2	43.5
Wheat flour	109.3	111.3	113.4	116.0
Corn	2.3	2.3	2.3	2.3
Millet	0.5	0.5	0.5	0.5
Sorghum	1.7	1.7	1.7	1.7
Total	156.4	158.7	161.1	164.0

growth per capita rice consumption by 1995 increases by 0.6 kg, wheat increases by 4.2 kg, and corn increases by 0.1 kg. Consumption of millet and sorghum does not change significantly.

Allowing prices to follow past trends increases rice consumption slightly, decreases wheat consumption slightly, and decreases sorghum consumption slightly when compared to the results for constant relative prices. Total per capita consumption of cereals is almost the same under the two different price assumptions. The per capita consumption of cereals increases by about 3.1 percent in 1995 over the base year of 1985 assuming a 1.0 percent income growth. Under price trends rice consumption increases by 2.4 percent and wheat increases by 3.6 percent assuming a 1.0 percent income growth.

Meats

Projected per capita consumption to 1995 for the meats group is presented in Table XXVII. The quantity demanded by 1995 for beef, fish, mutton, and poultry increase while the quantity demanded for camel decreases. The negative expenditure elasticity causes the quantity demanded for camel to decrease. The significant change in meat consumption is with poultry. Assuming constant prices and a 1.0 percent change in income growth poultry consumption is projected to increase by 2.9 percent in 1995. Assuming price trend for poultry and a 1.0 percent increase in income growth, consumption increases by 40 percent. This shows the dramatic effect decreasing poultry prices have on consumption. The percentage change in the quantity demanded for mutton is less than that for beef even though the per capita consumption for mutton is greater than for beef.

TABLE XXVII

MEATS: PROJECTED PER CAPITA CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE AND INCOME GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	Kg/Person			
Constant Relative Prices				
Beef	5.5	5.6	5.7	5.9
Camel	2.8	2.8	2.7	2.6
Fish	4.4	4.5	4.5	4.6
Mutton	7.3	7.4	7.5	7.6
Poultry	34.0	34.5	35.0	35.6
Total	54.0	54.8	55.4	56.3
Price Trends				
Beef	5.9	6.1	6.2	6.4
Camel	2.8	2.8	2.7	2.6
Fish	4.4	4.4	4.5	4.6
Mutton	7.8	7.9	8.0	8.2
Poultry	46.2	46.9	47.6	48.4
Total	67.1	68.1	69.0	70.2

The complementary relationship of poultry with beef and mutton leads to some of the increase in consumption for the latter two meats as a result of decreasing poultry prices. Under the assumption of price trends, total meat consumption is projected to increase by 27.7 percent with a 1.0 percent annual growth in income. For individual meats these increases are 12.7 percent for beef, 2.3 percent for fish, 9.6 percent for mutton, and 40.0 percent for poultry.

Vegetables

Projected per capita consumption to 1995 for the vegetable group is presented in Table XXVIII. The projected increase in per capita consumption of vegetables is modest and comes about through income growth. In fact, results for price trends indicate that vegetable prices are expected to increase and thus decrease consumption slightly relative to the results for constant relative prices.

Tomatoes, onions, and potatoes are the major vegetables in quantity consumed. Tomatoes account for about one-half of the total quantity of vegetables consumed. The three vegetables of tomatoes, onions, and potatoes account for about 90 percent of total quantity of vegetables consumed. Under the assumption of price trends, and a 1.0 percent growth rate in income, consumption of total vegetables is projected to increase by 2.0 percent in 1995. For the three major vegetables this means an increase of 0.3 kg for tomatoes, 0.5 kg for onions, and 0.6 kg for potatoes.

Fruits

Projected per capita consumption to 1995 for the fruit group is presented in Table XXIX. The increase in projected quantities demanded of fruits is very similar under the assumptions of constant relative prices and price trends. Per

TABLE XXVIII

VEGETABLES: PROJECTED PER CAPITA CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE AND INCOME GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	Kg/Person			
Constant Relative Prices				
Carrot	0.6	0.6	0.6	0.6
Eggplant	3.4	3.4	3.4	3.5
Garlic	0.4	0.4	0.4	0.4
Okra	1.6	1.7	1.7	1.8
Tomato	30.9	31.2	31.4	31.8
Potato	6.8	7.0	7.2	7.4
Onion	15.8	16.1	16.5	16.9
Total	59.5	60.4	61.2	62.4
Price Trends				
Carrot	0.6	0.6	0.6	0.6
Eggplant	3.3	3.3	3.3	3.4
Garlic	0.3	0.3	0.3	0.4
Okra	1.5	1.6	1.6	1.6
Tomato	30.7	31.0	31.2	31.6
Potato	7.1	7.3	7.4	7.7
Onion	15.6	16.0	16.3	16.8
Total	59.1	60.1	60.7	62.1

TABLE XXIX

FRUITS: PROJECTED PER CAPITA CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE AND INCOME GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	Kg/Person			
Constant Relative Prices				
Banana	11.5	11.7	12.0	12.3
Grape	7.4	7.5	7.5	7.6
Watermelon	29.4	29.6	29.7	29.9
Citrus	25.1	25.7	26.3	27.0
Apple	10.6	10.9	11.2	11.7
Total	84.0	85.4	86.7	88.5
Price Trends				
Banana	11.5	11.8	12.0	12.3
Grape	7.4	7.4	7.5	7.6
Watermelon	29.5	29.7	29.8	30.0
Citrus	25.1	25.7	26.3	27.0
Apple	10.5	10.8	11.1	11.5
Total	84.0	85.4	86.7	88.4

capita fruit consumption is projected to increase by about 3.2 percent in 1995 over the base year 1985. Citrus consumption is expected to increase about 4.8 percent under the assumption of 1.0 percent annual growth in income. Apple is also expected to increase more than the average of all fruits.

Beverages, Sugar, and Dates

Projected per capita consumption to 1995 for beverages, sugar, and dates are presented in Table XXX. The quantity demanded for coffee and tea under constant relative prices is about the same for all levels of income growth. This is because of the low expenditure elasticities for coffee and tea. The quantity demanded for sugar increases only slightly with increases in income growth. However, the price trend for sugar and a 1.0 percent growth in income increases consumption by 70.0 percent over the base year. Because of a negative expenditure elasticity for dates, consumption decreases by about 1.4 percent.

Projected Aggregate Consumption

Tables XXXI through XXXV show the projected aggregate consumption to 1995 for the 26 food commodities. The projected aggregate consumption is computed by multiplying projected per capita consumption under constant relative prices and price trends along with four levels of income growth by projected population. Two levels of population are shown. The first level is a population projection of 11,547,000 by 1995 and is the result of the first order autoregressive model. It represents a low population growth rate. The second level is a population projection of 12,721,000 by 1995 and represents a fixed

TABLE XXX

BEVERAGES, SUGAR, AND DATES: PROJECTED PER CAPITA CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE AND INCOME GROWTH SCENARIOS, SAUDI ARABIA

	Income Growth (%)			
Price Assumption	0	0.5	1	1.6
	Kg/Person			
Constant Relative Prices				
Coffee	1.8	1.8	1.8	1.8
Tea	1.5	1.5	1.5	1.5
Sugar	40.8	41.1	41.5	41.9
Dates	28.3	28.1	27.9	27.7
Total	72.4	72.5	72.7	72.9
Price Trends				
Coffee	2.1	2.1	2.1	2.1
Tea	1.6	1.6	1.6	1.6
Sugar	68.2	68.8	69.3	70.0
Dates	28.3	28.1	27.9	27.7
Total	100.2	100.6	100.9	101.4

TABLE XXXI

CEREALS: PROJECTED TOTAL CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE, INCOME, AND POPULATION GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	mt			
Constant Relative Prices				
	Population (11,547,000)			
Rice	487,283.4	490,747.5	494,211.6	497,675.7
Wheat flour	1,264,396.0	1,288,645.0	1,312,893.0	1,342,916.0
Corn	26,558.1	26,558.1	27,712.8	27,712.8
Millet	5,773.5	5,773.5	5,773.5	5,773.5
Sorghum	20,784.6	20,784.6	20,784.6	20,784.6
Total	1,804,796.0	1,832,508.0	1,861,376.0	1,894,862.0
	Population (12,721,000)			
Rice	536,825.2	540,642.5	544,458.8	548,275.1
Wheat flour	1,392,949.0	1,419,663.0	1,446,377.0	1,479,452.0
Corn	29,258.3	29,258.3	30,530.4	30,530.4
Millet	6,360.5	6,360.5	6,360.5	6,360.5
Sorghum	22,897.8	22,897.8	22,897.8	22,897.8
Total	1,988,292.0	2,018,822.0	2,050,625.0	2,087,516.0
Price Trends				
	Population (11,547,000)			
Rice	491,902.2	495,366.3	498,830.4	502,294.5
Wheat flour	1,262,087.0	1,285,181.0	1,309,429.0	1,339,452.0
Corn	26,558.1	26,558.1	26,558.1	26,558.1
Millet	5,773.5	5,773.5	5,773.5	5,773.5
Sorghum	19,629.9	19,629.9	19,629.9	19,629.9
Total	1,805,950.0	1,832,508.0	1,860,221.0	1,893,708.0
	Population (12,721,000)			
Rice	541,914.6	545,730.9	549,547.2	553,363.5
Wheat flour	1,390,405.0	1,415,847.0	1,442,561.0	1,475,636.0
Corn	29,258.3	29,258.3	29,258.3	29,258.3
Millet	6,360.5	6,360.5	6,360.5	6,360.5
Sorghum	21,625.7	21,625.7	21,625.7	21,625.7
Total	1,989,564.0	2,018,822.0	2,049,353.0	2,086,244.0

TABLE XXXII

MEATS: PROJECTED TOTAL CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE, INCOME, AND POPULATION GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	mt			
Constant Relative Prices				
	Population (11,547,000)			
Beef	63,508.5	64,663.2	65,817.9	68,127.3
Camel	32,331.6	32,331.6	31,176.9	30,022.2
Fish	50,806.8	51,961.5	51,961.5	53,116.2
Mutton	84,293.1	85,447.8	86,602.5	87,757.2
Poultry	357,957.0	398,371.5	404,145.0	411,073.2
Total	588,897.0	632,775.6	639,703.8	650,096.1
	Population (12,721,000)			
Beef	69,965.5	71,237.6	72,509.7	75,053.9
Camel	35,618.8	35,618.8	34,346.7	33,074.6
Fish	55,972.4	57,244.5	57,244.5	58,516.6
Mutton	92,863.3	94,135.4	95,407.5	96,679.6
Poultry	394,351.0	438,874.5	445,235.0	452,867.6
Total	648,771.0	697,110.8	704,743.4	716,192.3
Price Trends				
	Population (11,547,000)			
Beef	68,127.3	70,436.7	71,591.4	73,900.8
Camel	32,331.6	32,331.6	31,176.9	30,022.2
Fish	50,806.8	50,806.8	51,961.5	53,116.2
Mutton	90,066.6	91,221.3	92,376.0	94,685.4
Poultry	533,471.4	541,554.3	549,637.2	558,874.8
Total	774,803.7	786,350.7	796,743.0	810,599.4
	Population (12,721,000)			
Beef	75,053.9	77,598.1	78,870.2	81,414.4
Camel	35,618.8	35,618.8	34,346.7	33,074.6
Fish	55,972.4	55,972.4	57,244.5	58,516.6
Mutton	99,223.8	100,495.9	101,768.0	104,312.2
Poultry	587,710.2	596,614.9	605,519.6	615,696.4
Total	853,579.1	866,300.1	877,749.0	893,014.2

TABLE XXIII

VEGETABLES: PROJECTED TOTAL CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE, INCOME, AND POPULATION GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	mt			
Constant Relative Prices				
	Population (11,547,000)			
Carrot	6,928.2	6,928.2	6,928.2	6,928.2
Eggplant	39,259.8	39,259.8	39,259.8	40,414.5
Garlic	4,618.8	4,618.8	4,618.8	4,618.8
Okra	18,475.2	19,629.9	19,629.9	20,784.6
Tomato	354,802.3	360,266.4	362,575.8	367,194.6
Potato	78,519.6	80,829.0	83,138.4	85,447.8
Onion	182,442.6	185,906.7	190,525.5	195,144.3
Total	687,046.5	697,438.8	706,676.4	720,532.8
	Population (12,721,000)			
Carrot	7,632.6	7,632.6	7,632.6	7,632.6
Eggplant	43,251.4	43,251.4	43,251.4	44,523.5
Garlic	5,088.4	5,088.4	5,088.4	5,088.4
Okra	20,353.6	21,625.7	21,625.7	22,897.8
Tomato	393,078.9	396,895.2	399,439.4	404,527.8
Potato	86,502.8	89,047.0	91,591.2	94,135.4
Onion	200,991.8	204,808.1	209,896.5	214,984.9
Total	756,899.5	768,348.4	778,525.2	793,790.4
Price Trends				
	Population (11,547,000)			
Carrot	6,928.2	6,928.2	6,928.2	6,928.2
Eggplant	38,105.1	38,105.1	38,105.1	39,259.8
Garlic	3,464.1	3,464.1	3,464.1	4,618.8
Okra	17,320.5	18,475.2	18,475.2	18,475.2
Tomato	354,492.9	357,957.0	360,266.4	364,885.2
Potato	81,983.7	84,293.1	85,447.8	88,911.9
Onion	180,133.2	184,752.0	188,216.1	193,989.6
Total	682,427.7	693,974.7	700,902.9	717,068.7
	Population (12,721,000)			
Carrot	7,632.6	7,632.6	7,632.6	7,632.6
Eggplant	41,979.3	41,979.3	41,979.3	43,251.4
Garlic	3,816.3	3,816.3	3,816.3	5,088.4
Okra	19,081.5	20,353.6	20,353.6	20,353.6
Tomato	390,534.7	394,351.0	396,895.2	401,983.6
Potato	90,319.1	92,863.3	94,135.4	97,951.7
Onion	198,447.6	203,536.0	207,352.3	213,712.8
Total	751,811.1	764,532.1	772,164.7	789,974.1

TABLE XXXIV

FRUITS: PROJECTED TOTAL CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE, INCOME, AND POPULATION GROWTH SCENARIOS, SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	mt			
Constant Relative Prices				
	Population (11,547,000)			
Banana	132,790.5	135,099.9	138,564.0	142,028.1
Grape	85,447.8	86,602.5	86,602.5	87,757.2
Watermelon	339,481.8	341,791.2	342,945.9	345,255.3
Citrus	289,829.7	296,757.9	303,686.1	311,769.0
Apple	122,398.2	125,862.3	129,326.4	135,099.9
Total	969,948.0	986,113.8	1,001,124.0	1,021,909.0
	Population (12,721,000)			
Banana	146,291.5	148,835.7	152,652.0	156,468.3
Grape	94,135.4	95,407.5	95,407.5	96,679.6
Watermelon	373,997.4	376,541.6	377,813.7	380,357.9
Citrus	319,297.1	326,929.7	334,562.3	343,467.0
Apple	134,842.6	138,658.9	142,475.2	148,835.7
Total	1,068,564.0	1,086,373.0	1,102,910.0	1,125,808.0
Price Trends				
	Population (11,547,000)			
Banana	132,790.5	136,254.6	138,564.0	142,028.1
Grape	85,447.8	85,447.8	86,602.5	87,757.2
Watermelon	340,636.5	342,945.9	344,100.6	346,410.0
Citrus	289,829.7	296,757.9	303,686.1	311,769.0
Apple	121,243.5	124,707.6	128,171.7	132,790.5
Total	969,948.0	986,113.8	1,001,124.0	1,020,754.0
	Population (12,721,000)			
Banana	146,291.5	150,107.8	152,652.0	156,468.3
Grape	94,135.4	94,135.4	95,407.5	96,679.6
Watermelon	375,269.5	377,813.7	379,085.8	381,630.0
Citrus	319,297.1	326,929.7	334,562.3	343,467.0
Apple	133,570.5	137,386.8	141,203.1	146,291.5
Total	1,068,564.0	1,086,373.0	1,102,910.0	1,124,536.0

TABLE XXXV

BEVERAGES, SUGAR, AND DATES: PROJECTED TOTAL CONSUMPTION BY 1995 UNDER ALTERNATIVE PRICE, INCOME, AND POPULATION GROWTH SCENARIOS,SAUDI ARABIA

Price Assumption	Income Growth (%) 0	0.5	1	1.6
	mt			
Constant Relative Prices				
	Population (11,547,000)			
Coffee	20,784.6	20,784.6	20,784.6	20,784.6
Tea	17,320.5	17,320.5	17,320.5	17,320.5
Sugar	471,117.6	474,581.7	479,200.5	483,819.3
Dates	326,780.1	324,470.7	322,161.3	319,851.9
Total	836,002.8	837,157.5	839,466.9	841,776.3
	Population (12,721,000)			
Coffee	22,897.8	22,897.8	22,897.8	22,897.8
Tea	19,081.5	19,081.5	19,081.5	19,081.5
Sugar	519,016.8	522,833.1	527,921.5	533,009.9
Dates	360,004.3	357,460.1	354,915.9	352,371.7
Total	921,000.4	922,272.5	924,816.7	927,360.9
Price Trends				
	Population (11,547,000)			
Coffee	24,246.6	24,246.6	24,246.6	24,246.6
Tea	18,473.6	18,473.6	18,473.6	18,473.6
Sugar	787,437.2	794,364.8	800,137.8	808,220.0
Dates	326,751.8	324,442.6	322,133.4	319,824.2
Total	1,156,909.0	1,161,527.0	1,164,991.0	1,170,764.0
	Population (12,721,000)			
Coffee	26,714.1	26,714.1	26,714.1	26,714.1
Tea	20,353.6	20,353.6	20,353.6	20,353.6
Sugar	867,572.2	875,204.8	881,565.3	890,470.0
Dates	360,004.3	357,460.1	354,915.9	352,371.7
Total	1,274,644.0	1,279,732.0	1,283,548.0	1,289,909.0

guest worker level of 2.06 million and a three percent annual growth of the remaining population. It represents a most probable level of population. The results of projected aggregate consumption over the period 1985-1995 are presented in Appendix B.

