FACTORS AFFECTING RICE CONSUMPTION IN SAUDI ARABIA

by

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CHAPTER I

INTRODUCTION

During the past decade, the Kingdom of Saudi Arabia has undergone rapid economic growth and development. This expansion stems from the increase in the Kingdom's production of petroleum--oil being the source of most of the country's exports, foreign exchange, and government revenues. However, despite this growth, Saudi Arabia is one of the top foodstuff importers among developing countries. It has been estimated that the value of Saudi agriculture imports in 1981 increased about 33 percent to approximately $6 billion--double the 1979 value and six times the 1976 level.

Among agricultural imports, rice is entirely imported from abroad, for the local production of rice is very insignificant. As the main element of the Saudi diet, rice is worthy of study from the production and marketing aspects, as Saudi Arabia is almost entirely dependent on the international market: i.e. dependent on export receipts as well as on import supplies. The purpose of this paper is to point out the factors influencing the consumption of that completely imported staple food.

The Significance of the Study

Rice is the main staple food in Saudi Arabia, accompanied by meat. Although one may argue that wheat is the main meal, the taste in the last 25 years has changed toward rice. Meeting the rapidly growing demand for rice is a critical challenge for the country's policy makers due to the following reasons:

1. Full dependence on an unreliable source of imported rice.
2. Insignificant local production of rice.
3. Substantial gains in the standard of living accompanied by a 3 percent annual rate of population growth--rice consumption rising with the increase in population and income.

The Objectives of the Study

1. To develop the demand equation for rice.
2. To identify the most important factors affecting the consumption of rice.
3. To use the model in forecasting the rice demand up to 1990.

Plan of the Study

This paper will present first a background of Saudi Arabia; then it will discuss aspects of agricultural development and foreign trade. Next, the quantitative analysis for rice consumption will be presented, and an OLS model will be applied on the available time series data.

Following this, the results of the analysis will be used to forecast the future rice demand to the year 1990. In the summary chapter, policy implications and recommendations will be offered.

CHAPTER II

BACKGROUND ABOUT SAUDI ARABIA

Location and Climate

Saudi Arabia occupies four-fifths of the Arabian Peninsula and is boardered by the Red Sea on the west and by the Arabian Gulf, Qatar, Oman and the United Arab Emirates on the east. To the north, it borders Jordon, Iraq, and Kuwait, and to the South, Yemen and the Republic of South Yemen. The total area of Saudi Arabia is approximately 2.25 million square kilometers or about one-third the size of the United States.

Although Arabia is surrounded on three sides by sea, aridity is the dominant feature. Moreover, Saudi Arabia is the largest country on earth without rivers. In fact, the intense heat of the summer months is the best known feature of the Arabian climate. Summer temperature averages usually range between 95^{O} F and 120^{O} F. In winter, temperatures range between 32^{O}F and 75^{O}F, but can drop below the freezing point in some areas. Rainfall is scanty and irregular, occurring mostly during the months from October to April. The precipitation varies from about 100 mm in the north to less than 25 mm in the Rub-AL-Khali or the empty quarter, while there is more in the mountains on the west,

and perhaps as much as 300 mm in the southern part of the coastal range. This total could hardly support plant growth, especially in view of the high evaporation rates observed in the country. Such climatic conditions can be summarized by: (a) high summer temperature, (b) moderately frosty winter, (c) low atmospheric humidity, (d) sporadic and scanty rainfall.

The Population

According to the 1974 Population Census, there were slightly over seven million people in the country, with an annual growth rate of 3 percent. Sixteen main urban areas were in existence at the end of 1974, and were inhabited by 38 percent of the total population, with an average size of six persons in each household. It is very difficult to obtain reliable population statistics of the non-settled Beduins, due to the great changes in their lifestyle--many of them turning to agriculture and some to life in the cities. However, it has been estimated that about 1.9 million are non-settled or nomads. The large migration experienced in Saudi Arabia from rural to urban cities by villagers and nomads is usually the result of a search for better employment opportunity, higher wages, better education, and a better standard of living. The urban population has grown very fast due to the large influx of people from the interior, as well as from outside the Kingdom.

There are three urban population centers in Saudi Arabia: the western region which includes Jeddah and the holy cities of Mecca and Medina, the central region which includes the capital city of Riyadh and the Qasim area, and the eastern region which includes the cities of Dammam, Al-Hofof and Dhahran. While the civilian labor force has been estimated to be 2.46 million in 1980 (25, p. 9), the agricultural sector employed only 25 percent at that time--against 25 percent in 1975 and 40 percent in 1970. This decline is due to the small growers' depressed returns, which pressured them to seek full- or part-time off-farm employment. Furthermore, during the Third Development Plan (1980-1985), further decline to 20 percent by 1985 is envisioned (7, p. 3). The agricultural sector employs a substantial number of foreign laborors. Over time, the agricultural sector is anticipated to become progressively more mechanized, replacing the present labor intensive techniques of cultivation. Other major employers include the areas of construction, trade, government, transport, non-oil manufacturing, and social and community services.

Agricultural Development

Of the total area of the Kingdom of 2.25 million square kilometers, only about 592,000 hectares, or about 0.3 percent of the total area, is reported to be under cultivation (7, p. 4), which is about 15 percent of the estimated arable land of 4 million hectares. Less than one-fourth of the cultivated land is irrigated, while the

remaining three-fourths are rainfed. An increase of the irrigated area from 50,000 to 170,000 hectares is anticipated by the Ministry of Agriculture and Water.

The Ministry of Agriculture and Water is the primary agency responsible for the formulation and implementation of the government's policy and development programs in the fields of agriculture, fisheries, forestry, range resources and livestock. Other major agencies include the Agricultural Bank, which is the main body for providing agricultural credit: the Industrial Development Fund, which provides loans for agro-industrial investors, and the Grain Silos and Flour Mills Organization which was set up in 1973 to build up stocks of feed grains for the country's needs, and for the sale of animal feed to farmers at subsidized prices.

The agricultural sector has continued to make notable advances over the last decade because of the facilities and incentives provided by the government. The value added by this sector to the GDP increased in real terms at the compound annual rate of 5.4 percent during the Second Plan Period (1975-1980), compared with 3.6 percent during the First Plan Period (1970-1975), and with 1.6 percent at constant prices between 1960-1970 (1, p. 8). Although the total agricultural revenue had jumped to 4648 million Saudi riyals in 1980, compared with 1392 million Saudi riyals in 1975 (23, p. 169), the contribution of the agricultural sector to the GNP rose insignificantly--to only 1.2 percent

compared with 1.1 percent for the two previous periods respectively. This is due to the massive contribution of the oil sector--revenue from exported oil having supplied the government with 96 percent of its total receipts in the year of 1975.

Currently, the agricultural sector provides only about half of the country's food requirements. Therefore, the deficit has to be imported. Furthermore, it appears that the demand for foodstuff is rising due to the growth of income and population. The key factors limiting the agricultural sector are the shortage of skilled labor, the outmoded irrigation system which increases the soil salinity, and the small size of average holdings.

