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**CONCESSIONAL SALES, OPEN MARKET DEMAND AND
CONSUMPTION OF RICE IN SRI LANKA, 1953-1989**

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CONCESSIONAL SALES, OPEN MARKET DEMAND AND CONSUMPTION OF RICE IN SRI LANKA, 1953-1989¹

by

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ABSTRACT

This paper analyses the impact of concessional sales of rice under public food distribution schemes on the open market demand and total consumption of rice in Sri Lanka from 1953 to 1989. The results show that, on average, 73 per cent of the concessional issues of rice under the non-targeted (universal) rationing scheme during 1953-1977 has served to replace a potential quantity that would have otherwise been demanded by consumers in the open market. The remaining 27 per cent has served as an addition to the total quantity of rice consumed in the country. Under the rationing and food stamp schemes targeted towards low-income households, the annual average replacement of the quantity of open market rice was 51 percent during 1978-1989, while the addition to the total consumption of rice was 49 per cent. This suggests that the targeting of public rice distribution during 1978-1989 was fairly successful in maintaining the consumption of rice, particularly by low-income households.

Key Words: Demand, Rice, Sri Lanka.

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I. INTRODUCTION

Rice, the staple food in Sri Lanka, supplies nearly 50 per cent of the daily calorie intake of an average consumer, about 75 per cent of the starchy staples, and over 33 per cent of proteins (Edirisinghe and Poleman, 1976). Rice accounts for about 25 per cent of total consumer expenditure on food (Central Bank of Ceylon, 1983).

In Sri Lanka, a public sector rice distribution scheme ('concessional market') and a private sector market ('open market') for rice have been in operation since the early 1940s. From 1953 to 1977, each person above 1 year of age was provided a weekly ration of rice at a subsidised price under a *non-targeted (universal) rationing scheme*. From 1978 onwards, under *targeted rationing and food stamp schemes* rice was sold to low-income households, comprising of about 50 per cent of the population. In the early 1960s and 1970s, the public sector handled the greater proportion of rice marketed, as government controls were imposed in these periods on virtually all economic activity in Sri Lanka, including controls over the movement, storage and pricing of rice. However, with the implementation of economic reforms since 1977, the public sector rice distribution scheme has been virtually dismantled by the early 1990s.

Several studies such as Edirisinghe and Poleman (1976), Gavan and Chandrasekera (1979), Goldman and Timmer (1982), Bogahawatte (1983), Samaratunga (1984), Edirisinghe (1987), Gunawardana (1987), Bhalla (1991), Gunawardana and Oczkowski (1992), and Gunawardana and Quilkey (1987; 1993a; 1993b) have analysed various aspects related to demand for and supply of rice, and welfare and financial impacts of public sector rice distribution schemes in Sri Lanka.

This paper has a different focus; its objective is to analyse the effects of public distribution of rice on: (i) the demand for rice in the open market and (ii) the consumption of rice in Sri Lanka. Previous studies on the rice sector of Sri Lanka have not undertaken a rigorous analysis on these issues, although Gavan and Chandrasekera (1979) analysed the effects of ration-subsidy-income on the consumption of rice. Based on an econometric analysis of time-series data for the period 1950 to 1976, they found that 1 additional Rupee of ration-subsidy-income resulted in additional rice consumption of about

0.54 kg. This implied that, on average, an increase of 1 kg of rice distributed free of charge through the ration led to an increase in rice consumption of nearly 0.18 kg.

In this paper, a per capita demand equation for open market rice is estimated to analyse separately the effects of the *non-targeted rice rationing scheme* (1953-1977), and the effects of *targeted rationing and food stamp schemes* (1978-1989) on the open market demand and total consumption of rice in Sri Lanka. A knowledge of these effects and of parameters in the open market demand function will be of interest to policy makers in Sri Lanka and in other developing countries operating or contemplating similar schemes, as well as to foodgrain exporting countries.

The rest of the paper is organised as follows: To provide the necessary background for the analysis, evolution of government policy and operations in the demand side of the Sri Lankan rice market are described, and previous studies on their impact are reviewed, in section II. The analytical framework is presented in section III. This is followed by a discussion of results in Section IV. Conclusions are presented in section V.