Cereals

Table XXXI shows the projected aggregate consumption by 1995 for cereals. The results for constant relative prices and zero income growth can no longer be considered the same as the 1985 base year now since population has increased from the 1985 level of 10,650,000. However, the aggregate consumption for constant relative prices and zero income growth can be considered the result for only a population change. Under constant relative prices and a population of 11,547,000 total aggregate cereals consumption increases by 27,712 mt with a 0.5 percent income growth compared to no income growth, 56,580 mt for a 1.0 percent income growth, and 90,066 mt for a 1.6 percent income growth.

If the most probable outcome is taken as a population of 12,721,000, income growth of 1.0 percent, and a continuation of price trends, the aggregate increase in cereals consumption over the result of the low population increase (11,547,000), zero income growth, and constant relative prices is 244,557 mt or a difference of 13.5 percent. The increase in wheat consumption under the same comparison is 178,165 mt or 14.1 percent. The same result for rice consumption is 62,263.8 mt or 12.8 percent.

Meats

Table XXXII shows the projected aggregate demand by 1995 for the meats group. The major result of these data depends on the assumption about relative prices. If the price of poultry meat continues to decline, this will have a greater effect on total meat consumption than will the differences in projected population. Assuming a 1.0 percent income growth rate, at constant relative prices the increase in total meat consumption from the lower population level to the higher population level is 65,039.6 mt or a difference of 10.2 percent. However, for the same income conditions the effect of decreasing poultry prices will increase aggregate meat consumption by 157,039.2 mt or 24.5 percent for the lower population and 173,005.6 mt or 24.5 percent for the higher population.

Vegetables

Table XXXIII shows the projected aggregate consumption to 1995 for the vegetable group. The projected higher population level increases the demand for vegetables by about 10.2 percent over the lower population level for the constant relative price result. At the 1.0 percent income growth level this amounts to about 71,848.8 mt of which tomatoes account for 36,863.6 mt or 51.3 percent of the total vegetable increase.

The trend is for increased vegetable prices. This decreases the demand for vegetables. At the 1.0 percent level of income growth and a population of 12,721,000 this is a decrease of 6,360.5 mt over the constant relative prices result or about a 0.8 percent decrease.

Fruits

Table XXXIV shows the projected aggregate consumption to 1995 for fruits. Income and population growth have significant effects on total aggregate consumption of fruits. Growth in income at the 1.6 percent level increases the aggregate demand for fruit by 5.4 percent over zero growth in income. The higher population level increases aggregate demand for fruit by about 10.2 percent over the lower population level. Increased prices gives a slightly lower aggregate demand for fruit in comparing the results for price trends with the results for constant relative prices.

Beverages, Sugar, and Dates

Table XXXV shows the projected aggregate consumption to 1995 for coffee, tea, sugar, and dates. Coffee and tea show significant effects in consumption with population growth. Lower prices also show increased consumption when comparing price trends with constant relative prices.

The higher population level increases the consumption of sugar about 10.2 percent for the 1.0 percent income growth and constant relative prices. Declining prices show a significant increase in sugar consumption amounting to about a 38.8 percent increase.

Date consumption shows a negative income effect and a positive population effect. The higher population level increases aggregate consumption by about 10.2 percent. Prices appear to have no effect.

CHAPTER V

POLICY ANALYSIS OF THE WHEAT COMMODITY MARKET

Introduction

The purposes of agricultural development policies in Saudi Arabia are to increase the level of self-sufficiency in basic food commodities and to stabilize food prices. To accomplish these purposes, the Saudi government has implemented several programs including product price supports, input subsidies, and investment subsidies (free land and no interest loans) to encourage investments in the agricultural sector. Increased growth in agricultural production has achieved other primary goals of reducing the dependency on the oil sector and diversifying the sources of national income. However, growth in the agricultural sector has resulted in wheat surpluses and a high government cost for the wheat subsidy program.

The anticipated growth in aggregate domestic demand for food commodities has decreased because of the reduction in the number of guest workers and a slowing in the rate of income growth. However, an abrupt change in government policies such as reducing consumer and producer subsidies may cause agricultural incomes to decrease and prices of food commodities to increase thus again increasing the demand for food commodity imports and decreasing the level of self-sufficiency. Making information available on expected food demand and food production should facilitate

government policy formulation and reduce the potential for unanticipated results in food commodity markets. This information also helps policy makers to determine the efficiency of resource allocation and the appropriate time for government interventions in the market.

Classical welfare analysis is a useful technique to provide the policy maker with needed information to evaluate alternative government policies. Thus, the purpose of this chapter is to estimate the social costs and benefits of past government policies and alternative future policies. Welfare analysis is applied only to the wheat commodity market because of its importance in meeting the goal of self-sufficiency in basic food commodities. Other food commodities can be analyzed in the same manner once the required data are obtained.

Wheat Commodity Market

Structure of the wheat commodity market changed over the period 1970-85 (Al-Abrahem). Commercial production of wheat started in the early 1980's. Prior to that traditional farmers were the main producers of wheat. Because of high cost of transportation, lack of storage facilities, and lack of price information on other markets, farmers sold their excess wheat in local markets immediately after harvest. The wheat subsidy program was implemented in late 1973 when the government paid SR 0.25 per kg directly to the farmers. Farmers sold their excess production in the open market and received the prevailing market price in addition to the subsidy. Import duties, import licensing, and exchange control were not applied to restrict wheat importations over the period 1970-82. Through 1976, wheat imports were entirely handled by private importers. According to Al-Abrahem, the state marketing board (GSFMO) joined the private

traders in importing wheat in 1977. In 1983, a royal decree gave the GSFMO the sole authority for wheat importation.

The government intervened more directly in 1978 when the GSFMO began purchasing wheat from farmers at SR 2.5 per kg. In 1979, the wheat price increased to SR 3.5 per kg and remained at that level until 1984 when self-sufficiency in wheat was achieved. Because of limited storage capacity, the amount of wheat production delivered to the GSFMO was only 3 percent in 1978, while in 1984 this amount increased to 96 percent (Table XXXVI). However, the quantity not bought by the GSFMO was sold by farmers in the market (Al-Abrahem).

According to Al-Abrahem there were in essence two sets of wheat prices during the 1978-84 period--the open market price and the government price. Starting in 1985, the government bought almost all the wheat produced domestically, thus effectively making the expected wheat price identical to the government support price. In 1985, the government lowered the wheat price support from SR 3.5 per kg to SR 2.00 per kg and it is expected to remain at this level through the fourth development plan.

Because of the increased wheat production, the import share of total wheat supply dropped from a record high of 96 percent in 1973 to 24 percent in 1984 (Table XXXVI). Imports of wheat and flour, such as wheat used for seed and flour for specialty bakery products, may continue as needed. The excess of Saudi wheat and flour will be exported through food aid arrangements (Al-Abrahem).

TABLE XXXVI

WHEAT COMMODITY MARKET DATA 1970-84, SAUDI ARABIA

Year	Total Domestic Wheat Production (MT)	Amount of Wheat Delivered to the GSFMO (MT)	Amount of Domestic Wheat Sold in the Open Market (MT)	Wheat Delivered to the GSFMO (%)	Percent of Wheat Sold in Open Market (%)	Wheat Supply Imported (%)
1970	135,000		135,000		100	70
1971	72,000		72,000		100	86
1972	39,000		39,000		100	89
1973	63,719		63,719		100	96
1974	153,385		153,385		100	62
1975	123,038		123,038		100	72
1976	92,540		92,540		100	84
1977	124,610		124,610		100	72
1978	119,928	3,297	116,631	3	97	79
1979	140,767	17,505	123,262	12	88	79
1980	141,732	32,882	108,850	23	77	60
1981	199,430	85,435	113,995	43	57	59
1982	375,000	239,690	177,045	64	36	53
1983	827,478	674,631	142,847	82	18	41
1984	1,401,649	1,346,943	54,706	96	4	24

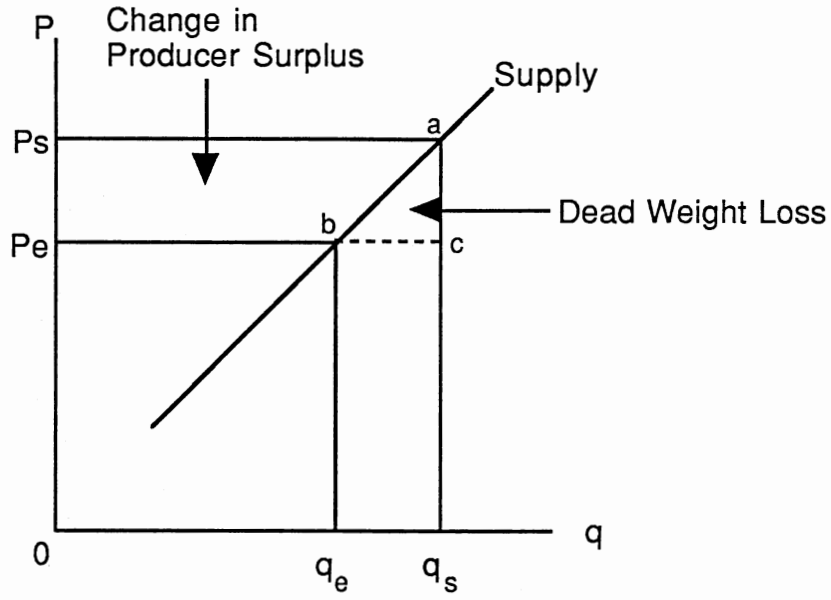
Source: Al-Abrahem, B. "An Econometric Analysis of Supply and Demand of Wheat in Saudi Arabia." Ph.D. thesis, Washington State University, Table 1.4 page 16 and Table 1.5 page 19, 1987.

Welfare Analysis for Period 1980-1985

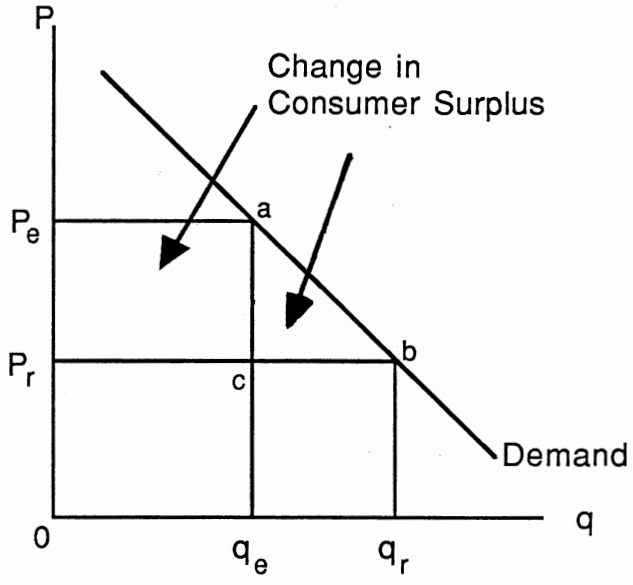
The purpose of the welfare analysis is to estimate gains and losses from government interventions in the wheat market from 1980 to 1985 and to evaluate alternative policies to 1995. Separate market levels for producers and consumers will be analyzed using partial equilibrium methods (Tweeten). This section presents an expost welfare analysis for the period 1980-1985.

Impact of government interventions in the wheat market at the producer level is shown graphically in Figure 5.1(a). The official support price paid to producers is P_s and results in the quantity of q_s. P_e and q_e are the competitive market clearing price and quantity, respectively. P_e is assumed to be the c.i.f. wheat price plus marketing margin in the absence of a support price (Tweeten). The support price generates a domestic market surplus equal to $q_s - q_e = \Delta q_s$, a public treasury cost equal to the area P_eP_sac, a gain to producers (producer surplus) equal to the area P_eP_sab, and a net social cost (dead weight loss) equal to the area abc. When Saudi Arabia produces wheat in excess of domestic demand, the market clearing price becomes the f.o.b. export price which is less than the c.i.f. import price. With a continued price support of P_s, the public treasury cost per unit of wheat exported increases by the difference between the c.i.f. and f.o.b. price.

The equivalent impact from government intervention in the wheat market at the consumer level is shown in Figure 5.1(b). The wheat flour market is used for the consumer level. The government administers retail prices indirectly by setting the wholesale price of wheat flour and limiting the percent mark-up or margin. The retail price P_r is observed in the market and the quantity demanded is calculated in terms of flour equivalent q_r.



(a) Producer Level (wheat)



(b) Consumer Level (wheat flour)

Figure 5.1. Graphical Analysis of Wheat Policy Intervention, Saudi Arabia

The competitive market clearing price P_e is assumed equal to the c.i.f. import price for wheat flour plus the marketing margin. The competitive market clearing price has been higher than the domestic retail price. The lower domestic retail price has been justified for purposes of price stability and consumer assistance on basic food commodities. The consumer subsidy increases wheat flour consumption by $q_r - q_e = \Delta q_d$, public treasury cost equal to $(P_e - P_r)q_r$, and consumer surplus equal to the area P_rP_eab.

Producer Support Price

The net social cost (NSC) or dead weight loss from the producer subsidy is the area under the supply curve above the market clearing price P_e and up to the support price P_s. Assuming a linear approximation for supply between q_e and q_s, the NSC can be calculated as:

$$NSC = 0.5\, \Delta P_s\, \Delta q_s \qquad (5.1)$$

where

$\Delta P_s = P_s - P_e$

$\Delta q_s = q_s - q_e$.

The free market price (P_e) is calculated as the c.i.f. price (P_m) plus the expected marketing margin. The marketing margin is calculated by viewing the difference between the c.i.f. price and the producer price during the period 1971-1979 when the wheat commodity market was generally considered a free market (Table XXXVII). The marketing margin for 1974 was excluded because of its abnormal low value. Expected marketing margin is calculated by regressing the marketing margin on the c.i.f. price using OLS with zero intercept. The following results:

TABLE XXXVII

MARKETING MARGIN AND FREE MARKET PRICE FOR WHEAT COMMODITY AT PRODUCER LEVEL, SAUDI ARABIA

Year	Wheat Imports (MT)	Wheat Value ($1,000)	Exchange Rate SR/$1	Import Price SR/MT	Producer Price SR/MT	Marketing Margin SR/MT	Expected Mkt. Mag. SR/MT	Free Mkt. Price SR/MT	Change in Supply Price SR/MT
1971	79,187	7,834	4.50	445.19	800	354.81	320.74	765.93	34.07
1972	101,699	11,289	4.15	459.56	730	270.44	331.10	790.65	-60.65
1973	77,103	13,067	3.71	627.06	850	222.94	451.77	1078.83	-228.83
1974	68,252	18,998	3.55	988.15	1000	11.85	*	*	*
1975	12,649	2,789	3.52	776.13	1200	423.87	559.18	1335.31	-135.31
1976	26,446	6,113	3.53	815.96	1470	654.04	587.87	1403.83	66.17
1977	51,732	14,675	3.53	1001.37	1780	778.63	721.45	1722.82	57.18
1978	55,957	16,466	3.40	1000.49	1740	739.51	720.82	1721.31	18.69
1979	289,657	82,412	3.36	967.35	1800	832.65	696.95	1664.30	135.70
1980	172,249	50,881	3.33	983.66	3500		708.69	1692.35	1807.65
1981	439,653	106,773	3.38	820.86	3500		591.40	1412.26	2087.74
1982	567,633	116,736	3.43	705.39	3500		508.21	1213.61	2286.39
1983	434,335	107,259	3.45	851.98	3500		613.82	1465.80	2034.20
1984	177,460	59,860	3.52	1187.35	3500		855.45	2042.80	1457.20
1985	170,300	44,570	3.62	947.41	2000		682.58	1629.98	370.02
1986	128,000	35,830	3.70	1113.76	2000		802.43	1916.19	83.81

Source: Food and Agriculture Organization of the United Nation (FAO), Production Yearbook, Rome, various issues, 1971-86

* indicates that year is excluded from analysis.

$$M = \underset{(0.054)}{0.7205\, P_m} \qquad (5.2)$$

$$\bar{R}^2 = 0.72$$

where M is the expected marketing margin and P_m is the import price (c.i.f.) for wheat. The regression has a high $\bar{R}^2$ and a low standard error of the coefficient.