Agricultural Credit

Farmers have easy access to interest free loans from the Agricultural Bank. The Bank offers short, medium, and long term loans to agricultural investors. Started in 1964 with a limited number of borrowers and with loans amounting to approximately 4.4 million riyals, the bank has expanded its services through 11 branches. During the fiscal year of 1979-1980, the amount of loans was estimated to be about 7.73 billion riyals.

Agricultural Subsidies

Saudi Arabia already has some of the most elaborate farm subsidies. Efforts to disperse some of the petroleum wealth to rural areas have included more benefits for

farmers with each successive year. Saudi Arabia has been a food deficit country and will, in all probability, continue to be for many years to come. Therefore, to compensate that deficit, the government has launched a subsidy program designed to achieve a gradual but sustained growth in agricultural production. The scheme is aimed at stimulating private investment in agriculture, increasing resource productivity, and emphasizing the production of selected staple food commodities (13, p. 51). Existing subsidies, their rates, conditions and dates are presented in Table 1.

These efforts have been able to attract substantial amounts of private capital to all fields of agriculture--particularly in dairy, poultry and livestock. Many new agricultural investors have taken advantage of the subsidy payments and investment incentives, the greater use of machinery and the (freely distributed) improved seed have also contributed to the agricultural production rise. About 117 thousand hectares of land have been distributed for agricultural investment for individuals and companies as of the middle of 1980 (17, p. 19). New irrigation methods such as sprinklers and drip irrigation were introduced and greenhouses have been utilized for intensive vegetable production.

Agricultural Production

Saudi Arabia is one of the success stories of agricultural development in the Middle East. The wheat production has increased 195 percent since 1975, as shown by

TABLE 1

Current Agricultural Subsidies
Their Rates, Conditions, and Years of Introduction

	Year	Rate
Inputs		
Farm machinery	1973	45% of price
Chemical fertilizers	1973	50% of total cost
Concentrate feed (36% or more-protein)	1973	50% of total cost
Irrigation engines and pumps	1974	50% of price
Dairy-equipment	1974	30% of price
Poultry-equipment	1974	30% of price
Air freight transportation for dairy cattle (200 or more)	1975	Total cost
Date palm (30 trees or more of selected varieties)	1976	50 riyals[1] for newly planted tree
Feed grain for drought relief (offered in kind)	1974	Nominal price of 100 riyal/ton
Outputs		
Wheat	1973	0.25 riyal/Kg
Rice	1973	0.30 riyal/Kg
Sorghum	1973	0.25 riyal/Kg
Millet and barley	1975	0.15 riyal/Kg
Dates	1976	0.25 riyal/Kg

Source: A Guide to Agricultural Investment in Saudi Arabia, Dept. of Research and Development, Ministry of Agriculture and Water.

[1] 3.38 Saudi riyal = 1 U.S. dollar.

Table 2. Egg production has risen 300 percent; and it was estimated by the FAO that the country would be self-sufficient in egg production by 1982 (7, p. 26). Furthermore, total vegetable production increased to about 2 million tons in 1981. The country, with eleven million date trees, donated about 9,000 tons of Saudi dates to the World Food Programs. A considerable shift from millet and sorghum to wheat has been experienced recently by farmers. The annual milk production has increased more than threefold between 1978 and 1980. In addition to the 16 milk farms in operations, 5 new projects are under implementation and 54 projects are under study. Livestock production witnessed modest expansion and lagged behind the rapid growth in demand for meat. This was due to the drought conditions and over grazing which affected the quality of pasture lands. An insignificant local production of rice of about 2000 tons has been produced annually in the oasis of Hofuf with technicians from Taiwan, which provides only about one-half of one percent of the national rice consumption (29, p. 71). Multiple cropping together with the mechanized cultivation have raised the alfalfa output level 140 percent over the 1975-76 level.

Foreign Trade

Although one of the major objectives of the Kingdom's development policy is to diversify the sources of the national income, oil revenue still remains the predominant contributor to the GDP and export earning. On the import

TABLE 2

Estimated Production of Selected
Major Agricultural Products
(thousand metric tons)

	1975-1976	1981	Percentage Change (75/76-81)
Wheat	93	275	+195
Millet	17	15	- 11.8
Sorghum	154	100	- 35
Barley	12	25	+108
Corn	7	25	+257
Watermelon	248	770	+210
Tomatoes	165	560	+240
Onions	75	100	+ 33
Alfalfa	542	1,300	+140
Dates	257	350	+ 36
Grapes	42	65	+ 55
Poultry meat	21	81	+286
Eggs	15	60	+300

Source: (i) 1975-1976 Derived from "A Guide to Agricultural Investment in Saudi Arabia, Ministry of Agriculture and Water, Saudi Arabia.

(ii) 1981 Derived from "Middle East and North Africa, Review of Agriculture in 1981 and Outlook for 1982." by John B. Parker, USDA, ERS.

side, even though the commodities being produced within the country have been steadily rising, the country depends substantially upon imports from the international market. The importance of foreign trade to the country's economy is expressed in terms of the contribution of export and imports to the GDP (Table 3). Exports and imports made up 81 percent of GDP in 1970, 98 percent of GDP in 1972 and 137 percent of GDP in 1974. Obviously, exports are more important to the GDP than imports because of the huge oil revenue to the country's economy. In fact, Saudi Arabia has exported about one-fourth of the total world need for crude oil between 1970-1977 (11, p. 24). Nonetheless, because the country is inhabited by only about 8 million people, the import contribution comes out as anticipated.

Being fully dependent on the foreign market, inflation was one of the most disturbing economic phenomenon during the first two years of the Second Development Plan (1975-1980). A number of measures were taken to bring inflation under control. These measures include increased imports of goods and services, price controls, and periodic salary and wage increases. As a result of this policy, a 7 percent inflation rate was witnessed in 1981 (31, p. 11), against a rate of 22 percent in 1977 (23, p. 6).

Exports

Crude and refined oil make up most of the Saudi export. Crude and refined oil exports have increased thirty-three fold in current prices--from 10.9 billion riyals in 1970 to

TABLE 3

The Contribution of Exports and Imports to the GDP (billion riyals)

Year	GDP	Total Exports	Total Imports	EXP/GDP	IMP/GDP
1970	17.4	10.9	3.2	(.63)	(.18)
1971	22.92	17.1	3.7	(.75)	(.16)
1972	28.3	22.8	4.7	(.81)	(.17)
1973	40.5	33.3	7.2	(.82)	(.18)
1974	99.32	126.2	10.1	(1.27)	(.10)
1975	139.6	104.4	14.8	(.74)	(.11)
1976	164.5	135.1	30.7	(.82)	(.19)
1977	205.1	153.2	51.7	(.75)	(.25)
1978	223.7	138.2	69.2	(.62)	(.31)
1979	249.5	213.2	81.7	(.85)	(.33)
1980	386.5	362.2	100.3	(.93)	(.26)

Source: --Achievements of the First and Second Development Plans, Ministry of Planning.

--The GDP figures are derived from IMF.