Rearranging terms for the change in wheat supply, the competitive market clearing quantity for wheat is:

$$q_e = q_s - \Delta q_s. \qquad (5.3)$$

The change in wheat quantity (Δq_s) is computed utilizing the direct supply price elasticity for wheat as follows:

$$E_s = [(q_s - q_e)/(P_s - P_e)](P_s/q_s) = (\Delta q_s/\Delta P_s)(P_s/q_s)$$

or $$\Delta q_s \approx (\Delta P_s/p_s)q_s(E_s) \qquad (5.4)$$

where E_s is the direct price supply elasticity of wheat.

There are various ways to estimate the own price supply elasticity including direct estimation of the supply function, weighted average of input demand elasticities, aggregation of area and yield elasticities, programming approach, simulation approach, and duality approach. These methods are explained in Henneberry (1986). Henneberry defines the short-run and long-run elasticities as "...a short-run supply elasticity measures the short-run supply response to a given change in price. It is usually defined as the supply response evolving in one year. A long-run supply elasticity measures supply response to a given change in price after sufficient time has passed for full supply response over many years."

A short-run own price supply elasticity of wheat is estimated for Saudi Arabia using direct estimation of the supply function while the long-run own price supply elasticity is estimated using the aggregation of area and yield elasticities. Ordinary Least Squares (OLS) was applied using a Cobb-Douglas function, where supply is a function of wheat price. Results of the double log function using data for the years 1971 to 1985 are:

$$\text{Log TOTS} = \underset{(0.27)}{-5.6885 + 1.41 \text{ Log P}} \qquad (5.5)$$

$$\bar{R}^2 = 0.67$$

where TOTS and P are total domestic supply available and production price expressed in logs, respectively. The short-run own price elasticity is 1.41. The value in parenthesis is the standard error.

The long-run supply elasticity of wheat is computed by using aggregation of the acreage elasticity and the yield elasticity with respect to price (Henneberry):

$$(E)_{sp} = (E)_{yp} + (E)_{ap} \qquad (5.6)$$

where

$(E)_{sp}$ = the supply elasticity with respect to product price,

$(E)_{yp}$ = the elasticity of yield with respect to product price, and

$(E)_{ap}$ = the elasticity of crop area with respect to product price.

Tweeten and Quance make an adjustment to the supply elasticity for the negative effect of higher acreage on yields as production moves to lower yielding land, thus equation (5.6) becomes:

$$(E)_{sp} = (E)_{yp} + (E)_{ap} [1 + (E)_{ya}] \quad (5.6)$$

where $(E)_{ya}$ is the elasticity of yield with respect to area.

Tweeten and Quance (1969, pg. 349) state "...if crop area is expanded on marginal lands, E_{ya} is negative; if area is expanded on superior lands (say recently irrigated), E_{ya} is positive. If yield and area are independent, then the total supply elasticity .... is a simple sum of the yield and area elasticity."

The long-run $(E)_{ap}$ and the short-run $(E)_{yp}$ were estimated by Al-Abrahem (1987) and the result of his estimations are equal to 1.67 and 0.36, respectively. He assumed yield and area are independent, thus $(E)_{ya}$ is equal to zero. Equation (5.6) is used to estimate a long-run own price supply elasticity of wheat equal to 2.03. Own price supply elasticities of wheat for various developed and developing countries are presented in Table XXXVIII from the Henneberry reference. Both the long-run and short-run own supply price elasticities of wheat estimated for Saudi Arabia appear reasonable. Short-run supply elasticity is used to measure welfare analysis in the producers market.

After computing Δq_s and with ΔP_s the net social cost from the producer's support price is calculated from equation (5.1). The gain to producers is equal to the total area of the rectangular P_eP_sac minus the net social cost (dead weight loss):

$$\text{Gain to producers} = (P_s - P_e)\, q_s - 0.5\, \Delta q_s\, \Delta P_s. \quad (5.7)$$

The distribution of gains and losses from the producer price support for wheat is calculated and presented in Table XXXIX. The open market price varied from about 35 percent of the support price in 1982 to 81.5 percent of the support price in 1985. The open market clearing quantity varied from 7.7 percent of actual production in 1982 to 73.9 percent in 1985. The public

TABLE XXXVIII

OWN PRICE SUPPLY ELASTICITIES OF WHEAT FOR SELECTED DEVELOPED AND DEVELOPING COUNTRIES

	Countries	Period	Method of Estimation	Short-Run Elasticity	Long-Run Elasticity
1	India	1960-80	DSF	.31	.41
2	Pakistan	1960-80	DSF	.10	.15
3	Pakistan	1962/63-82/83	DSF	.14	.40
4	Turkey	1961-76	II ASA	.22	.58
5	Taiwan	1960-80	DSF	.30	.45
6	South Korea	1960-89	DSF	.30	.45
7	Egypt	1960-80	DSF	NA	.39
8	Kenya	1964-79	DSF	1.51	4.10
9	Tanzania	1966-78	DSF	.99	3.02
10	Japan	1910-41	DSF	.01-.26	.02-1.16
11	Japan	1966-80	DSF	.30	.60
12	France	1946-61	DSF	.63	NA
13	Canada	1947-66	DFS	.42-.75	.62-1.30
14	U.S.A.	1960-80	NA	.45	.80
15	U.S.A.	NA	NA	.45-.52	.25-2.55
16	Ec-9	1961-76	IIASA	1.09	2.89
17	Australia	1960-80	DFS	.31	.90
18	New Zealand	1945-65	DFS	.96	1.58
19	European Community	1960-80	DFS	.30	.90
20	West Germany	1976	GOL	NA	.42-1.29
21	United Kingdom	1976	GOL	NA	.47-1.42
22	United Kingdom	1924-39	A&C	.33-.41	.46-.98
23	EC	1960-80	DSF	.30	.90

DSF = Direct Estimation of the supply function.
II ASA = International Institute for Applied System Analysis Model
A&C = Askari, Hossein and John Cummings. Agricultural Supply Response, A Survey of Ecometric Evidence. Praeger Publishers, 1976.
GOL = World Grain-Oilseeds-Livestock Model
NA = Not Available

Source: Henneberry, S. A Review of Agricultural Supply Responses for International Policy Models, Oklahoma State University, Stillwater, 1986.

TABLE XXXIX

DISTRIBUTION OF GAINS AND LOSSES FROM PRODUCER PRICE SUPPORT FOR WHEAT, SAUDI ARABIA, 1980-1985

Item	Notation	Units	1980	1981	1982	1983	1984	1985
Wheat production	q_s	1,000 MT	142	187	375	885	1407	1980
Producer price	P_s	SR/MT	3500	3500	3500	3500	3500	2000
C.I.F. price	P_m	SR/MT	984	821	705	852	1187	947
Marketing margin	M	SR/MT	709	591	508	614	855	683
Open market price	$P_e = P_m + M$	SR/MT	1693	1412	1213	1466	2042	1630
Change in price	$\Delta P_s = P_s - P_e$	SR/MT	1807	2088	2287	2034	1458	370
Supply elasticity	E_s	--	1.41	1.41	1.41	1.41	1.41	1.41
Change in quantity	$\Delta q_s = (\Delta P_s/P_s)q_s E_s$	1,000 MT	103	157	346	725	826	516
Clearing quantity	$q_e = q_s - \Delta q_s$	1,000 MT	39	30	29	160	581	1464
Net social cost	$NSC_s = 0.5\ \Delta P_s\ \Delta q_s$	SR1,000	93,060	163,908	395,651	737,325	602,154	95,460
Public cost	$PUBC_s = \Delta P_s\ q_s$	SR1,000	256,594	390,465	859,912	1,800,090	2,051,406	732,600
Gain to producers	$GPROD_s = PUBC_s - NSC_s$	SR1,000	163,534	226,548	464,261	1,062,765	1,449,252	637,140
Cost per SR transferred	$ESUB_s = (PUBC_s + NSC_s)/GPROD_s$	SR	2.14	2.45	2.70	2.39	1.83	1.30

treasury costs for the wheat price support varied from SR 256,594,000 in 1980 to SR 2,051,406,000 in 1984. The average annual public costs for the 6 year period was SR 1,015,176,000. The net social cost from using too many resources in production of wheat ranged from SR 93,060,000 in 1980 to SR 737,325,000 in 1983. The gain to wheat producers ranged from SR 163,534,000 in 1980 to SR 1,449,252,000 in 1984 or an average annual gain over the 6 year period of SR 667,250,000. The efficiency of transferring one SR to wheat producers varied from SR 1.30 in 1985 to SR 2.70 in 1982.

The extent of the transfers and public cost of wheat supply is considerably more when the input subsidies are included such as irrigation equipment subsidies, fertilizer subsidies, and free interest loans on land improvement and capital equipment.

Consumer Subsidies

Welfare analysis at the consumer level measures costs and gains from the consumer subsidy. The Saudi government sells wheat and wheat products to wholesalers under cost to stabilize food prices and protect domestic production. Without government intervention the wheat and wheat equivalent price would be the c.i.f. price plus marketing margin. The quantity of imported wheat or wheat equivalent is multiplied by the conversion rate of wheat to flour, which is 80 percent on average in the Saudi flour mills (Al-Abraham), then the c.i.f. flour price is computed by dividing the value of imported wheat and wheat equivalent products by the quantity of flour equivalent as presented in Table XL.

Al-Abraham has estimated the average free market retail price of wheat flour to be SR 2.94 per kg over the 1981-1984 period and includes an average marketing margin of SR 1.68 per kg and an average c.i.f. price of flour of

TABLE XL

COMPUTED FREE MARKET PRICE AND AVERAGE NATIONAL RETAIL PRICE OF WHEAT FLOUR, 1971-85, SAUDI ARABIA

Year	Quantity of Imported Wheat or Wheat eqv. (MT)	Value of Imported Wheat or Wheat eqv. (1,000 $)	Exchange Rate SR/$	Quantity of Flour Equivalent 0.8 (MT)	C.I.F. Price of Flour (SR/Kg)	Marketing Margin (134% of cif) (SR/Kg)	C.I.F. Price of Flour Plus Mkt. Marg. (SR/Kg)	Average National Retail Price of Flour (SR/Kg)
1971	294,009	24,693	4.50	235,207	0.47	0.63	1.11	0.81
1972	352,616	29,553	4.15	282,092	0.43	0.58	1.02	0.73
1973	257,660	33,838	3.71	206,128	0.61	0.82	1.43	1.04
1974	264,389	62,415	3.55	211,511	1.05	1.40	2.45	1.45
1975	352,354	75,752	3.52	281,883	0.95	1.27	2.21	1.73
1976	494,318	108,613	3.53	395,454	0.97	1.30	2.27	1.74
1977	427,806	103,113	3.53	342,244	1.06	1.43	2.49	1.82
1978	610,252	141,932	3.40	488,201	0.99	1.32	2.31	1.85
1979	888,237	242,848	3.36	710,589	1.15	1.54	2.69	1.87
1980	780,003	242,071	3.33	624,002	1.29	1.73	3.02	1.87
1981	707,893	190,010	3.38	566,314	1.13	1.52	2.65	2.33
1982	744,480	165,980	3.43	595,584	0.96	1.28	2.24	2.13
1983	624,090	154,770	3.45	499,272	1.07	1.43	2.50	2.08
1984	481,270	125,470	3.52	385,016	1.15	1.54	2.68	2.00
1985	170,300	44,570	3.62	136,240	1.18	1.59	2.77	2.67

Source: Food and Agriculture organization of the United Nations, Trade Yearbook, Rome, various issues. International Financial Statisitcs (IFS) 1987. Retail price of flour is obtained from Al-Abrahem's thesis for the period 1971-84. The retail price of flour for the year 1985 is computed by using the following formula:

$$(RPFl_t)(\alpha l_t) + (RPFd_t)(\alpha d_t) = RPF_t$$

where $RPFl_t$, $RPFd_t$, αl_t, αd_t and $RPFt$ are retail price of imported flour, retail price of local flour, percentage share of imports in total available supply, and percentage share of local wheat production in total available supply, and average national retail price of flour in time t, respectively.

SR 1.26 per kg. Information on government pricing of wheat flour is not available. Therefore, the Al-Abraham research is used to compute the marketing margin and free market price over the period 1971-85. The free market retail price of wheat flour is obtained from adding the c.i.f. flour price to the marketing margin with the results presented in Table XL.

The demand elasticity for wheat flour equivalent estimated in Chapter III is used to calculate public costs and consumer gains at the retail market level from the consumer subsidy. The expected quantity consumed at the free market price is obtained as follows:

$$\Delta q_d = \left(\frac{\Delta P_d}{P_r}\right) q_r E_d \qquad (5.8)$$

and

$$\Delta q_e = q_r - \Delta q_d \qquad (5.9)$$

where

q_r = consumption of wheat flour at subsidized retail price,

P_r = average national subsidized retail price of flour,

E_d = demand elasticity of wheat flour equivalent,

P_e = free market retail price of flour, and

q_e = consumption of flour at free market price.

Public cost and consumer gains (consumer surplus) are the following:

$$\text{Public cost} = q_r (P_e - P_r) \qquad (5.10)$$

$$\text{Consumer gains} = q_r (P_e - P_r) - 0.5 (q_r - q_e) (P_e - P_r). \qquad (5.11)$$

The gain to consumers and the public cost from the consumer price subsidy for consumption of wheat flour equivalent for the period 1980-1985 are presented in Table XLI. The open market price varied from as low as 3.4 percent over the subsidized retail price in 1985 to 61.5 percent over the subsided price in 1980. The open market clearing quantity varied from 90.8 percent of actual consumption in 1980 to 99.5 percent of actual consumption in 1985. The public treasury costs from the wheat consumption subsidy varied from SR 83,974,000 in 1985 to SR 866,640,000 in 1980. The average annual public costs for the 6 year period was SR 402,949,500. Consumers of wheat flour are the gainers from the public subsidy and on average gained SR 391,787,000 per year over the 6 year period. The subsidy is highly efficient, however, in transferring one SR to consumers. The cost varied from SR 1.003 in 1985 to SR 1.048 in 1980 to transfer one SR to consumers. This would be an efficient way to distribute income to low income people.

Net Social Welfare

The overall distribution of benefits and costs from the government policies for wheat production and consumption are presented in Table XLII. Total benefits are distributed to producers and consumers. Consumers benefitted proportionally more in 1980 and 1981 relative to producers. However, the absolute magnitude of benefits were much higher in 1983 and 1984 with producers receiving about 70 percent of the total benefits.

Public costs follow closely the distribution of benefits. The consumer subsidies were a major component of public costs in 1980 and 1981 with the producer support price subsidies being the major component in 1983 and 1984. The total public and social costs of transferring one SR to producers and consumers ranges from SR 1.23 in 1980 to SR 2.37 in 1982.

TABLE XLI

DISTRIBUTION OF GAINS AND LOSSES FROM CONSUMER PRICE SUBSIDY FOR WHEAT FLOUR, SAUDI ARABIA, 1980-1985

Item	Notation	Units	1980	1981	1982	1983	1984	1985
Wheat flour consumption	q_r	1,000 MT	753,600	741,684	1,017,979	1,127,844	941,237	933,045
Retail price	P_r	SR/Kg	1.87	2.33	2.13	2.08	2.00	2.67
C.I.F. price of flour	P_m	SR/Kg	1.29	1.13	0.96	1.07	1.15	1.18
Marketing margin	$M = 1.34\ (P_m)$	SR/Kg	1.73	1.51	1.29	1.43	1.54	1.58
Open market price	$P_e = P_m + M$	SR/Kg	3.02	2.64	2.25	2.50	2.69	2.76
Change in price	$\Delta P_d = P_e - P_r$	SR/Kg	1.15	0.31	0.12	0.42	0.69	0.09
Demand elasticity	E_d	--	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15
Change in quantity	$\Delta q_d = \left(\frac{\Delta P_d}{P_r}\right) q_r E_d$	1,000 MT	-69,517	-14,800	-8,603	-34,161	-48,709	-4,718
Clearing quantity	$q_e = q_r + \Delta q_d$	1,000 MT	684,083	726,884	1,009,376	1,093,683	892,528	928,327
Public cost	$PUBC_d = \Delta P_d\ q_r$	SR1,000	866,640	229,922	114,014	473,694	649,453	83,974
Gain to consumers	$GCONS_d = PUBC_d - 0.5\Delta P_d \Delta q_d$	SR1,000	826,668	227,628	113,498	466,520	632,648	83,762
Cost per SR transferred	$ESUB_d = PUBC_d / GCONS_d$	SR	1.048	1.010	1.005	1.015	1.027	1.003

TABLE XLII

DISTRIBUTION OF BENEFITS AND COSTS OF GOVERNMENT POLICIES FOR WHEAT PRODUCTION AND CONSUMPTION, SAUDI ARABIA, 1980-1985

Item	Notation	Units	1980	1981	1982	1983	1984	1985
Benefits								
Producers	$GPROD_s$	SR1,000	163,534	226,548	464,261	1,062,765	1,449,252	637,140
		(%)	(16.5)	(49.9)	(80.4)	(69.5)	(69.9)	(88.4)
Consumer	$GCONS_d$	SR1,000	826,668	227,628	113,498	446,520	632,648	83,762
		(%)	(83.5)	(50.1)	(19.6)	(30.5)	(30.4)	(11.6)
Total	$GTOT = GPROD_s + GCONS_d$		990,202	454,176	577,759	1,529,285	2,081,900	720902
Public Costs								
Producer Subsidy	$PUBC_s$	SR1,000	256,594	390,456	859,912	1,800,090	2,051,406	732,600
		(%)	(22.8)	(62.9)	(88.3)	(79.2)	(76.0)	(89.7)
Consumer Subsidy	$PUBC_d$	SR1,000	866,640	229,922	114,014	473,694	649,453	83,974
		(%)	(77.2)	(37.1)	(11.7)	(20.8)	(24.0)	(10.3)
Total	$PTOT = PUBC_s + PUBC_d$		1,123,234	620,378	973,926	2,273,784	2,700,859	816,574
Net Social Cost	NSC_s	SR1,000	93,060	163,908	395,651	737,325	602,154	95,460
Total Costs (Public and Social) to Transfer one SR to Producers and Consumers $ETOT = (PTOT + NSCs)/GTOT$		SR	1.23	1.73	2.37	1.97	1.59	1.27

Wheat Policy for Self-Sufficiency 1986-1995

This section is an analysis of wheat policy under the assumption of self-sufficiency for the period 1986-1995 in Saudi Arabia. The reported wheat production in 1986 was 2,000,000 mt (USDA, 1987) and the amount of imports was 128,000 mt for a total supply of 2,128,000 mt (FAO). This indicates that about 6 percent of total wheat supply is imported and includes wheat seed and wheat equivalent specialty products. The amount of wheat imports in 1985 was 7.9 percent and in 1984 was 11.2 percent. The level of wheat self-sufficiency is assumed at 94 percent of total wheat supply for the period 1986-1995.

Wheat flour consumption projections are taken from the results of the demand simulations given in Chapter IV. The scenario assumed is a continuation of relative price trend for wheat flour, income growth of one percent per capita, and population growth of three percent beginning in 1989. Actual estimated population is used for the 1986-1989 period. The terminal population projection for 1995 is 12,721,000. Wheat flour consumption projections, q_f, are given in Table XLIII.

The wheat equivalent, q_w, of wheat flour consumption is computed assuming a 80 percent milling ratio. Wheat for nonfeed use, q_{nf}, was 175,000 mt in 1986 (USDA) and is assumed to remain constant for the projected period. Total wheat demand is

$$q_d = q_w + q_{nf}. \tag{5.12}$$

Wheat imports are

$$q_m = 0.06\, q_d \tag{5.13}$$

and wheat production assuming 94 percent self-sufficiency is

TABLE XLIII

WELFARE ANALYSIS OF WHEAT PRICE SUPPORT POLICY FOR 94 PERCENT SELF-SUFFICIENCY, SAUDI ARABIA, 1986-1995

Item	Notation	Units	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Wheat flour consumption	q_f	1,000 MT	1,165	1,184	1,202	1,219	1,253	1,289	1,325	1,363	1,403	1,443
Wheat equivalent (80% milling)	q_w	1,000 MT	1,456	1,480	1,503	1,524	1,565	1,611	1,656	1,704	1,754	1,804
Wheat for nonfood use	q_{nf}	1,000 MT	175	175	175	175	175	175	175	175	175	175
Total wheat demand	$q_d = q_w + q_{nf}$	1,000 MT	1,631	1,655	1,678	1,699	1,740	1,786	1,831	1,879	1,929	1,979
Wheat imports (6%)	$q_m = 0.06\ q_d$	1,000 MT	98	99	101	102	104	107	110	113	116	119
Wheat production (94% self-sufficiency)	$q_s^* = q_d - q_m$	1,000 MT	1,533	1,556	1,577	1,597	1,636	1,679	1,721	1,766	1,813	1,860
Change in wheat production from 1985	$\Delta q = q_s^* - q_s\ (1985)$	1,000 MT	-447	-424	-402	-383	-344	-301	-259	-213	-166	-119
Price change from 1985	$\Delta P = \Delta q \frac{Ps(1985)}{qs(1985)} \frac{1}{E_s}$	SR/MT	-320	-304	-288	-274	-246	-216	-186	-153	-119	-85
New price support	$P_s^* = P_s(1985) + \Delta P$	SR/MT	1,680	1,696	1,712	1,726	1,754	1,784	1,814	1,847	1,881	1,915
C.I.F. wheat price	P_m	SR/MT	995	995	995	995	995	995	995	995	995	995
Marketing margin	$M = 0.7205\ P_m$	SR/MT	717	717	717	717	717	717	717	717	717	717
Open market wheat price using c.i.f. price	$P_e = P_m + M$	SR/MT	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712	1,712
Change in wheat price from c.i.f. price	$\Delta P_s^* = P_s^* - P_e$	SR/MT	-32	-16	0	14	42	72	102	135	169	203

TABLE XLIII (Continued)

Item	Notation	Units	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Change in wheat quantity from Δp_s^*	$\Delta q_s^* = \left(\frac{\Delta P_s^*}{P_s^*}\right) q_s^* E_s$	1,000 MT	-41	-21	0	5	55	96	136	182	230	278
Open market clearing quantity	$q_e = q_s^*$ for $\Delta P_s^* < 0$ $q_e = q_s^* - \Delta q_s^*$ for $\Delta P_s^* > 0$	1,000 MT	1,533	1,556	1,577	1,592	1,581	1,583	1,585	1,584	1,583	1,582
Net social cost	$NSC_s^* = 0$ for $\Delta P_s^* < 0$ $NSC_s^* = 0.5\ \Delta P_s^*\ \Delta q_s^*$ for $\Delta P_s^* > 0$	SR1,000	0	0	0	35	1,155	3,156	6,936	12,285	19,435	28,217
Public cost	$PUBC_s^* = 0$ for $\Delta P_s^* < 0$ $PUBC_s^* = \Delta P_s^*\ q_s^*$ for $\Delta P_s^* > 0$	SR1,000	0	0	0	22,358	68,712	120,888	175,542	238,410	306,397	377,580
Gain to Producers	$GPROD_s^* = PUBC_s^* - NSC_s^*$	SR1,000	0	0	0	22,323	67,557	117,432	168,606	226,125	286,962	349,363
Cost per SR transferred	$ESUB_s^* = PUBC_s^*/GPROD_s^*$	SR	-	-	-	1.002	1.02	1.03	1.04	1.054	1.07	1.08

$$q_s^* = q_d - q_m. \tag{5.14}$$

The projected values of q_f, q_w, q_{nf}, q_d, q_m, and q_s^* are given in Table XLIII for the 1986-1995 period.

The actual production of wheat in 1985 was 1,980,000 mt. The change in wheat production from 1985 to meet the policy of 94 percent self-sufficiency is

$$\Delta q = q_s^* - q_s\ (1985). \tag{5.15}$$

This change in production is given in Table XLIII and ranges from -447,000 mt in 1986 to -119,000 mt in 1995. This would indicate that Saudi Arabia had more than self-sufficiency wheat production capacity in 1985 to meet the projected wheat demand by 1995 assuming a 94 percent self-sufficiency wheat policy.

The 1985 price support was SR 2,000 per mt. A computed change in price support from 1985 to meet the policy objective of 94 percent self-sufficiency in wheat is

$$\Delta P = \Delta q \frac{P_s(1985)}{q_s(1985)} \frac{1}{E_s} \tag{5.16}$$

where E_s is the price elasticity of supply and is taken as equal to 1.41. The change in price ranges from SR -320 per mt in 1986 to SR -85 per mt in 1995 (Table XLIII). The new price support under this policy scenario is

$$P_s^* = P_s\ (1985) + \Delta P. \tag{5.17}$$

The new price support ranges from SR 1,680 in 1986 to SR 1,915 in 1995 (Table XLIII).

The new price support is compared with the expected open market price to determine welfare changes for the wheat policy under the scenario of self-sufficiency. The expected c.i.f. price, P_m, of wheat is taken as the average for the three years 1983-1985. The marketing margin is

$$M = 0.7205\ P_m \tag{5.18}$$

where the margin coefficient is taken from equation (5.2). The open market price computed from the c.i.f. imported price and marketing margin is equal to

$$P_e = P_m + M. \tag{5.19}$$

The difference in wheat price from the new price support and P_e is

$$\Delta P_s^* = P_s^* - P_e. \tag{5.20}$$

Projected values of P_m, M, P_e, and ΔP_s^* are given in Table XLIII. The change in price, ΔP_s^*, is negative for the years 1986-1988 indicating that the new price support would be lower than the open market price computed from the c.i.f. wheat import price.

The change in wheat quantity from ΔP_s^* is

$$\Delta q_s^* = \frac{\Delta P_s^*}{P_s^*} E_s\, q_s^* \tag{5.21}$$

where E_s is the supply elasticity and assumed to be 1.41. The open market clearing quantity takes on different values depending on whether Δq_s^*, the change in wheat quantity computed from ΔP_s^*, is positive or negative. If ΔP_s^* is negative, meaning the c.i.f. price adjusted for marketing margin is greater than the new support price, then the open market clearing quantity is equal to the self-sufficiency level, q_s^*. If ΔP_s^* is positive, then new support price is greater

than the open market price using the c.i.f. price plus marketing margin and producers are receiving an advantage from the 94 percent self-sufficiency policy. The open market clearing quantity can be summarized as the following:

$$q_e = q_s^* \text{ for } \Delta P_s^* < 0 \tag{5.22}$$

and

$$q_e = q_s^* - \Delta q_s^* \text{ for } \Delta P_s^* > 0 \tag{5.23}$$

The results for q_e^* are given in Table XLIII.

The net social cost from the new price support policy for 94 percent self-sufficiency in wheat production is the following:

$$NSC_S^* = 0 \text{ for } \Delta P_S^* < 0 \tag{5.24}$$

and

$$NSC_S^* = 0.5\ \Delta P_S^*\ \Delta q_S^* \text{ for } \Delta P_S^* > 0. \tag{5.25}$$

Net social cost from the new price support policy is zero for years 1986-1988 and then increases from SR 35,000 in 1989 to SR 28,217,000 in 1995 (Table XLIII).

The public costs from the new price support policy are

$$PUBC_S^* = 0 \text{ for } \Delta P_S^* < 0 \tag{5.26}$$

$$PUBC_S^* = \Delta P_S^*\ q_S^* \text{ for } \Delta P_S^* > 0. \tag{5.27}$$

In this case, public costs are zero for years 1986-1988 and increase from SR 22,358,000 in 1989 to SR 377,580,000 in 1995.

The gain to producers from the new price support policy is

$$GPROD_S^* = PUBC_S^* - NSC_S^*. \quad (5.28)$$

The cost of transferring one SR to producers is computed as

$$ESUB_S^* = PUBC_S^*/GPROD_S^*. \quad (5.29)$$

This is a measure of efficiency of transfering one SR to producers from the new wheat support price policy. These ratios varied from 1.002 for 1986 to 1.08 for 1995. Even though the public costs are high for the new wheat support price policy, a major part of the social costs of the program are realized as gains to the wheat producers.

In comparing the results of Table XXXIX with Table XLIII, the efficiency of the new price support policy is much higher because the price support is kept at a level only sufficient to give 94 percent self-sufficiency. Consumer benefits are not calculated but would depend on the trend in relative price of flour.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS

Summary

Study Objectives

Major factors contributing to increased food demand in Saudi Arabia over the last two decades have been growth in population, growth in real per capita income, and food subsidies. Composition of the food basket in Saudi Arabia is also changing because of the differential effects of the above factors on individual food commodities and because of changes in tastes and preferences of the Saudi people. These latter changes are not addressed in this study.

In recent years, there have been changes in the above factors indicating that past trends in growth in commodity demands may not hold for the future. The demand for guest workers will decrease because of completion of large infrastructure and development projects. This will reduce growth in population to the natural rate of increase. Growth in per capita income will take on a more normal rate compared to the rate exhibited during the era of high energy prices and high values of export demand. Government policies of the future will be considerably different from the past especially toward food subsidies. Consumer and producer subsidies will be reduced and more market oriented policies will be directed towards investments, imports, exports, and commodity pricing.

It becomes important to anticipate the effects of these changes on growth of food demand and to focus food policies toward attaining more basic overall development goals. Thus, making available information on expected future food demand and food production will facilitate government policy formulation to reduce the potential for unanticipated food shortages and excesses.

The overall objective of this research was to develop and apply a framework for analyzing the effects of selected government policies on commodity demand and supply in Saudi Arabia. Specific objectives were to: (1) specify and review theoretical models for analysis of the effects of Saudi Arabia government policies on food commodity markets; (2) estimate food demand systems for Saudi Arabia at different levels of commodity aggregation; (3) utilize the demand systems for projecting food commodity demand to 1995; and (4) to apply the above results in the analysis of government wheat policies on commodity demand and supply, government costs, and social welfare.

Procedures

The concept of Marshallian demand theory and separability of utility is used to estimate the complete commodity demand system for Saudi Arabia. Three demand systems were estimated: (1) aggregated 11 sector social accounts, (2) aggregated 6 food and one nonfood commodity system, and (3) disaggregated 26 food and one nonfood commodity complete demand system. The 6 food commodity groups are cereals, meats, vegetables, fruits, beverages and sugar, and dates. The Frisch method was applied to estimate the first two demand systems. The disaggregated demand system was estimated in two steps. First was to estimate within group parameters using the Seemingly Unrelated Regression (SUR) model for the period 1971-1985. Second was to estimate cross parameters using as basis the theoretical demand properties.

The second step requires the following information: (1) a complete set of income elasticities, (2) the money flexibility parameter, and (3) a full set of expenditure shares. Slutsky symmetry, Engel aggregation, and homogeneity restrictions were imposed in estimating the complete demand system.

The estimated complete demand system was used to project consumption for the 26 food and one nonfood commodities for the period 1986-1995. Eight different scenarios were used to compare results of projected per capita consumption and included four different levels of income growth and two different price assumptions, constant relative prices and price trends. Aggregate consumption was projected by combining results of the 8 scenarios on projected per capita consumption with two scenarios on population growth. The population scenarios included a first order autoregressive projection and a combination of fixed guest worker force of 2.06 million by 1990 and three percent growth of the remaining population.

A welfare analysis of the wheat commodity market was completed for the period 1980-1985 by comparing the results of government policy programs of producer support price and consumer subsidies with results under conditions of competitive open market. Results were compared including wheat production, flour consumption, producer and consumer prices, open market prices, open market clearing quantities, producer gains, consumer gains, public costs, welfare losses, and costs per transfer of one Saudi Riyal to producers and consumers. Similar welfare analyses were completed for the period 1985-1995 using projected consumption levels of wheat flour and projected levels of wheat support prices to attain a prespecified level of 94 percent self-sufficiency in wheat production.

Results

Results of the estimated complete demand system in terms of coefficient signs and magnitudes appear consistent with demand theory. All direct price elasticities are negative, indicating an inverse relationship between consumption and price. Consumption of 9 commodities will change significantly with price changes and include mutton, poultry, okra, tomato, onion, banana, coffee, sugar, and tea. Income elasticities for 23 of the 26 food commodities are positive, implying normal goods. The three commodities with negative income elasticities are camel, tea, and dates, implying these commodities are inferior goods. All food commodity income elasticities are less than unity. The weighted income elasticities by commodity groups were found to be highest for vegetables and fruits followed by meats and cereals. Thus, if expenditures increase, consumption of vegetables and fruits will increase significantly. Significant cross-price elasticities were found for several commodities within groups providing a direct means of assessing the nature and magnitude of interdependence among commodities. Statistical tests of the estimated disaggregated demand systems show that systems can be used as shortrun forecasting models for determining food consumption.

Projections indicate steady increases in consumption per capita for all food and nonfood commodities except camel and dates for the period 1986-1995. Projected aggregate consumption increases under the assumption of growth in real income and population. Camel and dates consumption show a negative income effect while tea consumption shows a negative price effect.

The per capita consumption of cereals increases by about 3.1 percent annually over the period 1985-1995 assuming price trends and a 1.0 percent income growth. Rice and wheat flour are the major cereals consumed. Wheat

is produced domestically under high subsidy cost therefore it is important for policy makers to know projected wheat demand to design efficient policies for meeting domestic demand. Wheat consumption increases at about the same rate as population because of low income elasticity and price inelastic demand. Aggregate consumption increases by 276,877 mt or 23.7 percent in 1995 compared to 1985 under the above assumptions.

For the meats group, highest increases in consumption by 1995 occur in poultry. Poultry is price elastic (-1.64) and the price trend is downward thus increasing poultry consumption significantly. Assuming price trends and a 1.0 percent income growth, per capita consumption increases by 40 percent. Aggregate consumption increases by 243,671 mt or 67 percent compared to consumption in 1985.

Tomatoes, onions, and potatoes are the major vegetables consumed in quantity. Tomatoes account for about one-half of the total quantity of vegetables consumed. The three vegetables account for about 90 percent of total quantity of vegetables consumed. Under the assumption of price trends and a 1.0 percent growth in income, aggregate consumption increases by 21 percent for tomatoes, 24 percent for onions, and 30 percent for potatoes over the 1985-1995 period. The increase in projected quantities demanded for fruits, beverages, and sugar are relatively low and are due to projected constant prices.