362.9 billion riyals in 1980. As shown in Table 4 the contribution of crude oil to the total exports has risen from 83 percent in 1970 to 95 percent in 1980, while refined oil has decreased from 16 percent to 5 percent, respectively. At the same time, the country's other exports constitute a negligible amount, only about 0.8 percent of the total exports in 1980.

Imports

The total CIF imports has increased about one-hundred fold between 1975-1981, with an annual average growth of 41 percent. As shown in Table 5, from a high growth rate of 107 percent in 1976, the growth in imports decelerated to 18 percent in 1979. Thereafter, it rose to 23 percent in 1980 and 35 percent in 1981. Despite the declining share of the foodstuff imports to the total imports--from 32 percent in 1970 to 14 percent in 1981--the current value of foodstuff imports has increased from 1097 million riyals in 1971 to 18800 million riyals in 1981--an increase of about seventeen fold. Nonetheless, the average change on the level of foodstuff imports has experienced a 31 percent increase annually. The nonfoodstuff imports have experienced an increasing share in total imports from 68 percent in 1970 to 86 percent in 1981.

About 80 percent of the country's imports came from fourteen major industrial countries (see Table 6). The U.S. ($6 billion) accounted for 20 percent and Japan ($5 billion) for 18 percent of Saudi Arabia's total imports. The UK

TABLE 4

Exports of Saudi Arabia
Current Prices
(million riyals)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Crude oil	9080	15076	20608	30736	119031	96918	126862	145338	130212	200225	342979
Refined oil	1799	1998	2093	2461	6908	6756	7833	7327	6900	11019	16886
Others	28	27	60	112	284	738	457	544	1130	1939	3021
Grand total	10907	17092	22761	33309	126223	104412	135152	153209	138242	213183	362886

Source: Achievements of the First and Second Development Plans, Ministry of Planning.

TABLE 5

Imports of Saudi Arabia
(million riyals)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Grand total	3197	3667	4708	7197	10149	14823	30691	51662	69180	81624	100350	135342 (1)
% annual change	-	15	28	53	41	46	107	68	34	18	23	35
Foodstuff	1011	1097	1221	1686	2022	2301	3536	5365	7802	10432	14136	18800 (2)
% annual growth of foodstuff import	-	8	11	38	20	14	54	52	45	34	35	33
Share of foodstuff to total import	32	30	26	23	20	15	11	10	11	13	14	14
Non-foodstuff	2186	2570	3487	5511	8127	12522	27155	46297	61378	71192	86214	116542
% annual change	-	18	36	58	48	54	117	70	33	16	21	35
Share of non-foodstuff	68	70	74	77	80	84	88	90	89	87	86	86

Source: Achievements of the First and Second Development Plans, Ministry of Planning.
(1) SAMA.
(2) The 1981 figures are derived from Middle East and North Africa, Review of Agriculture in 1981 and Outlook for 1982, by John B. Parker, USDA, ERS, Supplement 8 to WAS-27.

TABLE 6

Saudi Imports by Origin
(Million U.S. Dollars)

	1978	1979	1980	Percentage Share in 1980
U.S.	4,370	4,875	5,768	20.4
Japan	3,284	3,808	4,882	17.3
Germany	2,079	2,412	2,358	8.4
U.K.	1,511	1,895	2,441	8.6
Italy	1,467	1,883	2,075	7.3
France	877	1,100	1,456	5.2
Six country subtotal	13,588	15,968	18,980	67.2
Other 8 industrial countries	2,414	2,838	4,123	14.6
Total 14 industrial countries	16,000	18,806	23,103	81.8
Rest of the world	4,021	4,725	5,134	18.2
Total FOB import (in dollars)	20,021	23,531	28,238	100
Total CIF import (in dollars)	23,425	27,531	33,320	

Source: SAMA, Annual report (1981)

stands third among the major importers, followed by Germany, Italy and France.

It is worth pointing out that the Ministry of Commerce provides subsidies to certain types of imported food, which form an important part of the people's diet; flour, rice, sugar, milk and milk products, vegatable oil and margarine, and chilled and frozen meat. This program was effective in controlling the inflation rate for food prices. The government spent 3 billion riyals in food subsidies in 1981 with an expected distribution of 4 billion riyals in 1982.

Rice imports have tripled between 1974 and 1981 (as shown in Table 7) during the same period. The U.S. share of Saudi rice imports averaged about 53 percent; Basmati rice, which is imported from Pakistan and India, contributed about 25 percent of the total rice imports, while Thailand rice imports have experienced a decline in the percentage share, in the last two years, though it contributed about 18 percent in the period of 1974-1981. Lastly, other sources of rice--such as Egypt, Australia, Italy--together contributed about an average of 3 percent of the total annual rice imports. According to one estimate, Saudi Arabia ranked sixth among the major rice importers of the world for the two successive years, 1980 and 1981, and ranked fifth in 1982 (30, p. 17).

TABLE 7

Saudi Rice Imports by Region
(1000 metric tons)

Year	U.S.	% Share	Pakistan Basmati	% Share	Thailand (Siami)	% Share	Others	% Share	Total
1974	61.00	45.00	15.00	11.00	44.90	33.00	1.36	1.00	136.00
1975	36.90	41.00	34.20	38.00	18.00	20.00	0.90	1.00	90.00
1976	92.20	36.00	81.90	32.00	79.40	31.00	2.56	1.00	256.00
1977	94.20	60.00	36.11	23.00	25.12	16.00	1.57	1.00	157.00
1978	362.02	66.00	87.34	22.00	39.70	10.00	7.94	2.00	397.00
1979	181.20	56.00	71.40	22.00	48.95	15.00	22.17	7.00	323.75
1980	202.50	56.00	113.70	31.00	36.17	9.90	12.00	3.30	363.00
1981	248.80	60.00	99.80	24.00	38.70	9.30	26.90	6.50	414.18
Average share		52.50		25.40		18.00		2.85	

Source: Various reports of the Ministry of Commerce, Saudi Arabia.

CHAPTER III

THE FACTORS OF DEMAND AND THE ESTIMATED DEMAND EQUATION FOR RICE

The most important determinants of a demand equation, as suggested by most economic studies, appear to be: population, income, the relative price of the commodity and the price of close substitutes. Other unquantifiable variables such as change in taste and preference can best be represented by a time trend factor. The ordinary least square (OLS) estimation procedure is used to estimate the demand equation for rice. The analysis is based on economic theory, statistical properties, and the author's experience.

Demand Determinants

(1) Price of Rice

According to economic theory, there exists an inverse relationship between the good's own price and its quantity consumed. The higher the price, the less is demanded. Whenever this law does not hold, the product is called Giffen good. In Saudi Arabia, rice is a necessary staple food and therefore, the inverse relation holds. The rice retail prices which directly affect consumer demand were derived by averaging price figures of thirteen Saudi cities over seventeen years.

(2) Price of Substitutes

Wheat is the main substitute for rice in the local diet. In accordance with economic theory, the quantity demanded of a good is positively related to the price of its substitute. The price fluctuation of wheat does influence the level of rice consumed and vice-versa.