Results of the welfare analysis show that the support price on wheat provided annual gains to producers ranging from SR 163,534,000 to SR 1,449,252,000 in the 1980-1985 period. Gains to consumers from price subsidies ranged from SR 83,762,000 to SR 826,668,000 for the same period. The cost of transferring one SR to consumers is lower than for producers. The efficiency of transferring one SR to wheat producers ranged from SR.1.15 in

1985 to SR 1.85 in 1982, while the efficiency for consumers ranged from SR 1.003 in 1985 to SR 1.048 in 1980. Producers received about 70 percent of the total benefits for the period. In 1980 and 1981, the consumer subsidy was the major component of public cost while in 1983 and 1984, the producer support price was the major component. The total public and social costs of transferring one SR to producers and consumers ranged from SR 1.23 in 1980 to SR 2.37 in 1982.

Saudi Arabia was 94 percent self-sufficient in wheat consumption for 1985. If the same level of self-sufficiency were maintained for the projected period of 1986-1995, the support price for wheat could be reduced from SR 2,000 per mt in 1985 to SR 1,680 in 1986 and then gradually increased to SR 1,915 in 1995. The new support price would be lower than the c.i.f. open market price for the years 1986 to 1988 and hence there would be no public cost. There would be no incentive to raise the support price to a comparable c.i.f. open market price and export the excess production because the high marketing costs would increase the f.o.b. export price to where Saudi Arabia would not be competitive with other world producers.

As the demand for wheat increases, the new support price in 1989 becomes higher than the c.i.f. open market price and producers again benefit from the policy of 94 percent self-sufficiency. By the year 1995 this policy provides a gain to producers of SR 349,363,000, a public cost of SR 377,580,000, and a loss to society of SR 28,217,000. However, the cost per SR transferred to producers is only SR 1.08.

Conclusions

Food demand increased dramatically during the last two decades which led the Saudi Arabia government to implement a series of agricultural policies

to increase domestic production and decrease imports. However, because of changes in the demand for food in the 1980's these policies became very costly to the government. There was a need to reevaluate current policies and to formulate new policies for the coming decade. This requires a more comprehensive system for evaluating changes in demand. This study provides a complete demand system for 26 food commodities and an analytical framework for evaluating welfare changes from policy changes.

The following are some summary conclusions from this study:

1. Differences in demand parameters and price trends for the 26 food commodities identified in the demand system lead to different results in expected projections of per capita food consumption for Saudi Arabia. Meats and fruits in general have the highest income elasticities of demand and dates and cereals have the lowest income elasticities of demand. Meats and fruits also have the highest price elasticities of demand. Individual commodities with price elasticities of demand greater than one are sugar, poultry, mutton, coffee, and okra. Commodities with price elasticities less than -0.25 are carrots, dates, wheat flour, other cereals, and grapes. Commodities with significant increases in price trends are other cereals, beef, camel, and fish. Commodities with significant decreases in price trends are poultry, carrot, rice, tea, sugar, banana, and citrus. Commodities with significant increases in per capita consumption are sugar, poultry, beef, citrus, and coffee. Commodities decreasing in per capita consumption are camel, dates, and sorghum.

2. The price elasticity of demand for wheat flour is very inelastic in Saudi Arabia and of a magnitude of about -0.15. This is comparable to the price elasticity for developed countries. The U.S. price elasticity is about -0.11 (Huang). A consumer subsidy for wheat flour changes per capita consumption

very little but benefits consumers significantly, particularly low income consumers. The efficiency of transferring a SR to consumers through a wheat flour price subsidy is high ranging from SR 1.003 to SR 1.048.

3. Wheat producers have gained considerable benefits from price supports over the 1980-1985 period. However, these gains have been at very high government cost and social cost. The efficiency of transfers to wheat producers is very low ranging from a cost of SR 1.30 to SR 2.70 to transfer one SR to the producers.

Policy Implications

A number of policy implications flow out of the results of the analyses presented and include the following.

1. For Saudi Arabia to maintain the policy goal of 94 percent self-sufficiency in wheat production, the price support in 1986 could have been reduced from SR 2,000 per mt to SR 1,680 or about 16 percent. However, with increased demand for wheat and with the same policy goal of self-sufficiency, the support price would need to increase to about SR 1,915 by 1995 or only about 4 percent less than the current price support. If the international price of wheat stays constant, this price support will again come at a very high government cost.

2. Marketing efficiency in Saudi Arabia is very low with the current data indicating a marketing margin of about 74 percent of the c.i.f. price for wheat. If marketing efficiency improves so that the marketing margin is significantly reduced, then the support price for wheat will again be very high and there will be an excess of wheat production.

3. Lowering the price support for wheat should shift resources out of wheat and into other cereals, particularly barley and sorghum, which are in high demand for livestock feed. Because the demand for meat (poultry, beef, and mutton) is increasing, there is significant room for increasing the production of livestock feeds which decreases the demand for imports and thus indirectly achieves higher levels of overall self-sufficiency in food commodities.

4. Allowing the price of wheat to decrease will decrease consumption of rice which is a cereal commodity almost completely imported. The expected increase in rice consumption from 1985 to 1995 is about 100,117 mt. A one percent decrease in the price of wheat flour is expected to decrease per capita consumption of rice by about 0.23 percent. However, because the price of wheat flour is already heavily subsidized, it is not realistic to expect further price decreases.

Study Limitations And Further Research

Results of this study are limited by the accuracy of the data and the models used for estimation. The demand systems estimated for the aggregated social accounts and the aggregated food commodity groups relied on the assumptions of want independence and separability of utility. Budget shares, income elasticities, and the direct price elasticity of one sector or one commodity group were from other studies.

Information and data on marketing margins are limited. More research on market structure of other agricultural commodities in Saudi Arabia needs to be completed for analysis of policy alternatives. For example, little is known about the fodder crops and how they compete for resources and how they are marketed regionally.

The welfare analysis completed in this study for wheat and wheat policies used the partial equilibrium model. However, wheat production competes for resources with other commodities and wheat flour competes in markets with other commodities. A more closed system where prices, quantities, and incomes are simultaneously determined in a general equilibrium framework would allow more realistic evaluations of policy alternatives.

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APPENDIX A

THE SOURCE OF DEMAND DATA

TABLE XLIV

CEREAL CONSUMPTION PER CAPITA, 1971-1985, SAUDI ARABIA

Year	Rice (Kg)	Flour (Kg)	Corn (Kg)	Millet (Kg)	Sorghum (Kg)
1971	25.0	45	1.5	4.2	5.0
1972	28.2	51	2.0	4.0	2.2
1973	27.7	42	1.9	1.8	2.1
1974	24.6	52	1.8	1.8	3.2
1975	27.4	59	1.5	1.7	3.3
1976	27.4	71	3.0	0.2	1.8
1977	37.5	64	4.7	0.4	1.3
1978	37.2	66	6.9	0.3	3.9
1979	37.3	77	3.9	0.7	2.0
1980	33.7	100	2.6	0.8	3.9
1981	43.2	95	1.7	0.6	3.7
1982	45.2	126	2.0	0.3	5.8
1983	44.2	135	1.4	0.7	3.6
1984	40.6	109	4.0	0.6	2.2
1985	41.6	100	4.7	0.2	2.4

Source: Consumptions are obtained from Ministry of Agriculture and Water, Department of Economic Studies and Statistics, Saudi Arabia Food Balance Sheets 1974-1984.

TABLE XLV

MEAT CONSUMPTION PER CAPITA, 1971-1985, SAUDI ARABIA

Year	Beef (Kg)	Camel (Kg)	Fish (Kg)	Mutton (Kg)	Poultry (Kg)
1971	1.5	6.50	2.78	2.5	2.49
1972	1.4	6.20	2.70	2.6	3.10
1973	1.6	5.80	2.77	2.7	3.80
1974	1.7	5.50	2.80	2.6	7.50
1975	1.5	5.40	2.70	2.4	7.60
1976	1.9	5.30	2.60	2.8	7.70
1977	3.6	3.95	2.80	3.8	15.9
1978	3.2	3.90	2.60	4.1	16.0
1979	3.4	3.85	2.70	4.4	16.1
1980	5.7	2.75	4.80	6.5	24.2
1981	5.6	2.70	4.60	6.0	24.4
1982	5.5	2.65	5.00	5.5	24.6
1983	6.6	2.60	6.10	8.9	31.7
1984	6.7	2.55	6.00	9.1	26.1
1985	8.6	2.50	5.91	9.7	34.7

Source: Consumptions are obtained from Ministry of Agriculture and Water, Department of Economic Studies and Statistics, Saudi Arabian Food Balance Sheets 1974-1984.

TABLE XLVI

VEGETABLES CONSUMPTION PER CAPITA, 1971-1985, SAUDI ARABIA

Year	Carrot (SR/Kg)	Eggplant (SR/Kg)	Garlic (SR/Kg)	Orka (SR/Kg)	Tomato (SR/Kg)	Potato (SR/Kg)	Onion (SR/Kg)
1971	0.20	3.0	0.30	1.60	23.79	2.20	4.53
1972	0.20	3.1	0.20	1.57	25.64	2.30	4.05
1973	0.25	3.2	0.10	1.50	24.39	1.98	6.71
1974	0.30	3.3	0.11	1.60	27.00	1.90	13.5
1975	0.30	3.4	0.12	1.60	27.30	1.90	13.5
1976	0.30	3.5	0.07	1.60	27.30	1.90	13.5
1977	0.40	1.7	0.20	0.80	19.50	3.90	15.9
1978	0.40	1.8	0.15	0.80	19.40	3.90	15.9
1979	0.40	1.9	0.25	0.80	19.30	3.90	15.9
1980	0.50	2.9	0.40	0.80	27.30	6.80	11.1
1981	0.50	2.8	0.41	1.20	27.20	6.80	11.1
1982	0.50	3.0	0.39	1.20	27.10	6.80	11.1
1983	0.40	3.4	0.60	1.50	32.30	10.3	10.4
1984	0.50	3.4	0.70	1.10	33.40	8.70	11.3
1985	0.55	3.5	0.65	1.23	30.97	8.87	10.8

Source: Consumptions are obtained from Ministry of Agriculture and Water, Department of Economic Studies and Statistics, Saudi Arabian Food Balance Sheets 1974-1984.

TABLE XLVII

FRUITS CONSUMPTION PER CAPITA, 1971-1985, SAUDI ARABIA

Year	Banana (Kg)	Grape (Kg)	Watermelon (Kg)	Citrus (Kg)	Apple (Kg)
1971	3.50	4.4	25.04	5.88	1.23
1972	3.80	5.3	25.00	7.57	1.99
1973	4.00	4.4	24.20	9.30	2.90
1974	4.40	5.0	25.00	10.8	2.80
1975	4.60	5.9	25.50	10.6	3.90
1976	4.20	5.8	24.50	10.7	4.10
1977	7.90	6.4	21.60	19.3	7.70
1978	8.00	6.2	21.50	19.2	7.60
1979	7.80	6.0	21.70	19.1	7.50
1980	12.0	7.1	28.00	24.5	8.40
1981	12.5	6.9	26.00	24.4	8.30
1982	13.0	7.0	27.00	24.3	8.20
1983	12.8	6.4	35.60	26.6	12.0
1984	12.9	7.6	34.70	23.8	10.5
1985	12.5	9.3	72.00	25.2	10.0

Source: Consumptions are obtained from Ministry of Agriculture and Water, Department of Economic Studies and Statistics, Saudi Arabian Food Balance Sheets 1974-1984.

TABLE XLVIII

BEVERAGES, SUGAR, AND DATES CONSUMPTION PER CAPITA, 1971-1985, SAUDI ARABIA

Year	Coffee (SR/Kg)	Tea (SR/Kg)	Sugar (SR/Kg)	Dates (SR/Kg)
1971	1.05	0.70	1.060	30.95
1972	1.10	1.10	0.990	25.02
1973	1.20	1.25	1.200	39.90
1974	1.40	1.30	16.50	38.30
1975	1.10	0.80	16.50	40.30
1976	0.90	0.90	16.50	39.30
1977	0.80	1.40	16.60	37.90
1978	0.70	1.40	15.70	38.90
1979	2.70	1.40	16.00	36.90
1980	1.70	1.50	35.00	31.40
1981	1.90	1.40	35.00	32.40
1982	1.50	1.60	35.00	30.40
1983	2.00	1.70	37.10	31.20
1984	1.60	1.80	43.60	33.60
1985	1.40	1.96	22.94	33.50

Source: Consumptions are obtained from Ministry of Agriculture and Water, Department of Economic Studies and Statistics, Saudi Arabian Food Balance Sheets 1974-1984.

TABLE XLIX

WHEAT BALANCE SHEET, 1971-1985, SAUDI ARABIA

Year	Wheat Production 1000 MT	Total Imports 1000 MT	Total Supply 1000 MT	Feed Use 1000 MT	Seed Use 1000 MT	Waste 1000 MT	Non-food Use 1000 MT	Consumption 1000 MT	Per Capita Consumption (Kg)	Producer Price SR/MT	Wheat C.I.F. (SR/MT)
1971	42	294	346	2	5	15	21	325	50.20	800	376
1972	39	384	403	1	5	17	22	381	57.20	730	345
1973	64	366	410	2	7	17	25	385	56.10	850	486
1974	153	509	662	4	5	26	36	626	88.60	1,000	833
1975	132	540	682	3	6	27	36	646	88.70	1,200	754
1976	93	664	757	2	6	30	38	718	92.90	1,470	770
1977	125	767	842	3	6	36	45	797	96.30	1,780	780
1978	120	730	898	3	7	34	44	854	97.70	1,740	830
1979	150	1,022	881	4	7	47	57	824	90.80	1,800	904
1980	142	930	1,261	4	7	43	54	1,207	128.1	3,500	1,020
1981	187	893	1,317	5	16	44	64	1,253	128.4	3,500	900
1982	376	811	1,321	10	29	49	88	1,233	122.1	3,500	780
1983	885	620	1,464	20	49	57	126	1,338	128.1	3,500	860
1984	1,407	481	1,546	35	58	76	160	1,386	128.4	3,500	930
1985	1,980	115	1,515	50	70	84	184	1,331	125.0	2,000	981

Source: Columns 2 - 10 are from USDA, Economic Research Service, Data User Service for Saudi Arabia. Column 11 is from Al-Abrahem, B. "An Econometric Analysis of Supply and Demand of Wheat in Saudi Arabia." Ph. D. thesis, Washington State University, 1987.

APPENDIX B

PER CAPITA AND AGGREGATE PROJECTED CONSUMPTION

TABLE L

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER PRDEDICTED PRICES AND 1.6 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95
(Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.36	42.48	42.65	42.81	42.94	43.08	43.22	43.33	43.44	43.55
Wheat flour	109.51	110.12	110.80	111.39	112.01	112.67	113.31	113.97	114.65	115.33	116.02
Corn	2.34	2.34	2.33	2.33	2.32	2.32	2.31	2.31	2.31	2.31	2.31
Millet	0.51	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Sorghum	1.75	1.74	1.73	1.72	1.70	1.70	1.69	1.68	1.68	1.68	1.68
Beef	5.48	5.61	5.72	5.82	5.92	6.00	6.10	6.16	6.23	6.30	6.36
Camel	2.82	2.82	2.80	2.80	2.78	2.75	2.73	2.71	2.67	2.64	2.61
Fish	4.44	4.44	4.44	4.45	4.45	4.47	4.48	4.49	4.52	4.54	4.56
Mutton	7.33	7.43	7.52	7.63	7.72	7.81	7.89	7.98	8.05	8.12	8.17
Poultry	33.96	35.88	37.50	39.52	41.20	42.65	44.05	45.64	46.54	47.60	48.43
Carrot	0.58	0.58	0.59	0.59	0.60	0.60	0.61	0.61	0.62	0.62	0.63
Egg Plant	3.36	3.36	3.35	3.35	3.34	3.34	3.35	3.35	3.36	3.37	3.38
Garlic	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.36	0.36
Okra	1.63	1.62	1.61	1.62	1.60	1.60	1.61	1.61	1.62	1.62	1.63
Tomato	30.88	30.92	30.96	31.05	31.09	31.17	31.26	31.34	31.43	31.48	31.57
Potato	6.84	6.93	7.02	7.10	7.22	7.30	7.37	7.44	7.51	7.59	7.66
Onion	15.75	15.82	15.91	16.04	16.09	16.22	16.35	16.47	16.60	16.66	16.78
Banana	11.49	11.57	11.65	11.73	11.82	11.90	11.98	12.07	12.15	12.23	12.32
Grape	7.39	7.41	7.42	7.44	7.50	7.47	7.49	7.51	7.53	7.55	7.57
Mellon	29.41	29.48	29.54	29.60	29.66	29.72	29.78	29.84	29.90	29.95	30.01
Citrus	25.12	25.30	25.48	25.66	25.85	26.04	26.22	26.41	26.60	26.80	27.00
Apple	10.56	10.65	10.73	10.82	10.92	11.01	11.11	11.22	11.32	11.43	11.53
Coffee	1.80	1.84	1.87	1.91	1.93	1.96	1.99	2.01	2.04	2.06	2.07
Sugar	40.80	44.65	47.87	51.40	53.98	56.75	59.70	62.86	66.25	68.10	70.03
Tea	1.50	1.51	1.52	1.53	1.54	1.54	1.55	1.56	1.56	1.57	1.57
Dates	28.29	28.23	28.17	28.12	28.05	27.98	27.93	27.87	27.81	27.75	27.69
Nonfood (Index)	1.14	1.16	1.18	1.21	1.23	1.25	1.28	1.30	1.33	1.35	1.38