(3) Income (GNP)

For most agricultural commodities, income and demand are positively related. Exceptions are those inferior commodities for which the reverse holds. Rice in Saudi Arabia obviously falls in the first category called normal good.

Per capita disposable income is a preferred measure of income since it indicates consumer purchasing power. However, a per capita disposable income series was not available. A reasonable proxy for personal income is GNP per capita, which is used in this study.

The effect of income on rice consumption tend to be a low influence, because it accounts for a small percentage of the consumer total expenditures. However, rice is considered a normal good since it is a major component of the daily main meal.

(4) Population

Usually, there is a positive relationship between the demand for food and the size of population. The demographic factors, e.g., change in population composition, or population growth influence the total demand for food (21,

p. 138). The growth rate of population in Saudi Arabia is 3 percent which means that the population size will double in about 23 years. This factor has been evaluated both as an implicit as well as explicit independent variable.

(5) Time Trend

The time trend is a common proxy variable used to capture changes in consumers taste and preference over time. Tastes and preferences are hard to quantify hence a trend variable is often used. Throughout time, rice consumption became the major substitute for wheat. The traditional meal in Saudi Arabia has gradually shifted toward rice (meat and rice are the main food dishes).

The Demand Equation

Given the determinants of demand discussed earlier, a demand equation can be specified. The following model is hypothesized for the demand equation:

$$Q_{D_T} = F(PRT, YPT, PWT, T)$$

where

Q_{D_T} = Per capital quantity demanded of rice in kilogram in year T.

PRT = Retail Price of rice, riyal/kg in year T.

YPT = GNP per capita (thousand riyal/capita) in year T.

PWT = Retail Price of wheat, riyal/Kg of year T.

T = Time Trend.

The demand equation is derived from annual data for the 17 year period from 1964 through 1980. The demand equation

is estimated by means of ordinary least square (OLS) procedure. It is assumed that the equation errors are normally distributed with zero mean and constant variance. Hence, the estimated coefficients will be then consistent, asymptotically efficient and will have approximately normal distribution. This will make it possible to use t-test for approximate statistical inferences.

Different formulations were tried to establish the most reasonable demand equation with the property of economic logic. Considerations included the relationship between per capita consumption of rice and inflation: A general index of living cost was entered as a separate independent variable to take into account inflationary changes in the economy.

Different quantity dependent equations were estimated by the (OLS) technique but in all of the estimated equations the Durbin-Watson test statistic falls in the inconclusive region. Therefore, the Cochrane-Orcutt iterative technique (CORC) was applied to correct for serial correlation. Per capita demand equations were estimated to save degrees of freedom, but total quantity dependent equations were also tried and gave a good fit.

The results of the different trials are stated in Table 8. As can be seen from Table 8, equations 1 and 2 have a fairly high $\bar{R}^2$ but they did not meet our theoretical expectations: Both the GNP per capita and the GNP signs in the two equations are negative which is contrary to the belief that rice is a normal staple good in Saudi Arabia.

TABLE 8

ESTIMATED REGRESSION COEFFICIENT FOR RICE DEMAND IN SAUDI ARABIA
USING COCHRANE-ORCUTT ITERATIVE TECHNIQUES

Dependent Variable		Constant	PRT	YPT	GI*	PWT	GNP	Pop	T	R^2	$\bar{R}^2$	DW
	Without Moving Averages											
1. Q_{D_T}	Coeff.	25.694	-22.251	-.0004	.129	10.708			1.205	.831	.747	2.390
	t	(3.670)	(-3.861)	(-.693)	(1.874)	(.831)			(1.444)			
2. Q_T**	Coeff.	-256.618	-175.500		741.576	110.128	-250.578	79.3691		.911	.866	2.477
	t	(-1.463)	(4.205)		(1.682)	(1.179)	(-0.5772)	(2.259)				
	With Moving Averages											
3. Q_{D_T}	Coeff.	-39.92	-26.55	.0006	.04	(9.05)			1.66	.966	.945	2.39
	t	(5.05)	(-3.8)	(.902)	(.59)	(.88)			(3.8)			
4. Q_{D_T}	Coeff.	43.37	-27.19	.0009		10.09			1.7	.965	.949	2.43
	t	(8.5)	(-10.07)	(2.84)		(1.04)			(4.22)			

*GI = stands for the general index of living costs.

**Q_T = Total quantity consumed in year T.

Furthermore, an inferior good is one for which consumption decreases as income increases. In this sense, the per capita consumption of rice has been rising significantly together with GNP per capita income from 1975 and on as the data in Appendix I suggests. One may conclude that the negative signs of the per capita income and the GNP which are contrary to a priori expectations, are obvious evidence of a multi-collinearity problem (10, p. 180, 28, p. 337). So equations 1 and 2 might be ruled out.

The three years moving average* technique was applied for smoothing out many irregular fluctuations of the raw

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*The Moving Average Technique is a technique used to smooth irregular fluctuations in the time series data.

e.g., given the numbers 1, 5, 3, 4, 2, 6, 7, a moving average of order 3 is given by the sequence.

$$\frac{1+5+3}{3}, \frac{5+3+4}{3}, \frac{3+4+2}{3}, \frac{4+2+6}{3}, \frac{2+6+7}{3}$$

i.e. 3, 4, 3, 4, 5

To locate each number in the moving average at its appropriate position to the original data.

Original Data	Moving Average of Order 3
1	
5	3
3	4
4	3
2	4
6	5
7	

Each number of the moving average being the mean of the 3 numbers.

Source: Schaum's Outline Series, Theory and Problems of Statistics by Murray R. Spigel, published by McGraw-Hill Book Company, 1961.

data. Although this technique has the shortcominig of losing two degrees of freedom, it did give a more comparable figures as in Appendix II. As a result of applying this process, equations 3 and 4 came out with a better fit, and with the expected signs.

The coefficients of equations 3 and 4 are estimated based on a 15 years data. As shown from Table 8, equation 3 comes out with a good fit reflected by the high values of R^2 and $\bar{R}^2$. Moreover, the coefficients have the signs one would expect a priori. However, three out of the five regressors are statistically insignificant even at 10 percent level based on t-value, i.e., the t-ratio of the coefficients of the GNP per capita (YPT); the general index of living costs (GI) which is added as an independent regressor (deflator) to take account of the inflationary effect; and the Price of wheat (PWT) where wheat is the main substitute. According to Gujarati, multi-collinearity among a set of independent variables in any equation can be detected by high value of R^2 associated with none or very few of the regression coefficients are individually statistically significant on the basis of t-test (10, p. 181). In equation 3, the problem of multi-collinearity among the regressors is suspect. Kennedy had attributed the multi-collinearity problem to the possibility that some regressors might vary together, i.e., the regressors may have a common time trend (15, p. 128). In model 3 per capita income (YPT), GI and the prices have a common time

trend. One remedial measure for the multi-collinearity problem is to drop one of the collinear variables. The most reasonable candidate variable to be deleted is the GI, since YPT and PWT have to be retained due to their importance in economic theory of demand.

Equation 4, as shown in Table 8, fits the data well and has the correct signs for the coefficients. Furthermore, because of the deletion of the deflator (GI), (YPT) becomes statistically significant at the 5 percent level based on the t-ratio.

With reference to the results from Table 8, equation 4 is the one which has the most desirable properties based on economic theory and statistical characteristics. Hence, it will be used in further analysis:

$$Q_{D_T} = 43.37 - 27.19\ PRT + .0009\ YPT + 10.09\ PWT + 1.7T$$

t - statistic (-10.07) (2.84) (1.04) (4.22)

$R^2 = .965$ $\bar{R}^2 = .949$ DW = 2.43, $F_{(4,9)} = 55.27$

rHo $(\hat{\rho}) = -.5$ t - rHo $(\hat{\rho}) = -2.17$

Evaluation of the Demand Equation

This section focuses first on the statistical properties of the model. The economic properties are evaluated in the second part of the section.

(I) Statistical Properties

(a) Coefficient of determination (R^2): The result of the analysis indicated that over 96 percent of the variation of the per capita consumption of rice in Saudi

Arabia has been explained by the regressors included in the model; Pindyck and Rubinfeld state that "roughly speaking, we associate a high value of R^2 with a good fit of the regression line and a low value of R^2 with a poor fit" (20, p. 63); hence, the analysis result is considered to be highly satisfactory. Therefore, the variation of per capita consumption of rice can be strongly explained by the retail prices of rice, the GNP per capita, the retail prices of wheat, and the time trend variable.

(b) Interpretation of the regression coefficients: The coefficient of retail price of rice (PRT) has the value of -27.19, which can be interpreted to mean that an increase of 1 Saudi riyal in the retail prices of rice will lead to a 27.19 kilogram decrease in the per capita quantity demanded of rice with the effect of all variables held constant. The t=ratio of -10.07 is highly significant at 1 percent level of significance.

The coefficient of GNP per capita income (YPT) has a low value of .0009 which can be interpreted to mean that an increase of 1 Saudi riyal in the GNP per capita will only lead to a .0009 kilogram increase in the per capita demand for rice. In another word, an increase of 10000 riyal in the GNP per capita income will lead only to 9 kilogram increase in the per capita quantity demanded of rice provided that other factors effect held constant. The low magnitude of the coefficient on GNP per capita of .0009 is not surprising, because food expenditures are a small

proportion of total expenditures. The t-ratio of 2.84 turns out to be significant at 1 percent level of significance.

The coefficient of the retail price of wheat (PWT) has the value of 10.09 which can be interpreted to mean that holding other factor effect constant, an increase of 1 riyal in the retail price of wheat (main substitute for rice) will lead to a 10.09 kilogram increase in the per capita rice consumption. Due to the large standard error of this coefficient, the calculated t-ratio is only 1.04 which is not significantly different from zero at 5 percent level of significance.

The coefficient of the time trend variable (T) has the value of 1.7 which indicates that during the study period, there was a trend toward increasing the per capita quantity demanded by 1.7 kilogram annually. The calculated t-ratio is 4.222 which is significantly different from zero at the 1 percent level of significance.

(c) Durbin-Watson statistics: The d-statistic of 2.43 fall in the indeterminante region at which one can neither accept nor reject the null hypothesis of serial correlation. It should be born in mind that the above selected demand equation was the result of applying the Cochrane-Orcutt interative procedure which is statistically used to correct for serial correlation. The OLS model for the demand equation before applying the Cochrane-Orcutt technique is the following:

Equation 4a:

$$Q_{D_T} = 44.7 - 25.5\ PRT + .001YPT + 5.07\ PWT + 1.67T$$

(t) (-6.5) (3.07) (.47) (2.9)

$R^2 = .92$ $\bar{R}^2 = .89$ DW = 2.85

The Durbin Watson test of the OLS equation of 2.85 falls in the indeterminante region, but after applying the Cochrane-Orcutt technique, the d-statistic dropped to 2.43 and the variance of all of the coefficients as shown in the variance covariance matrice had dropped indicating that the corrected model for serial correlation is more efficient in the econometric sense.

(d) The F-statistic of 55.27 is highly significant at 1 percent level of significance allowing us to reject the null hypothesis that all explanatory variables coefficients are jointly equal zero. In other words, that means that a linear relationship does exist between the dependent variables and the included regressors.

(II) Economic Properties of the Model

After evaluating the demand equation statistically, we will test the economic logic behind it. To do so, it is necessary to relate the signs and the magnitudes of the included regressors to the dependent variable. Usually the researcher has an idea about the expected signs of the estimated coefficient when building an econometric model based on statistical and economic factors and the researcher's experience.

In the selected demand model, the signs of the coefficients reflect the correct direction as one would expect a priori.

The coefficient of PRT (Retail Price of Rice) has a negative sign which coincides with theoretical expectation. The magnitude of Retail Price is fairly high value at 27.19. However, since rice is a staple food in Saudi Arabia, one may expect that rice demand would be price inelastic. The calculated own price elasticity of demand for rice is -1.3 which is somewhat higher in absolute value than expected, because rice is a staple food in the country. However, the available data reflects a controlled price of rice, which do not fluctuate as much as in the free market. This generates a demand curve with little slope which results in a higher price elasticity than would be found in a free market. Alimami had calculated the rice own price elasticity of demand in Sierra Leone to be -.294, which is lower than our calculated elasticity (3, p. 59). Chaiwat Konjing had concluded that demand for rice in Thailand is elastic which no one would expect for most farm products; particularly since rice is a staple food in Thailand (6, p. 28).

The coefficient of GNP per capita income (YPT) has, as expected, a positive sign. With a low magnitude of .0009, the calculated GNP per capita income elasticity is .25. That as interpreted as: "A one percent increase in the GNP per capita will increase rice consumption by about .25 percent." George and King found that the income elasticity

of demand for rice in the U.S. equals -.6 (9, p. 70). Al goosi had concluded that the income elasticity of demand for wheat in Saudi Arabia equals .385 (1, p. 56). Using per capita GNP as a proxy for per capita income, our calculated income elasticity of demand for rice is consistent with the belief that rice is a normal staple food in Saudi Arabia.

The coefficient of PWT (Retail Price of Wheat) has, as expected, a positive sign, which means that when the price of wheat goes up, people will consume more rice. This result is consistent with the hypothesis that wheat is a substitute for rice. However, since PWT is not statistically significant based on the t-test, I would expect other varieties of rice to be closer substitutes to each other than wheat. This cross relation is called the substitution effect.

Finally, the coefficient of the time trend is positive with a high magnitude of the value of 1.7. That is of course suggested that there is a trend to increase the per capita consumption of rice by the amount of 1.7 kilogram annually. The author is suspicious of this result, but it should be pointed out that the time trend variable does not only stand for the change in preference and taste. It can act as a proxy for other non-quantifiable variables. The time trend variable may be said to represent several changes in the institutional and psychological factors, changes in migration pattern, and the population composition of urban areas where more rice is consumed than in the rural areas.

Therefore, the coefficient of the time trend 1.7 is not only attributable to change in taste over time, but also is a reflection of several other possible effects as well.