TABLE LI

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER PREDICTED PRICES AND 1 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95
(Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.32	42.41	42.55	42.68	42.77	42.88	42.98	43.05	43.13	43.20
Wheat flour	109.51	109.87	113.29	110.65	111.01	111.42	111.80	112.19	112.62	113.03	113.45
Corn	2.34	2.34	2.33	2.32	2.32	2.31	2.31	2.31	2.30	2.30	2.30
Millet	0.51	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.49	0.49
Sorghum	1.75	1.74	1.73	1.72	1.70	1.70	1.69	1.68	1.68	1.68	1.67
Beef	5.48	5.59	5.69	5.78	5.86	5.93	5.99	6.05	6.10	6.14	6.19
Camel	2.82	2.82	2.82	2.81	2.81	2.79	2.78	2.76	2.74	2.71	2.69
Fish	4.44	4.43	4.43	4.43	4.43	4.44	4.45	4.45	4.47	4.48	4.50
Mutton	7.33	7.42	7.50	7.60	7.68	7.75	7.82	7.90	7.95	8.01	8.05
Poultry	33.96	35.81	37.37	39.31	40.92	42.27	43.59	45.09	45.90	46.85	47.59
Carrot	0.58	0.58	0.59	0.59	0.59	0.60	0.60	0.60	0.61	0.61	0.61
Egg plant	3.36	3.35	3.34	3.34	3.32	3.33	3.32	3.33	3.33	3.33	3.34
Garlic	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35
Okra	1.63	1.62	1.61	1.60	1.58	1.58	1.58	1.58	1.58	1.58	1.59
Tomato	30.88	30.89	30.90	30.95	30.96	31.01	31.06	31.11	31.17	31.18	31.24
Potato	6.84	6.91	6.98	7.04	7.13	7.19	7.24	7.29	7.34	7.39	7.44
Onion	15.75	15.79	15.82	15.91	15.92	16.00	16.09	16.17	16.25	16.26	16.34
Banana	11.49	11.54	11.59	11.65	11.70	11.75	11.80	11.85	11.90	11.96	12.01
Grape	7.39	7.40	7.41	7.42	7.43	7.44	7.45	7.46	7.47	7.48	7.49
Mellon	29.41	29.46	29.50	29.54	29.59	29.62	29.67	29.70	29.74	29.78	29.81
Citrus	25.12	25.23	25.34	25.46	25.57	25.69	25.80	25.92	26.03	26.15	26.27
Apple	10.56	10.61	10.65	10.71	10.76	10.81	10.87	10.93	10.99	11.06	11.12
Coffee	1.80	1.84	1.87	1.91	1.93	1.96	1.98	2.01	2.04	2.05	2.07
Sugar	40.80	44.60	47.78	51.25	53.77	56.47	59.35	62.42	65.73	67.50	69.35
Tea	1.50	1.51	1.52	1.53	1.54	1.54	1.55	1.56	1.56	1.57	1.57
Dates	28.29	28.25	28.21	28.17	28.13	28.09	28.05	28.02	27.98	27.94	27.90
Nonfood (Index)	1.14	1.15	1.17	1.18	1.19	1.21	1.22	1.24	1.25	1.27	1.28

TABLE LII

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER PREDICTED PRICES AND .5 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95 (Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.30	42.35	42.47	42.56	42.63	42.71	42.78	42.82	42.87	42.91
Wheat flour	109.51	109.67	109.88	110.03	110.18	110.38	110.55	110.73	110.94	111.14	111.34
Corn	2.34	2.34	2.33	2.32	2.32	2.31	2.31	2.30	2.30	2.30	2.30
Millet	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.49	0.49	0.49
Sorghum	1.75	1.74	1.73	1.71	1.70	1.70	1.69	1.68	1.68	1.67	1.67
Beef	5.48	5.58	5.66	5.74	5.81	5.86	5.91	5.96	5.99	6.02	6.06
Camel	2.82	2.83	2.83	2.83	2.84	2.83	2.82	2.81	2.79	2.77	2.75
Fish	4.44	4.43	4.42	4.42	4.41	4.41	4.42	4.42	4.43	4.44	4.45
Mutton	7.33	7.41	7.48	7.57	7.64	7.70	7.76	7.83	7.86	7.92	7.94
Poultry	33.96	35.76	37.26	39.14	40.68	41.97	43.20	44.63	45.36	46.24	46.89
Carrot	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.60	0.60
Egg plant	3.36	3.35	3.34	3.33	3.31	3.31	3.30	3.30	3.30	3.30	3.30
Garlic	0.35	0.35	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33	0.33
Okra	1.63	1.61	1.60	1.59	1.56	1.56	1.56	1.56	1.55	1.55	1.55
Tomato	30.88	30.86	30.85	30.87	30.85	30.88	30.90	30.92	30.95	30.94	30.97
Potato	6.84	6.89	6.94	6.99	7.06	7.10	7.13	7.16	7.19	7.22	7.25
Onion	15.75	15.75	15.75	15.80	15.78	15.83	15.87	15.92	15.96	15.93	15.98
Banana	11.49	11.52	11.54	11.57	11.60	11.62	11.65	11.68	11.70	11.73	11.75
Grape	7.39	7.40	7.40	7.40	7.40	7.40	7.41	7.41	7.42	7.42	7.43
Mellon	29.41	29.44	29.47	29.50	29.52	29.55	29.57	29.59	29.61	29.63	29.65
Citrus	25.12	25.17	25.23	25.28	25.34	25.40	25.45	25.51	25.57	25.63	25.68
Apple	10.56	10.58	10.58	10.61	10.62	10.65	10.67	10.70	10.72	10.76	10.78
Coffee	1.80	1.84	1.87	1.91	1.93	1.96	1.98	2.00	2.04	2.05	2.06
Sugar	40.80	44.56	47.70	51.12	53.60	56.24	59.06	62.07	65.30	67.00	68.78
Tea	1.50	1.51	1.52	1.53	1.54	1.54	1.55	1.56	1.56	1.57	1.57
Dates	28.29	28.27	28.25	28.23	28.20	28.18	28.16	28.14	28.12	28.10	28.08
Nonfood (Index)	1.14	1.15	1.15	1.16	1.17	1.17	1.18	1.19	1.19	1.20	1.21

TABLE LIII

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER PREDICTED PRICES AND CONSTANT INCOME GROWTH, SAUDI ARABIA, 1986-95
(Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.27	42.29	42.38	42.45	42.49	42.54	42.58	42.59	42.61	42.63
Wheat flour	109.51	109.46	109.47	109.40	109.36	109.34	109.31	109.28	109.28	109.27	109.26
Corn	2.34	2.34	2.33	2.32	2.31	2.31	2.30	2.30	2.30	2.29	2.29
Millet	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.49	0.49	0.49	0.49
Sorghum	1.75	1.73	1.73	1.71	1.70	1.69	1.68	1.67	1.67	1.67	1.67
Beef	5.48	5.57	5.64	5.70	5.75	5.80	5.83	5.87	5.89	5.90	5.93
Camel	2.82	2.84	2.85	2.86	2.86	2.86	2.86	2.86	2.84	2.83	2.82
Fish	4.44	4.42	4.41	4.40	4.39	4.39	4.39	4.38	4.39	4.39	4.40
Mutton	7.33	7.40	7.46	7.54	7.60	7.65	7.70	7.76	7.78	7.82	7.84
Poultry	33.96	35.71	37.15	38.97	40.44	41.66	42.82	44.17	44.83	45.63	46.21
Carrot	0.58	0.58	.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Egg plant	3.36	3.35	3.33	3.32	3.30	3.29	3.29	3.28	3.28	3.27	3.27
Garlic	0.35	0.35	0.34	0.34	0.33	0.33	0.33	0.33	0.33	0.33	0.32
Okra	1.63	1.61	1.59	1.58	1.55	1.54	1.54	1.53	1.53	1.52	1.51
Tomato	30.88	30.84	30.79	30.79	30.74	30.74	30.74	30.73	30.73	30.70	30.70
Potato	6.84	6.88	6.91	6.93	6.99	7.01	7.02	7.04	7.05	7.06	7.07
Onion	15.75	15.72	15.68	15.70	15.64	15.65	15.66	15.67	15.68	15.62	15.62
Banana	11.49	11.50	11.49	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50
Grape	7.39	7.39	7.38	7.38	7.37	7.37	7.37	7.37	7.36	7.36	7.36
Mellon	29.41	29.42	29.44	29.45	29.46	29.47	29.47	29.48	29.48	29.49	29.49
Citrus	25.12	25.11	25.11	25.11	25.11	25.11	25.11	25.11	25.11	25.11	25.10
Apple	10.56	10.54	10.52	10.51	10.49	10.49	10.48	10.47	10.46	10.46	10.45
Coffee	1.80	1.84	1.87	1.91	1.93	1.95	1.98	2.01	2.03	2.05	2.06
Sugar	40.80	44.53	47.62	51.00	53.42	56.00	58.76	61.71	64.87	66.51	68.21
Tea	1.50	1.51	1.52	1.53	1.54	1.54	1.55	1.56	1.56	1.57	1.57
Dates	28.29	28.29	28.28	28.28	28.28	28.27	28.27	28.27	28.27	28.27	28.27
Nonfood (Index)	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14

TABLE LIV

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER CONSTANT PRICES AND INCOME , SAUDI ARABIA, 1986-95
(Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.188	42.19	42.19	42.19	42.19	42.19	42.19	42.19	42.19	42.19
Wheat flour	109.51	109.51	109.51	109.51	109.51	109.51	109.51	109.51	109.51	109.51	109.51
Corn	2.34	2.34	2.34	2.34	2.34	2.34	2.34	2.34	2.34	2.34	2.34
Millet	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Sorghum	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Beef	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48
Camel	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82
Fish	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.438	4.44
Mutton	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
Poultry	33.96	33.96	33.96	33.96	33.96	33.96	33.96	33.96	33.96	33.96	33.96
Carrot	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Egg plant	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36
Garlic	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Okra	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Tomato	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88
Potato	6.84	6.84	6.84	6.84	6.84	6.84	6.84	6.84	6.84	6.84	6.84
Onion	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75
Banana	11.49	11.49	11.49	11.49	11.49	11.49	11.49	11.49	11.49	11.49	11.49
Grape	7.39	7.39	7.39	7.39	7.39	7.39	7.39	7.39	7.39	7.39	7.39
Mellon	29.41	29.41	29.41	29.41	29.41	29.41	29.41	29.41	29.41	29.41	29.41
Citrus	25.12	25.12	25.12	25.12	25.12	25.12	25.12	25.12	25.12	25.12	25.12
Apple	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56	10.56
Coffee	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Sugar	40.80	40.80	40.80	40.80	40.80	40.80	40.80	40.80	40.80	40.80	40.80
Tea	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Dates	28.29	28.29	28.29	28.29	28.29	28.29	28.29	28.29	28.29	28.29	28.29
Nonfood (Index)	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14

TABLE LV

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER CONSTANT PRICES AND 1.6 PERCENT OF INCOME GROWTH , SAUDI ARABIA, 1986-95
(Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.28	42.37	42.46	42.55	42.64	42.73	42.82	42.91	43.00	43.10
Wheat flour	109.51	110.17	110.83	111.50	112.17	112.85	113.53	114.21	114.90	115.59	116.28
Corn	2.34	2.34	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.36
Millet	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Sorghum	1.75	1.75	1.75	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76
Beef	5.48	5.52	5.56	5.60	5.64	5.68	5.72	5.76	5.80	5.84	5.89
Camel	2.82	2.80	2.78	2.76	2.74	2.71	2.69	2.67	2.65	2.63	2.61
Fish	4.44	4.45	4.47	4.49	4.50	4.52	4.53	4.55	4.57	4.58	4.60
Mutton	7.33	7.36	7.39	7.42	7.46	7.49	7.52	7.55	7.58	7.61	7.64
Poultry	33.96	34.12	34.28	34.44	34.60	34.77	34.93	35.09	35.26	35.43	35.59
Carrot	0.58	0.58	0.59	0.59	0.60	0.60	0.60	0.61	0.61	0.62	0.62
Egg plant	3.36	3.37	3.38	3.40	3.41	3.42	3.43	3.44	3.45	3.46	3.47
Garlic	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.38	0.38	0.38	0.39
Okra	1.63	1.65	1.66	1.67	1.68	1.69	1.71	1.72	1.73	1.75	1.76
Tomato	30.88	30.97	31.05	31.14	31.23	31.31	31.40	31.49	31.58	31.67	31.76
Potato	6.84	6.90	6.95	7.01	7.06	7.12	7.18	7.23	7.29	7.35	7.41
Onion	15.75	15.86	15.98	16.09	16.21	16.33	16.44	16.56	16.68	16.80	16.92
Banana	11.49	11.57	11.65	11.73	11.81	11.89	11.97	12.05	12.14	12.22	12.31
Grape	7.39	7.41	7.44	7.46	7.48	7.50	7.52	7.54	7.56	7.58	7.60
Mellon	29.41	29.46	29.51	29.56	29.61	29.67	29.72	29.77	29.82	29.87	29.92
Citrus	25.12	25.30	25.48	25.67	25.85	26.04	26.23	26.42	26.61	26.81	27.00
Apple	10.56	10.66	10.77	10.88	10.98	11.09	11.20	11.31	11.42	11.54	11.65
Coffee	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.81	1.81
Sugar	40.80	40.91	41.02	41.13	41.23	41.34	41.45	41.56	41.67	41.78	41.89
Tea	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Dates	28.29	28.24	28.18	28.12	28.06	28.00	27.95	27.89	27.83	27.77	27.72
Nonfood (Index)	1.14	1.16	1.18	1.21	1.23	1.26	1.28	1.31	1.33	1.36	1.38

TABLE LVI

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER CONSTANT PRICES AND 1 PERCENT OF INCOME GROWTH , SAUDI ARABIA, 1986-95
(Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.24	42.30	42.36	42.41	42.47	42.53	42.58	42.64	42.70	42.75
Wheat flour	109.51	109.92	110.34	110.75	111.17	111.60	112.01	112.43	112.86	113.28	113.71
Corn	2.34	2.34	2.34	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35
Millet	0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Sorghum	1.75	1.75	1.75	1.75	1.75	1.76	1.76	1.76	1.76	1.76	1.76
Beef	5.48	5.51	5.53	5.56	5.58	5.61	5.63	5.66	5.68	5.71	5.73
Camel	2.82	2.81	2.79	2.78	2.77	2.75	2.74	2.73	2.71	2.70	2.69
Fish	4.44	4.45	4.46	4.47	4.48	4.49	4.50	4.51	4.52	4.53	4.54
Mutton	7.33	7.35	7.37	7.39	7.41	7.43	7.45	7.47	7.49	7.51	7.53
Poultry	33.96	34.06	34.16	34.26	34.36	34.46	34.56	34.67	34.77	34.87	34.97
Carrot	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.61
Egg plant	3.36	3.35	3.38	3.38	3.39	3.40	3.40	3.41	3.42	3.42	3.43
Garlic	0.35	0.35	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.37
Okra	1.63	1.64	1.65	1.66	1.66	1.67	1.68	1.69	1.69	1.70	1.71
Tomato	30.88	30.93	30.99	31.04	31.10	31.15	31.21	31.26	31.32	31.37	31.43
Potato	6.84	6.88	6.91	6.94	6.98	7.01	7.05	7.09	7.12	7.16	7.19
Onion	15.75	15.82	15.89	15.97	16.04	16.11	16.18	16.25	16.33	16.40	16.48
Banana	11.49	11.54	11.59	11.64	11.69	11.74	11.79	11.84	11.89	11.94	11.99
Grape	7.39	7.41	7.42	7.43	7.45	7.46	7.47	7.48	7.50	7.51	7.52
Mellon	29.41	29.44	29.47	29.51	29.54	29.57	29.60	29.63	29.67	29.70	29.73
Citrus	25.12	25.23	25.35	25.46	25.58	25.69	25.81	25.93	26.05	26.16	26.28
Apple	10.56	10.63	10.69	10.76	10.82	10.89	10.96	11.03	11.09	11.16	11.23
Coffee	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Sugar	40.80	40.87	40.94	41.00	41.07	41.14	41.21	41.28	41.34	41.41	41.48
Tea	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Dates	28.29	28.26	28.22	28.18	28.15	28.11	28.08	28.04	28.00	27.97	27.93
Nonfood (Index)	1.14	1.15	1.17	1.18	1.20	1.21	1.23	1.24	1.26	1.27	1.29

TABLE LVII

PROJECTIONS OF PER CAPITA CONSUMPTION UNDER CONSTANT PRICES AND .5 PERCENT OF INCOME GROWTH , SAUDI ARABIA, 1986-95
(Kg)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	42.19	42.22	42.24	42.27	42.30	42.33	42.36	42.39	42.41	42.44	42.47
Wheat flour	109.51	109.72	109.93	110.13	110.34	110.55	110.76	110.97	111.18	111.39	111.60
Corn	2.34	2.34	2.34	2.34	2.34	2.34	2.35	2.35	2.35	2.35	2.35
Millet	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.52
Sorghum	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.76
Beef	5.48	5.50	5.51	5.52	5.53	5.55	5.56	5.57	5.58	5.60	5.61
Camel	2.82	2.81	2.81	2.80	2.79	2.79	2.78	2.77	2.77	2.76	2.75
Fish	4.44	4.44	4.45	4.45	4.46	4.46	4.47	4.47	4.48	4.48	4.49
Mutton	7.33	7.34	7.35	7.36	7.37	7.38	7.39	7.40	7.41	7.42	7.43
Poultry	33.96	34.01	34.06	34.11	34.16	34.21	34.26	34.31	34.36	34.41	34.46
Carrot	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59
Egg plant	3.36	3.37	3.37	3.37	3.38	3.38	3.38	3.39	3.39	3.39	3.40
Garlic	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Okra	1.63	1.64	1.64	1.64	1.65	1.65	1.66	1.66	1.66	1.67	1.67
Tomato	30.88	30.91	30.93	30.96	31.00	31.02	31.04	31.07	31.10	31.12	31.15
Potato	6.84	6.87	6.88	6.89	6.91	6.93	6.94	6.96	6.98	7.00	7.01
Onion	15.75	15.79	15.82	15.86	15.89	15.93	15.97	16.00	16.04	16.07	16.11
Banana	11.49	11.51	11.54	11.56	11.59	11.61	11.64	11.66	11.69	11.71	11.74
Grape	7.39	7.40	7.41	7.41	7.42	7.43	7.43	7.44	7.45	7.45	7.46
Mellon	29.41	29.43	29.44	29.46	29.47	29.49	29.51	29.52	29.54	29.54	29.57
Citrus	25.12	25.17	25.23	25.29	25.35	25.40	25.46	25.52	25.58	25.64	25.69
Apple	10.56	10.59	10.63	10.66	10.69	10.72	10.76	10.79	10.82	10.86	10.89
Coffee	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Sugar	40.80	40.83	40.87	40.90	40.94	40.97	41.00	41.04	41.07	41.11	41.14
Tea	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Dates	28.29	28.28	28.26	28.24	28.22	28.20	28.18	28.17	28.15	28.13	28.11
Nonfood (Index)	1.14	1.15	1.15	1.16	1.17	1.18	1.18	1.19	1.20	1.20	1.21

TABLE LVIII

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER PREDICTED PRICES AND 1.6 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95
(MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	448990.5	455927.6	463271.3	470059.3	483037.9	496578.3	510491.4	524499.0	539006.4	553951.0
Wheat flour	1166306.	1167245.	1189206.	1209827.	1229777.	1267432.	1306045.	1346169.	1387974.	1431176.	1475858.
Corn	24948.67	24775.74	25038.03	25258.36	25467.38	26061.33	26654.72	27289.85	27944.54	28623.47	29327.13
Millet	5477.238	5410.075	5472.194	5489.360	5513.139	5433.935	5746.291	5866.887	6009.716	6153.705	6302.498
Sorghum	18659.10	18401.28	18617.39	18645.04	18704.33	19106.43	19471.68	19864.16	20349.81	20835.38	21336.71
Beef	58411.55	59442.24	61364.58	63244.38	64990.01	67539.08	70132.70	72808.22	75410.75	78039.06	80899.40
Camel	30049.94	29854.68	30082.70	30297.67	30472.11	30963.01	31445.30	31963.65	32358.63	32775.62	33199.19
Fish	47260.93	47022.64	47698.00	48314.92	48906.05	50249.10	51652.73	53090.99	54682.87	56328.94	58018.57
Mutton	78095.72	78782.85	80728.44	82901.24	84805.61	87822.24	90935.42	94301.42	97400.02	100769.9	103982.2
Poultry	361664.2	380281.2	402494.3	429249.0	452381.6	479723.1	507685.6	539143.5	563449.4	590636.2	616036.4
Carrot	6166.048	6188.799	6319.133	6451.448	6572.263	6790.092	7017.513	7249.564	7490.058	7723.640	7976.940
Egg plant	35817.92	35578.84	35962.20	36411.80	36657.78	37626.43	38588.37	39620.51	40685.95	41763.61	42939.63
Garlic	3749.576	3714.323	3747.396	3786.588	3823.345	3924.498	4028.920	4147.850	4269.319	4415.484	4557.663
Okra	17392.57	17202.99	17327.19	17546.92	17529.56	18014.93	18509.41	19046.71	19605.78	20124.44	20750.71
Tomato	328865.6	327770.4	332374.6	337219.3	341297.6	350686.1	360272.3	370216.3	380485.7	390598.3	401567.2
Potato	72857.91	73481.92	75342.45	77137.08	79227.26	82088.56	84936.08	87900.62	90969.14	94151.44	97454.63
Onion	167751.6	167790.8	170744.1	174188.0	176678.2	182456.6	188442.7	194598.5	200980.7	206745.6	213509.0
Banana	122365.2	122657.2	125068.6	127451.7	129733.7	133854.6	138108.7	142527.0	147083.2	151813.5	156698.7
Grape	78750.42	78539.88	79675.73	80807.64	81858.23	84071.64	86348.90	88705.07	91133.35	93665.07	96253.61
Mellon	313220.6	312437.0	317096.8	321506.5	325680.9	334347.3	343250.4	352456.8	361919.4	371644.6	381708.1
Citrus	267485.8	268153.2	273475.5	278730.3	283786.2	292870.6	302256.5	312007.4	322078.8	332534.8	343346.1
Apple	112461.3	112855.2	115153.8	117564.5	119839.1	123897.4	128101.5	132476.9	137010.7	141806.7	146696.5
Coffee	19129.28	19499.04	20112.63	20737.14	21234.56	22045.04	22893.08	23783.09	24718.40	25520.32	26354.20
Sugar	434530.3	473237.0	513839.0	558271.1	592696.3	638339.4	688109.5	742461.5	802034.8	845103.1	890875.7
Tea	15956.21	16009.20	16312.15	16609.07	16860.67	17350.08	17855.84	18381.03	18925.42	19442.93	19977.60
Dates	301324.7	299238.4	302358.7	305259.3	307908.4	314802.6	321864.2	329143.2	336625.7	344326.4	352247.4
Nonfood (Index)	12145.75	12319.39	12712.64	13106.07	13500.13	14094.45	14715.45	15366.14	16048.26	16762.17	17510.39

TABLE LIX

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER PREDICTED PRICES AND 1 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95 (MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	448633.5	455202.7	462167.0	468566.0	481120.8	494214.4	507657.4	521171.9	535161.3	549562.0
Wheat flour	1166306.	1164636.	1183892.	1201728.	1218813.	1253326.	1288622.	1325242.	1363336.	1402627.	1443183.
Corn	24948.67	24770.35	25027.13	25241.87	25445.21	26032.98	26619.93	27248.30	27895.91	28567.43	29263.35
Millet	5477.238	5408.897	5469.812	5485.775	5508.339	5627.806	5738.791	5857.954	5999.258	6141.659	6288.792
Sorghum	18659.10	18397.28	18609.29	18632.86	18688.05	19085.65	19446.27	19833.91	20314.40	20794.60	21290.30
Beef	58411.55	59285.94	61042.21	62746.65	64309.05	66655.79	69033.56	71478.75	73838.76	76211.26	78796.88
Camel	30049.94	29941.19	30257.35	30561.91	30826.92	31414.25	31995.98	32617.64	33116.54	33640.55	34174.05
Fish	47260.93	46959.60	47570.17	48120.81	48644.29	49913.19	51238.68	52594.84	54099.09	55652.85	57245.36
Mutton	78095.72	78661.05	80478.94	82517.20	84282.28	87145.43	90095.17	93285.65	96201.65	99376.16	102385.4
Poultry	361664.2	379615.6	401086.0	426998.0	449221.8	475538.9	502376.9	532572.2	555605.9	581394.3	605335.5
Carrot	6166.048	6172.243	6285.358	6399.793	6502.204	6699.750	6905.629	7114.900	7331.227	7539.622	7766.055
Egg plant	35817.92	35537.10	35877.85	36283.76	36486.04	37406.24	38317.56	39296.32	40305.62	41324.64	42438.46
Garlic	3749.576	3700.597	3719.743	3744.750	3767.132	3852.516	3940.412	4041.742	4144.703	4270.753	4391.981
Okra	17392.57	17155.44	17231.52	17401.80	17336.55	17767.37	18204.63	18681.32	19176.44	19629.31	20184.23
Tomato	328865.6	327428.5	331681.4	336164.8	339875.5	348860.9	358023.5	367521.8	377321.8	386946.1	397397.4
Potato	72857.91	73263.32	74894.70	76450.46	78288.49	80874.71	83431.27	86086.47	88826.16	91659.86	94593.38
Onion	167751.6	167342.8	169833.1	172795.7	174798.1	180033.2	185443.5	190990.0	196726.2	201828.4	207874.3
Banana	122365.2	122343.6	124429.8	126476.4	128411.9	132152.2	136003.8	139996.0	144101.4	148355.3	152737.7
Grape	78750.42	78459.34	79512.36	80559.22	81522.92	83641.45	85818.99	88070.32	90388.27	92803.97	95270.92
Mellon	313220.6	312235.4	316687.6	320884.3	324841.0	333269.9	341923.6	350867.9	360055.0	369491.5	379251.7
Citrus	267485.8	267429.5	272000.9	276479.0	280734.5	288939.8	297395.2	306161.1	315189.4	324543.0	334190.1
Apple	112461.3	112441.8	114311.4	116276.7	118092.3	121644.5	125311.5	129117.0	133045.8	137198.3	141409.2
Coffee	19129.28	19494.97	20104.23	20724.15	21216.83	22022.04	22864.42	23748.37	24677.15	25472.41	26299.23
Sugar	434530.3	472771.2	512827.7	556623.8	590366.0	635204.2	684056.1	737361.7	795740.5	837645.1	882144.6
Tea	15956.21	16009.47	16312.72	16609.94	16861.84	17351.59	17857.70	18383.27	18928.04	19445.97	19981.07
Dates	301324.7	299468.2	302823.6	305963.5	308855.7	316013.6	323350.4	330916.9	338700.2	346714.6	354963.0
Nonfood (Index)	12145.75	12231.02	12530.97	12826.19	13117.21	13596.61	14094.02	14611.81	15150.94	15711.50	16295.23

TABLE LX

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER PREDICTED PRICES AND .5 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95 (MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	448334.7	454596.5	461243.9	467318.7	479520.3	492242.2	505294.8	518400.8	531961.2	545911.9
Wheat flour	1166306.	1162453.	1179459.	1194984.	1209704.	1241626.	1274201.	1307956.	1343032.	1379148.	1416367.
Corn	24948.67	24765.83	25018.00	25228.06	25426.65	26009.25	26590.82	27213.54	27855.24	28520.58	29210.02
Millet	5477.238	5407.911	5467.817	5482.774	5504.322	5622.676	5732.514	5850.480	5990.510	6131.585	6277.331
Sorghum	18659.10	18393.92	18602.50	18622.67	18674.42	19068.25	19425.00	19808.61	20284.78	20760.49	21251.51
Beef	58411.55	59155.30	60773.48	62332.73	63744.07	65924.54	68125.82	70383.45	72547.02	74713.05	77077.61
Camel	30049.94	30013.87	30404.43	30785.03	31127.34	31797.41	32464.84	33175.93	33765.17	34382.68	35012.74
Fish	47260.93	46906.95	47463.35	47958.82	48426.08	49633.46	50894.29	52182.66	53614.80	55092.71	56605.53
Mutton	78095.72	78559.14	80270.54	82196.88	83846.35	86582.35	89397.06	92442.92	95209.03	98223.39	101066.6
Poultry	361664.2	379058.7	399910.2	425121.5	446591.7	472061.1	497971.3	527127.5	549118.8	573763.4	596514.0
Carrot	6166.048	6158.405	6257.206	6356.842	6444.087	6624.978	6813.251	7003.988	7200.756	7388.843	7593.684
Egg plant	35817.92	35502.17	35807.35	36176.85	36342.78	37222.74	38092.11	39026.71	39989.73	40960.46	42023.11
Garlic	3749.576	3689.135	3696.736	3710.060	3720.675	3793.219	3867.746	3954.922	4043.106	4153.165	4257.826
Okra	17392.57	17115.71	17151.80	17281.16	17176.50	17562.56	17953.10	18380.55	18823.98	19223.91	19721.59
Tomato	328865.6	327142.3	331101.8	335284.1	338688.8	347338.8	356149.9	365279.0	374691.4	383912.7	373937.5
Potato	72857.91	73080.66	74521.69	75880.01	77510.61	78971.44	82190.87	84595.19	87069.71	89623.41	92261.13
Onion	167751.6	166968.2	169073.8	171638.1	173238.5	178027.5	182967.1	188017.9	193231.3	197799.2	203268.5
Banana	122365.2	122081.5	123897.1	125665.1	127314.9	130742.5	134264.7	137909.9	141649.8	145518.9	149496.6
Grape	78750.42	78391.93	79375.76	80351.71	81243.06	83282.68	85377.46	87541.93	89768.74	92088.70	94455.40
Mellon	313220.6	312066.6	316345.2	320364.1	324139.0	332369.9	340815.8	349542.1	358500.4	367697.3	377206.1
Citrus	267485.8	266824.7	270771.9	274607.1	278203.3	285686.8	293382.0	301346.6	309531.0	317996.0	326707.9
Apple	112461.3	112096.5	113610.5	115208.8	116648.6	119788.3	123020.5	126367.3	129812.4	133453.1	137126.7
Coffee	19129.28	19491.56	20097.20	20713.28	21201.99	22002.78	22840.44	23719.30	24642.64	25432.34	26253.26
Sugar	434530.3	472381.3	511982.2	555247.6	588420.8	632588.9	680677.9	733115.3	790505.2	831448.0	874896.1
Tea	15956.21	16009.71	16313.19	11610.66	16862.82	17352.85	17859.25	18385.14	18930.25	19448.52	19983.97
Dates	301324.7	299661.0	303213.5	306554.7	309651.6	317031.9	324601.1	332410.6	340448.0	348728.0	357254.1
Nonfood (Index)	12145.75	12157.55	12380.89	12596.45	12804.89	13193.14	13593.65	14008.43	14438.02	14882.30	15342.51

TABLE LXI

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER PREDICTED PRICES AND CONSTANT INCOME GROWTH, SAUDI ARABIA, 1986-95
(MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	448034.5	453987.9	460318.1	466068.4	477917.3	490268.0	502931.3	515630.4	528764.0	542267.6
Wheat flour	1166306.	1160264.	1175021.	1188246.	1200616.	1229979.	1259870.	1290810.	1322929.	1355946.	1389916.
Corn	24948.67	24761.29	25008.83	25214.19	25408.01	25985.42	26561.58	27178.64	27814.41	28473.56	29156.52
Millet	5477.238	5406.920	4565.812	5479.760	5500.287	5617.525	5726.212	5842.977	5981.731	6121.477	6265.834
Sorghum	18659.10	18390.55	18595.68	18612.43	18660.73	19050.78	19403.64	19783.20	20255.05	20726.26	21212.58
Beef	58411.55	59024.28	60504.58	61919.51	63181.24	65197.79	67225.49	69299.46	71271.49	73236.84	75387.36
Camel	30049.94	30087.10	30552.96	31010.89	31432.22	32187.18	32943.00	33746.70	34429.89	35145.11	35878.45
Fish	47260.93	46853.89	47356.24	47796.57	48207.75	49353.91	50550.48	51771.63	53132.43	54535.38	55969.64
Mutton	78095.72	78456.85	80061.63	81876.21	83410.49	86020.12	88700.86	91603.57	94221.69	97078.18	99758.28
Poultry	361664.2	378499.8	398731.9	423244.1	443963.9	468591.6	493582.3	521711.2	542675.1	566194.3	587777.0
Carrot	6166.048	6144.528	6229.039	6313.968	6386.200	6550.674	6721.649	6894.251	7071.962	7240.329	7424.288
Egg plant	35817.92	35467.09	35736.63	36069.73	36199.37	37039.23	37866.84	38757.59	39674.72	40597.65	41609.74
Garlic	3749.576	3677.651	3673.756	3675.521	3674.562	3734.546	3796.062	3869.539	3943.502	4038.237	4127.116
Okra	17392.57	17075.87	17072.04	17160.77	17017.12	17359.11	17703.80	18083.12	18476.26	18824.87	19267.27
Tomato	328865.6	326854.9	330520.3	334401.3	337500.2	345815.9	354276.8	363038.6	372066.0	380887.8	390490.3
Potato	72857.91	72897.51	74148.67	75311.01	76736.59	78875.72	80962.75	83122.33	85339.33	87622.11	89974.91
Onion	167751.6	166592.6	168314.0	170482.5	171685.1	176034.3	180511.4	185077.2	189781.1	193830.4	198741.9
Banana	122365.2	121818.6	123364.1	124855.1	126221.8	129640.9	132539.2	135844.4	139227.7	142722.7	146308.2
Grape	78750.42	78324.22	79238.72	80143.71	80962.76	82923.67	84935.97	87014.03	89150.34	91375.32	93642.74
Mellon	313220.6	311897.0	316001.5	319842.1	323435.0	331467.8	339706.0	348214.5	356944.7	365902.7	375161.1
Citrus	267485.8	266218.1	269542.3	272738.7	275682.3	282454.5	289403.1	294583.9	303946.3	311548.6	319356.3
Apple	112461.3	111750.6	112910.4	114145.6	115215.3	117951.4	120760.0	123662.5	126641.9	129791.7	132953.0
Coffee	19129.28	19488.13	20090.14	20702.36	21187.09	21983.45	22816.36	23690.13	24608.00	25392.12	26207.15
Sugar	434530.3	471989.7	511133.8	553868.0	586472.2	629971.6	677299.5	728871.9	785278.0	825265.2	867670.5
Tea	15956.21	16009.94	16313.67	16611.39	16863.80	17354.12	17860.82	18387.02	18932.46	19451.07	19986.90
Dates	301324.7	299854.8	303605.9	307149.9	310453.5	318058.5	325862.9	333918.7	342213.8	350763.6	359571.9
Nonfood (Index)	12145.75	12084.27	12231.98	12369.82	12498.60	12799.84	13108.76	13427.20	13755.41	14093.07	14441.17