Relative Performance of the Model

Theil's inequality coefficient, U, is used to evaluate the forecasting ability of the estimated model. The Theil's inequality coefficient, U, can be expressed as:

$$U = \frac{\sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_t - A_t)^2}}{\sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_t)^2} + \sqrt{\frac{1}{N}\sum_{i=1}^{N}(A_t)^2}}$$

Where N = Number of observations

P = The Predicted values of the dependent variable.

A = The Actual values of the dependent variable.

The coefficient U varies between 0 and 1. Generally a (U) value closer to zero will indicate a stronger forecasting ability of the model, while a closer (U) value closer to 1 represents a poor forecasting ability (27, p. 33). The calculated (U) for the demand equation turns out to be .03 which is a highly satisfactory indication of the ability of the model for forecasting.

The performance of the model can be evaluated also by examining the number of turning point errors and the frequency of under and over estimation. A visual plot comparing the actual and the estimated values against time

is given in Figure 1. From the plots, one can detect that three turning points of 1969, 1970, 1971 have not been captured by the model. However, our fitted model had an equal frequency of over estimation and under estimation.

Demand Projection Up to 1990

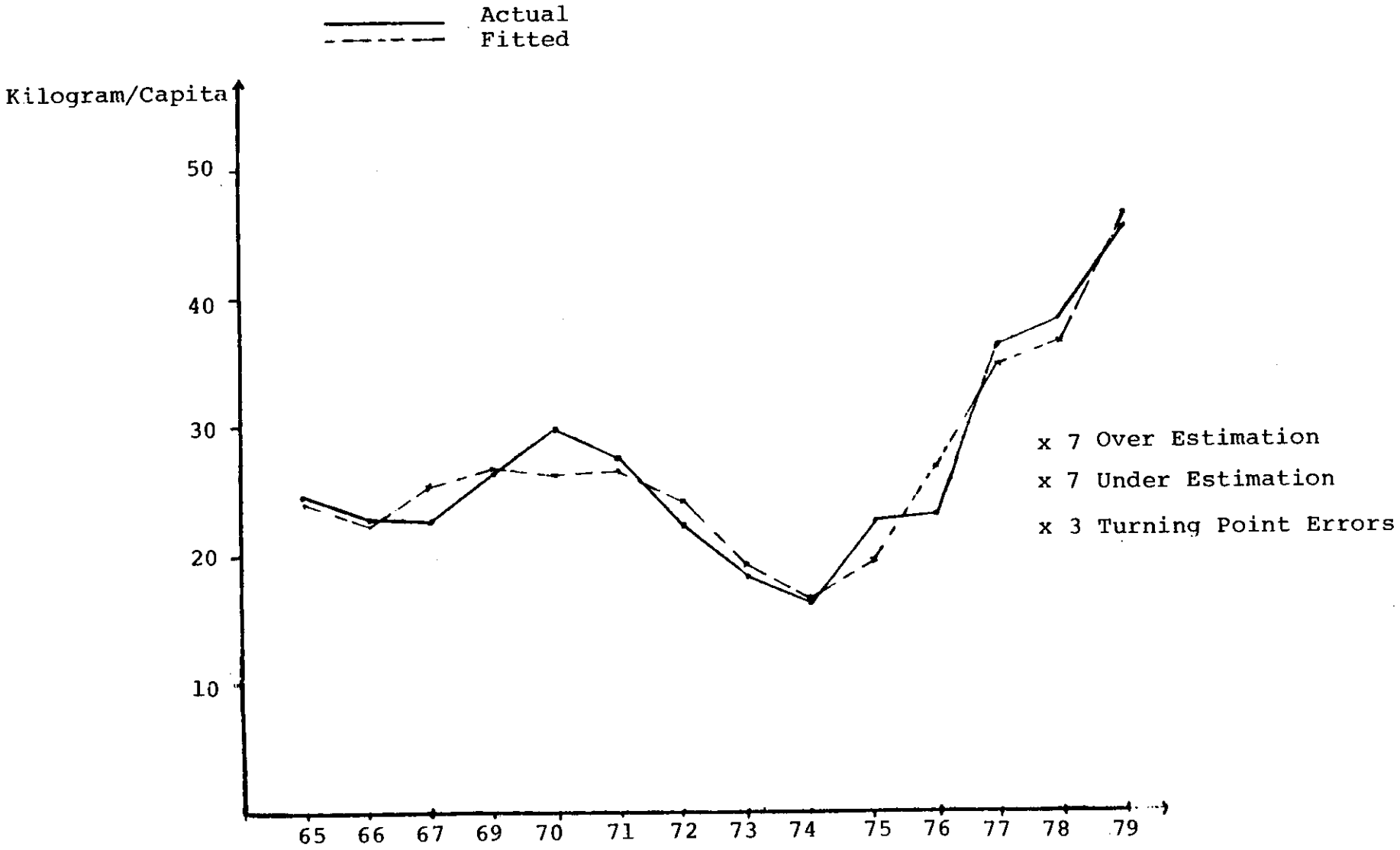
One of the most important purposes of this study is to obtain quantitive estimates of the rice needed for the rest of this decade. This is expected to be of certain use to the policymakers for decreasing their uncertainty of the expected demand for that staple food up to 1990. Such a study provides an approximate estimate of the size of rice imports for the specific period. In light of that estimate, policymakers may formulate their plans to make contractual agreements with the rice producing countries. Since the Saudi production of rice is quite insignificant, substantially all the expected demand for this staple food item will have to be imported.

It should be born in mind that, due to limitations on the data quality, the policymakers should deal carefully with the results obtained from this study. Furthermore, long term projections are based on specific assumptions which may or may not hold over the projected period.

The estimated demand equation 4 will be the basic framework for making the projection. In this study, each of the regressors will be forecast separately and then used in the estimated equation. It is assumed in this study that the foodstuff subsidies program supervised by the Ministry

Figure 1

PER CAPITA ANNUAL CONSUMPTION OF RICE



of Commerce will continue to cover the projection period. The program, discussed in Chapter II, provides cash subsidies for the foodstuff importers (rice and wheat are included), who are willing to keep the subsidized food prices in certain limits. The consumer, thus, is free from the effect of international market price fluctuations. The PRT and the PWT are assumed to follow their recent trend after the introduction of the program 1974-1980. The calculated average of the percentage annual increase of Retail Prices of rice (PRT) is equal .5 percent while the corresponding Value of the Retail Prices of wheat come out to be slightly higher, i.e., 3 percent for the period 1974-1980. The predicted prices of rice and wheat up to 1990 are shown in Table 9.

The population is assumed to follow the same trend, i.e., an annual increase in the total population of 3 percent. The predicted population up to 1990 is shown in Table 9 also. The study also assumes that the GNP is growing as planned by the government at 13 percent annual (1, p. 57). The GNP per capita income as a result of this policy will grow by an average of 8.8 percent annually, since GNP is divided by population to obtain the predicted GNP per capita income (YPT) as shown in Table 9.