TABLE LXII

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER CONSTANT PRICES AND INCOME, SAUDI ARABIA, 1986-95
(MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	447187.1	452840.2	458198.0	463176.1	474566.8	486252.7	498318.3	510721.4	523504.2	536666.7
Wheat flour	1166306.	1160830.	1175505.	1189413.	1202335.	1231903.	1262238.	1293559.	1325756.	1358938.	1393106.
Corn	24948.67	24831.54	25145.45	25442.96	25719.39	26351.89	27000.79	27670.77	28359.50	29069.31	29800.20
Millet	5477.238	5451.523	5520.438	5585.754	5646.441	5785.300	5927.760	6074.848	6226.051	6381.882	6542.342
Sorghum	18659.10	18571.50	18806.27	19028.78	19235.52	19708.57	20193.88	20694.96	21210.06	21740.92	22287.56
Beef	58411.55	58137.31	58872.26	59568.81	60216.00	61696.85	63216.10	64784.71	66397.20	68059.05	69770.26
Camel	30049.94	29908.86	30286.95	30645.30	30978.24	31740.07	32521.65	33328.63	34158.18	35013.12	35893.45
Fish	47260.93	47039.05	47633.69	48197.27	48720.91	49919.08	51148.31	52417.47	53722.14	55066.75	56451.29
Mutton	78095.72	77729.07	78711.69	79642.97	80508.26	82488.15	84519.37	86616.59	88772.47	90994.35	93282.22
Poultry	361664.2	359966.3	364516.8	368829.6	372836.8	382005.7	391412.4	401124.7	411108.6	421398.2	431993.5
Carrot	6166.048	6137.099	6214.681	6288.211	6356.529	6512.852	6673.227	6838.813	7009.031	7184.459	7365.098
Egg plant	35817.92	35649.76	36100.43	36527.55	36924.41	37832.47	38764.07	39725.94	40714.72	41733.76	42783.08
Garlic	3749.576	3731.972	3779.150	3823.863	3865.408	3960.468	4057.992	4158.685	4262.194	4368.872	4478.719
Okra	17392.57	17310.92	17529.76	17737.16	17929.87	18370.80	18823.18	19290.24	19770.38	20265.21	20774.74
Tomato	328865.6	327321.6	331459.5	335381.2	339024.9	347362.4	355916.0	364747.5	373826.0	383182.5	392816.9
Potato	72857.91	72515.85	73432.56	74301.38	75108.64	76955.74	78850.73	80807.29	82818.58	84891.44	78025.86
Onion	167751.6	166964.0	169074.7	171075.1	172933.8	177186.6	171549.8	186054.6	190685.5	195458.2	200372.6
Banana	122365.2	121790.7	123330.3	124789.5	126145.3	129247.5	132430.2	135716.2	139094.2	142575.6	146160.4
Grape	78750.42	78380.70	79371.55	80310.64	81183.18	83179.67	85227.92	87342.72	89516.68	91757.18	94064.24
Mellon	313220.6	311750.1	315691.1	319426.2	322896.7	330837.5	338984.1	347395.5	356042.2	364953.5	374129.6
Citrus	267485.8	266230.0	269595.6	272785.3	275749.0	282530.4	289487.5	296670.7	304054.8	311665.0	319501.2
Apple	112461.3	111933.4	113348.4	114689.5	115935.5	118786.6	121711.7	124731.8	127836.4	131036.0	134330.6
Coffee	19129.28	19039.47	19280.16	19508.28	19720.23	20205.19	20702.73	21216.44	21744.52	22288.76	22849.17
Sugar	434530.3	432490.3	437957.6	443139.3	447953.9	458970.1	470272.0	481941.1	493936.6	506299.3	519029.2
Tea	15956.21	15881.29	16082.06	16272.33	16449.13	16853.65	17268.66	17697.16	18137.64	18591.60	19059.05
Dates	301324.7	299910.1	303701.4	307294.6	310633.3	318272.5	326109.7	334201.7	342519.9	351092.8	359920.4
Nonfood (Index)	12145.75	12088.62	12241.43	12386.27	12520.84	12828.76	13144.66	13470.82	13806.11	14151.66	14507.48

TABLE LXIII

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER CONSTANT PRICES AND 1.6 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95 (MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	448141.3	454775.0	461137.7	467142.3	479651.5	492511.3	505809.0	519505.6	533644.7	548229.5
Wheat flour	1166306.	1167815.	1189695.	1211016.	1231538.	1269416.	1308500.	1349036.	1390940.	1434334.	1479245.
Corn	24948.67	24846.03	25174.81	25487.54	25779.48	26428.87	27095.47	27784.00	28492.18	29222.35	29974.57
Millet	5477.238	5454.704	5526.884	5595.540	5659.633	5802.200	5948.545	6099.706	6255.179	6415.482	6580.624
Sorghum	18659.10	18582.34	18828.23	19062.12	19280.46	19766.14	20264.69	20779.65	21309.29	21855.39	22417.97
Beef	58411.55	58548.99	59709.05	60843.38	61939.88	63912.43	65949.93	68064.88	70253.38	72521.76	74871.61
Camel	30049.94	29677.82	29820.78	29940.48	30032.00	30532.91	31043.10	31567.67	32103.26	32652.52	33214.93
Fish	47260.93	47208.46	47977.45	48719.97	49426.64	50824.52	52263.58	53753.30	55289.79	56877.78	58517.85
Mutton	78095.72	78052.06	79367.25	80640.04	81854.84	84216.27	86648.59	89167.57	91766.99	94454.75	97231.98
Poultry	361664.2	361660.4	367956.4	374062.5	379905.9	391080.4	402596.4	414527.7	426846.4	439589.5	452763.0
Carrot	6166.048	6181.317	6304.548	6425.130	6541.727	6750.887	6966.960	7191.269	7423.405	7664.040	7913.344
Egg plant	35817.92	35762.08	36328.30	36873.95	37392.00	38432.25	39502.69	40610.42	41752.46	42932.35	44150.46
Garlic	3749.576	3769.186	3854.903	3939.414	4021.918	4161.911	4306.917	4457.792	4614.341	4777.006	4945.946
Okra	17392.57	17439.78	17791.74	18136.28	18469.79	19064.85	19679.72	20318.16	20979.02	21664.21	22374.24
Tomato	328865.6	328238.4	333319.0	338207.5	342839.4	352254.3	361939.2	371958.9	382285.6	392951.5	403959.7
Potato	72857.91	73097.20	74614.81	76102.98	77546.46	80090.37	82720.41	85452.50	88282.09	91217.29	94260.42
Onion	167751.6	168164.9	171515.8	174793.5	177963.2	183651.0	189526.6	195626.2	201938.5	208481.9	215260.9
Banana	122365.2	122629.7	125034.4	127384.8	129655.1	133757.9	137995.1	142392.6	146942.1	151657.0	156540.4
Grape	78750.42	78596.52	79808.30	80975.96	82081.09	84331.19	86645.71	89040.15	91507.83	94056.50	96686.86
Mellon	313220.6	312289.9	316785.4	321088.5	325138.9	333711.5	342521.0	351627.8	361004.2	370680.6	380658.6
Citrus	267485.8	268165.2	273529.6	278777.9	283854.9	292949.2	302344.7	312098.8	322193.8	332659.0	343501.9
Apple	112461.3	113039.8	115600.5	118124.6	120588.2	124774.8	129111.0	133622.4	138303.0	143166.1	148216.5
Coffee	19129.28	19050.13	19301.75	19541.05	19764.41	20261.80	20772.35	21299.70	21842.07	22401.29	22977.38
Sugar	434530.3	433633.2	440275.6	446662.1	452707.9	465066.6	477777.7	490926.7	504476.5	518469.8	532910.2
Tea	15956.21	15880.55	16080.56	16270.06	16446.06	16849.73	17263.84	17691.39	18130.89	18583.82	19050.19
Dates	301324.7	299293.5	302453.9	305403.1	308086.6	315014.4	322108.0	329422.1	336926.8	344649.6	352588.8
Nonfood (Index)	12145.64	12323.82	12722.47	13123.50	13524.15	14126.30	14755.75	15416.06	16107.42	16831.87	17590.79

TABLE LXIV

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER CONSTANT PRICES AND 1 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95 (MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	447785.0	454052.0	460038.4	465658.3	477747.9	490166.8	503001.1	516210.2	529837.8	543885.8
Wheat flour	1166306.	1165204.	1184379.	1202908.	1220558.	1255287.	1291044.	1328064.	1366249.	1405721.	1446495.
Corn	24948.67	24840.63	25163.85	25470.89	25757.04	26400.12	27060.10	27741.70	28442.59	29165.15	29909.38
Millet	5477.238	5453.517	5524.478	5591.885	5654.706	5795.889	5940.781	6090.420	6244.294	6402.923	6566.312
Sorghum	18659.10	18578.30	18820.03	19049.67	19263.68	19744.64	20238.24	20748.01	21272.21	21812.60	22369.22
Beef	58411.55	58395.04	59395.38	60364.54	61290.88	63076.56	64916.34	66822.02	68788.90	70823.19	72925.74
Camel	30049.94	29763.82	29993.91	30201.61	30381.68	30977.88	31586.74	32213.55	32855.20	33514.21	34190.25
Fish	47260.93	47145.17	47848.87	48524.23	49162.09	50484.76	51844.64	53250.95	54699.53	56195.10	57737.98
Mutton	78095.72	77931.39	79121.96	80266.48	81349.72	83567.25	85847.95	88207.10	90637.93	93148.31	95738.88
Poultry	361664.2	361027.4	366669.0	372100.9	377252.4	387669.3	398386.6	409475.3	420904.5	432711.1	444898.3
Carrot	6166.048	6164.781	6270.871	6373.686	6471.994	6661.067	6855.882	7057.688	7265.988	7481.442	7704.141
Egg plant	35817.92	35720.13	36243.09	36744.29	37216.82	38207.35	39225.47	40278.13	41362.16	42481.10	43636.17
Garlic	3749.576	3755.258	3826.456	3895.887	3962.785	4085.574	4212.302	4343.755	4479.655	4620.426	4766.149
Okra	17392.57	17391.59	17693.51	17986.29	18266.43	18802.86	19355.67	19928.37	20519.59	21131.19	21763.44
Tomato	328865.6	327896.0	332623.8	337149.9	341411.0	350421.0	359680.0	369251.7	379106.7	389277.2	399765.1
Potato	72857.91	72879.74	74171.38	75425.59	76627.62	78906.07	81254.85	83688.88	86202.41	88803.36	91492.95
Onion	167751.6	167715.8	170600.7	173396.4	176069.5	181211.8	186510.2	191998.7	197663.7	203523.3	209579.9
Banana	122365.2	122315.6	124395.7	126410.0	128334.1	132056.8	135891.9	139864.0	143963.1	148202.4	152583.4
Grape	78750.42	78515.93	79645.65	80727.02	81744.86	83899.67	86113.98	88403.00	90759.69	93191.81	95699.74
Mellon	313220.6	312088.4	316376.5	320467.1	324300.3	332636.2	341197.0	350042.7	359144.6	368533.0	378208.9
Citrus	267485.8	267441.5	272054.7	276526.2	280802.5	289017.4	297482.0	306250.7	315301.9	324664.3	334341.7
Apple	112461.3	112625.7	114754.8	116830.7	118830.5	122505.9	126299.0	130233.4	134300.6	138513.5	142874.4
Coffee	19129.28	19046.15	19293.69	19528.81	19747.91	20240.66	20746.35	21268.60	21805.62	22359.23	22929.45
Sugar	434530.3	433206.4	439409.1	445344.1	450928.0	462782.4	474963.3	487554.7	500517.4	513894.3	527687.4
Tea	15956.21	15880.83	16081.12	16270.91	16447.21	16851.19	17265.64	17693.54	18133.41	18586.72	19053.49
Dates	301324.7	299523.4	302918.8	306107.7	309034.5	316266.2	323595.3	331197.4	339003.1	347040.0	355307.1
Nonfood (Index)	12145.64	12235.53	12540.77	12843.36	13140.67	13627.46	14132.75	14659.42	15206.92	15776.97	16370.19

TABLE LXV

PROJECTIONS OF AGGREGATE CONSUMPTION UNDER CONSTANT PRICES AND .5 PERCENT OF INCOME GROWTH, SAUDI ARABIA, 1986-95 (MT)

Commodity	1985	86	87	88	89	90	91	92	93	94	95
Rice	449296.5	447486.7	453447.2	459119.6	464418.7	476158.6	488210.7	500660.2	513465.4	526669.6	540273.4
Wheat flour	1166306.	1163020.	1179945.	1196158.	1211435.	1243569.	1276597.	1310742.	1345901.	1382191.	1419617.
Corn	24948.67	24836.10	25154.67	25456.96	25738.26	26376.05	27030.51	27706.31	28401.12	29117.31	29854.88
Millet	5477.238	5452.522	5522.463	5588.826	5650.852	5790.605	5934.283	6082.649	6235.189	6392.420	6554.347
Sorghum	18659.10	18574.91	18813.17	19039.25	19249.63	19726.64	20216.11	20721.54	21241.19	21776.82	22328.45
Beef	58411.55	58266.36	59133.89	59966.34	60752.41	62384.61	64062.73	65798.08	67585.50	69430.90	71334.57
Camel	30049.94	29836.06	30139.71	30422.09	30677.76	31355.71	32049.61	32764.93	33498.70	34253.55	35029.33
Fish	47260.93	47092.22	47741.43	48360.88	48941.56	50201.82	51496.18	52833.63	54209.87	55629.50	57092.65
Mutton	78095.72	77830.42	78917.07	79954.89	80928.95	83027.29	85182.75	87410.25	89702.72	92067.79	94505.70
Poultry	361664.2	360497.8	365594.0	370465.7	375043.6	384834.1	394892.9	405289.1	415990.2	427031.7	438414.8
Carrot	6166.048	6150.960	6242.783	6330.910	6414.147	6586.726	6764.169	6947.667	7136.679	7331.826	7533.144
Egg plant	35817.92	35685.02	36171.87	36636.03	37070.69	38019.91	38994.67	40001.79	41037.98	42106.73	43208.11
Garlic	3749.576	3743.627	3802.789	3859.796	3913.916	4022.690	4134.622	4250.448	4369.848	4493.210	4620.565
Okra	17392.57	17351.31	17611.65	17861.60	18097.79	18586.11	19088.24	19607.53	20142.45	20694.78	21264.60
Tomato	328865.6	327609.5	332042.6	336266.6	340218.9	348892.1	357797.8	366998.4	376463.8	386225.6	396284.6
Potato	72857.91	72698.04	73801.98	74862.76	75866.23	77927.22	80046.81	82239.13	84497.85	86830.37	89237.15
Onion	167751.6	167340.5	169837.9	172234.7	174498.5	179192.9	184019.5	189010.9	194152.1	199460.3	204936.3
Banana	122365.2	122053.6	123863.2	125599.1	127237.7	130648.1	134154.2	137779.8	141513.9	145368.9	149345.5
Grape	78750.42	78448.46	79508.83	80519.08	81464.24	83539.79	85670.93	87872.61	90137.62	92473.55	94880.55
Mellon	313220.6	311919.6	316034.5	319947.5	323599.5	331737.8	340091.6	348719.9	357593.9	366743.5	376168.9
Citrus	267485.8	266836.6	270825.5	274654.0	278270.7	285763.5	293467.7	301434.8	309641.6	318114.8	326856.1
Apple	112461.3	112279.9	114051.2	115757.8	117377.7	120636.5	123989.9	127459.9	131036.8	134732.4	138547.5
Coffee	19129.28	19042.82	19286.94	19518.57	19734.10	20222.96	20724.59	21242.57	21775.12	22324.06	22889.38
Sugar	434530.3	432849.1	438684.6	444243.1	449442.2	460877.0	472617.8	484746.9	497224.4	510092.3	523351.4
Tea	15956.21	15881.06	16081.59	16271.62	16448.16	16852.42	17267.15	17695.34	18135.52	18589.16	19056.27
Dates	301324.7	299716.2	303308.9	306699.1	309830.8	317245.2	324846.9	332692.3	340752.5	349055.4	357600.4
Nonfood (Index)	12145.64	12162.04	12390.58	12613.31	12827.79	13223.07	13631.00	14054.07	14491.38	14944.31	15413.09

VITA

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