TABLE 9

THE PREDICTED INDEPENDENT VARIABLES UP TO 1990

Year	GNP Billons/ of Riyals*	Population (1000)	GNP per Capita Income (YPT) Riyal/Capita	PRT Riyal/Kg	PWT Riyal/Kg
1983	474.42	9135.40	51932.04	2.82	2.17
1984	536.09	9409.50	56973.30	2.83	2.24
1985	605.80	9691.70	62507.10	2.84	2.31
1986	648.50	9982.50	68569.90	2.86	2.37
1987	773.52	10281.90	75231.20	2.88	2.45
1988	874.08	10590.40	82535.10	2.89	2.52
1989	987.70	10908.17	90546.81	2.91	2.60
1990	1116.12	11235.40	99339.60	2.92	2.68

*1 U.S. $ = 3.38 Riyal

Using the above predicted values for the independent variables, the projection of the per capita quantity demanded of rice is given by (20, p. 217):

$$\hat{Y}_{T+1} = \hat{\rho} Y_T + \hat{\alpha} \quad (1-\hat{\rho}) \quad + \Sigma \hat{\beta} \quad (X_{T+1} - \hat{\rho} X_T)$$

Where T starts from one in 1980, then two in 1981 ... and so forth, and $\hat{\alpha}$ and $\hat{\beta}$ are estimates from model 4 after applying the Cochrane-Orcutt technique. X_T, X_{T+1} are the predicted independent regressors from Table 9. $\hat{\rho}$ is the estimated correlation coefficient between errors in time period t and errors in time period t-1, and had the value of -.5.

For comparison purposes, the original OLS model (model 4a) will also be used, accounting for the same predicted exogenous variables. A summary of the projected quantities of rice is shown in Table 10.

TABLE 10

THE RICE DEMAND PROJECTION UP TO 1990

Year	Total Quantity Demanded (1000) Mt	
	CORC, Model 4	OLS Model 4a
1983	398.70	386.43
1984	452.03	459.18
1985	545.64	543.70
1986	627.80	617.92
1987	732.48	737.21
1988	833.57	854.33
1989	978.17	982.06
1990	1117.92	1131.40

CHAPTER IV

SUMMARY OF FINDINGS

The study had introduced the importance of rice in the Saudi daily meal, comparing its importance to wheat. The study assumed that the national preference has switched toward rice instead of wheat in the last 20 years. The significance of the study as pointed earlier, arises from the fact that rice is a staple food in a nation that imports nearly all its rice. Therefore, rice is considered a strategic good for the country in the sense that it is a staple good, yet local production is insignificant.

Continuation of the agricultural development process will require specific policies from the government. The input and the output subsidies together with the land distribution programs have attracted many investors to take part in the agricultural development process, as discussed in Chapter II, and should be continued. The importance of both exports and imports--which are effected by international market price fluctuations--to the Saudi GDP was pointed out. Since rice is completely imported, an inflation effect would be expected. To control the inflationary effect several measures were implemented, including the foodstuff import subsidies (which include rice) provided to importers who keep

their selling prices as planned by the Ministry of Commerce. That specific program had a significant impact on household consumers, in that any inflationary impact was dampened through price controls.

The analytical part of this study revealed that the per capita rice consumption can be explained by the retail prices of rice, the GNP per capita, the retail price of wheat (main substitute), and the time trend variable. The coefficient of determination R^2 is very high, indicating a good fit of the selected model. The selected model's ability for forecasting was tested using the Theil's inequality. The U value of .03 implies a highly satisfactory ability of the model for forecasting. The projected rice demand up to 1990 was calculated in Table 10.

The Study Limitations

As with any study, this study has its limitations. One major limitation is the level of reliability of the data set. The data were collected from different sources whereas a single source would have been preferred. However these sources are the currently available for the raw data.

As shown in Appendix I, the first column (QD) total quantity demanded was derived from various volumes of the FAO trade yearbook. To get these figures, rice exports were deducted from total rice imports, providing a measure of the rice quantity consumed in the corresponding year. The diverse fluctuation of that column's figures might be attributed to several factors, some of which are: lack of

current market assessment by the rice importers, without precise evaluation of the available rice stock in the local market; or, it might be attributed to price fluctuations. For example, rice prices in the international market increased in 1974, which led to a reduction in rice imports in 1975.

The GNP and the population figures were derived from the International monetary fund (IMF) statistics. Finally, the retail prices of rice, wheat, and the general index of living costs were derived from various reports of the Saudi Central Department of Statistics. The retail prices of both rice and wheat were calculated by averaging the thirteen documented regional market prices for each year to obtain a moderate picture of the whole price system.

Another caveat to be born in mind regarding this study is the possible lack of validity of the stated assumptions over the projection period. Three main assumptions were pointed out. First, it is assumed that the foodstuff subsidies program will continue to cover the projection period; second, the population growth rate of 3 percent annually is assumed to hold; finally, the GNP is assumed to grow at 13 percent annually.

The Foodstuff Subsidies Program has been effective in depressing the inflationary effect. So the consumer is free from the international market fluctuations. Furthermore the retail prices of wheat (PWT) up to 1990 is projected to increase by 23 percent compared to the 3 percent increase in

the retail prices of rice (PRT). If that assumption was relaxed for the projection period, wheat would become a more effective substitute for rice and one could expect the computed price elasticity of rice to decrease.

The annual growth rate of population is assumed to follow the same trend of 3 percent over the projection period. This variable has a vital role in identifying the projected quantity up to 1990, since the projected per capita consumption of rice is multiplied by the corresponding population for every year to arrive at the total quantity demanded.

However, the annual growth rate of population is subject to three main factors: birth rate, death rate, and migration pattern. The birth and the death rates are correlated to the public health facilities, educational level of people and the improvement of standard of living. The migration pattern is largely known by the temporary resident status of the foreign population who have contributed significantly to the implementation of the development plans as a part of the labor force. Their residency time is related to their period of contract. It has been projected (in the 1982 World Development Report issued by the World Bank) that the annual growth of the labor force will be 2.7 percent through 1980-2000, against 3.5 percent experienced in 1970-1980. Moreover, the average annual growth rate of population is expected to drop to 2.6 percent through 1980-2000 against 4.4 percent experienced in

the last decade. The assumption used in this study falls within these extremes.

The 13 percent annual growth of GNP assumption is also subjected to the policies related to the quantities and prices of the goods and services produced in the economy. Such a growth factor is largely effected by policies related to oil export levels and prices. Even for the relatively short eight year projection period used in this study, there is too much uncertainty in the petroleum market to speculate whether the annual growth rate for GNP assumption is too high or too low.

Policy Implications

Saudi Arabia is a food deficit country. The food shortage, however, have to be compensated through increasing the food production or increasing food imports or both. Unlike wheat production agronomy characteristics, rice is known for a high water requirement which Saudi Arabia lacks, even though research is being conducted by a Chinese team in the Eastern province of Saudi Arabia where rice is grown with an average of only 2000 tons annually. The research team is trying to improve the local rice variety by plant breeding with other Taiwanese rice varieties. In addition, efforts were devoted toward the selection of new varieties that can stand the local weather and soil conditions. However, the production of rice in Saudi Arabia has a low productivity of 1.5 tons per hectare compared to 6 tons per hectare experienced elsewhere in the world. Humaiden had

included rice production in that region among a group of crops that are incorporated in his linear programming analysis. The results show that rice should be excluded from the optimal crop production plan because of its relatively low profitability (13, p. 161). Moreover, rice's high requirement for water comprises a major constraint in growing that crop in a large quantity in Saudi Arabia.

Comparing rice to wheat, local production of wheat has been increasing dramatically after the introduction of the production subsidy program mentioned earlier (Chapter II). The government buys wheat from the local farmers in a way that maintains the local wheat prices above the imported prices which will directly encourage the farmers to expand wheat production since it has a lower water requirement than rice. In the current year, Saudi local production of wheat has risen to fulfill 80 percent of the local consumption requirement, compared to less than 1 percent of the local requirement seven years ago (4, p. 16).

The author, however, thinks that the rice research team should continue their work to identify drouth tolerant varieties. Rice should not be grown in areas of limited water where it may damage the long range stability of that scarce resource. More importantly, the rice import pattern should be dealt with cautiously. Rice is a completely imported food in a nation which considers rice as a staple diet. Meanwhile, local production of rice is insignificant at present and the need to build rice stock to offset

unexpected changes in the international market is inevitable. The assessment of the requirement for rice in the future is of particular interest to the policymakers in terms of imports to Saudi Arabia. This is indicated by an agreement with the Pakistani rice exporting agency to provide about 120 thousand tons of Basmati rice last year at the reasonable price of $700 per ton (which is $25 cheaper than the previous year) as a step toward providing a rice stock (17, p. 17). This agreement and other similar ones should be expanded with other major rice exporting countries on a long term basis, if possible. Such contractual agreements would help to provide the projected rice requirements to the country and simultaneously, decrease the uncertainty of the international market behavior for that strategic good.

Another point to be considered is the possibility of importing rice from cheaper sources such as Burma and Brazil, in addition to the usual suppliers. According to the FAO trade yearbook, Burma and Brazil offer the lowest rice prices per ton among rice exporting countries. In 1981, for instance, the export prices of rice in Burma, Brazil, the U.S., Italy and Hong Kong are $274.8, $304.9, $420.6, $499.8, and %528 per ton respectively. However, the long term rice export reliability of the two lower priced countries is not known and should be investigated.

It is a surprise that rice exports take place in Saudi Arabia when most of the rice requirement is imported from

abroad. Normally, commodity exports occur when there is a surplus or if there is an urgent need of foreign exchange. In Saudi Arabia, neither situation exists currently. The policy implications on exporting rice from the country, need careful evaluation.

A continued food import subsidy program, amounting to about 50 percent of the total cost in the case of rice imports, can be justified on distributional grounds. Rice importers who are willing to conform to the assigned prices by the Ministry of Commerce can obtain the subsidy. The import subsidy is obviously crucial in the case of rice since local rice production is insignificant in this rice consuming nation.

Suggestions for Further Research

Incorporating rice variety in the selected model is preferred but due to the data limitation (in terms of quantity consumed and retail prices for the different imported rice varieties), that alternative was not possible. Such information would be of use, if available, for establishing demand models and projections for every imported rice variety. The main varieties of rice imported to Saudi Arabia are American rice, Basmati rice from Pakistan and India, Siami rice from Thailand, and Egyptian rice. If detailed information about quantity of each rice variety over the study period are available, derivation of the consumption function would be more appropriate. For instance, using per capita quantity consumed of U.S. rice as a dependent variable

regressed on independent variables such as the retail price of imported American rice, the retail price of Basmati rice, and per capita income etc., would provide a better picture of demand. The justification for this proposal is that Basmati rice is a closer substitute than wheat for American rice. Based on the demand equations for the different rice varieties, a quantity forecast can be developed for each rice variety separately, upon which policymakers could base their assessment of future rice requirements so as to develop separate agreements with the corresponding rice producing countries. Interested researchers may disaggregate the data base to urban and rural people since rice is being consumed in the urban areas in larger quantities than in the rural areas. Another possibility is to disaggregate the data to immigrants and natural citizens, which will provide areas for further research about the rice consumption, patterns, tastes, and trends.

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APPENDICES

Appendix I, Raw Data

Year	Quantities Consumed of Rice Metric Tons QD	Average Retail Prices of Rice S.R./Kg PRT	Average Retail Prices of Wheat Sr./Kg PWT	Billions of Riyals GNP	Population 1000 POP	Cost of Living Index, Base Year 1963=100 G.I.	Trend T
1964	98876	.99	.55	7.31	5270	102.80	1
1965	140510	1.01	.60	8.17	5410	103.2	2
1966	142349	1.18	.50	10.00	5550	104.8	3
1967	125394	1.20	.81	10.43	5700	107.0	4
1968	124038	1.30	.81	11.63	5860	108.7	5
1969	150730	1.32	.72	12.73	6030	112.5	6
1970	202027	1.34	.76	13.57	6200	112.7	7
1971	200341	1.37	.72	17.24	6380	118.2	8
1972	124723	1.40	.70	20.59	6570	123.2	9
1973	109042	2.17	1.04	30.09	6760	143.1	10
1974	137340	2.70	1.38	82.35	6970	173.8	11
1975	91365	2.54	1.38	125.40	7180	233.9	12
1976	260827	2.67	1.26	165.39	7400	307.7	13
1977	161485	2.70	1.97	207.72	7630	343.6	14
1978	404069	2.80	1.84	225.53	7870	381.3	15
1979	339458	2.84	2.16	256.18	8110	388.1	16
1980	353068	2.70	1.99	391.20	8370	400.5	17

Appendix II

Refined Data by the 3 Year Moving Averages Technique

Year	Quantities Consumed of Rice Metric Tons QD	Average Retail Prices of Rice S.R./Kg PRT	Average Retail Price of Wheat S.R./Kg PWT	Billions of Riyals GNP	Population 1000 POP	Cost of Living Index, Base Year 1963=100 G.I.	Trend T
1965	127245	1.06	.55	8.49	5410.0	103.6	1
1966	136084.3	1.13	.64	9.53	5553.3	105.0	2
1967	130593.7	1.27	.71	10.69	5703.3	106.8	3
1968	133387.3	1.27	.78	11.60	5863.3	109.4	4
1969	158931.7	1.32	.76	12.64	6030.0	111.3	5
1970	184366	1.34	.73	14.51	6203.3	114.5	6
1971	175697	1.37	.73	17.13	6383.3	118.0	7
1972	144702	1.64	.82	22.64	6570.0	128.17	8
1973	123701.7	2.04	1.04	44.34	6766.7	146.7	9
1974	112582.3	2.47	1.27	79.28	6970.0	183.6	10
1975	163177.3	2.64	1.34	124.38	7183.3	238.5	11
1976	171225.7	2.64	1.54	166.17	7403.3	295.0	12
1977	275460.3	2.72	1.69	199.54	7633.3	344.2	13
1978	301670.7	2.78	1.99	229.81	7870.0	371.0	14
1979	365531	2.78	1.99	290.97	8116.7	384.97	15