II. GOVERNMENT INTERVENTION IN THE DEMAND SIDE OF THE RICE MARKET²

Non-targeted Rice Rationing Scheme

The Second World War adversely affected rice production and trade in the south and south-east Asian regions, causing rice shortages in Sri Lanka. Consequently, a rice rationing scheme was initiated in February 1942 by the colonial government of Ceylon (Sri Lanka). Rice rationing was initially introduced in 'non-self-supporting' areas of the country (mainly of urban areas), where a weekly ration of two measures (4 pounds or 1.82 kg) was issued to each person over three years of age, at the price of 21 cents per measure.

In July 1942, due to a further deterioration in supply, the weekly rice ration was reduced and the allotment was made to vary according to different categories of persons as

²This section draws on Gunawardana (1987, pp. 39-56), and Gunawardana and Quilkey (1987, pp. 232-248).

follows: Worker: 1.5 measures; Child: 1 measure; Infant: 0.75 measure; Others: 1.25 measures (Mahalingasivam, 1978). The government had become the sole importer of rice, wheat flour and sugar by the end of 1942. Thus, rice and other food items such as wheat flour, bread, sugar and spices were also provided under the rationing scheme. Although imports were the main source of rice for the rationing scheme, the government also purchased rice from domestic producers under the internal purchase scheme from 1942 to 1948 and under the guaranteed price scheme from 1948 (for details see, Gunawardana and Quilkey, 1993b).

In June 1943 the whole country was declared a 'non-self-supporting' area and, consequently, each person over three years of age became eligible for rationed rice. Rising prices of imported rice forced the government to increase the price of rationed rice during 1943-1949. However, to stabilise the cost of living, rationed rice was provided at prices below the import prices. The losses from the sale of imported rice were partly recovered from the profit earned through the sale of imported sugar and wheat flour. Since 1945, the government incurred losses from the sale of subsidised rice and other food items, under public food distribution schemes.

From early 1950s to 1978, the government provided rice to almost all persons older than one year, at subsidised prices. Since 1954, farmers and their families also received rice under the scheme. However, in certain periods from 1970 to 1977, income tax payers received smaller quantities of rationed rice and paid higher prices. From 1953 to 1967, rationed rice was sold at a subsidised price, but the full ration was issued free of charge in the years 1967, 1968 and 1969. From 1970 to 1978, a part of the ration was issued free and the other part was sold at a subsidised price. The changes in the weekly allotment and price of rationed rice during 1954-1977 are shown in Table 1. The proportion of rationed rice in per capita consumption of all rice increased from 59 per cent in 1953 to 85 per cent in 1965. The proportion declined gradually after 1966 but was still a substantial 55 per cent in 1977 (Table 2).

Table 1: Changes in the Weekly Allotment and Price of Rationed Rice, 1954-1977.

Date of Change		Quantum of Ration (Measures/Person)						Price of Paid Ration (Rs./Mea.)	
		NITP			ITP			NITP	ITP
Month	Year	Free	Paid	Total	Free	Paid	Total		
November	1954	0	2	2.0	0	2.0	2.0	0.55	0.55
May	1955	0	2	2.0	0	2.0	2.0	0.50	0.50
October	1955	0	2	2.0	0	2.0	2.0	0.25	0.25
May	1956	0	2	2.0	0	2.0	2.0	0.40	0.40
June	1958	0	2	2.0	0	2.0	2.0	0.35	0.35
June	1959	0	2	2.0	0	2.0	2.0	0.25	0.25
								(1st Mea.)	
								0.45	0.45
								(2nd Mea.)	
April	1960	0	2	2.0	0	2.0	2.0	0.25	0.25
December	1966	1.0	0	1.0	1	0	1.0	0.0	0.0
September	1970	1.0	1	2.0	0	2.0	2.0	0.75	0.75
November	1971	1.0	1	2.0	0	2.0	2.0	1.00	1.00
February	1973	1.0	1	2.0	0	2.0	2.0	1.60	1.00
								(1st Mea.)	
								1.60	
								(2nd Mea.)	
March	1973	1.0	1	2.0	0	2.0	2.0	1.40	1.00
								(1st Mea.)	
								1.40	
								(2nd Mea.)	
October	1973	0.5	.5	1.0	0	0.5	0.5	2.00	2.00
April	1974	0.5	1	1.5	0	0.5	0.5	2.30	2.30
July	1974	0.5	1	1.5	0	0.5	0.5	2.50	2.50
August	1974	0.5	1	1.5	0	0.5	0.5	2.20	2.50
November	1975	0.5	1	1.5	0	0.5	0.5	2.00	2.50
January	1976	0.5	.5+ 1		0	1+	1.0	2.00	2.00
April	1977	0.5	1	1.5	0	1.5	1.5	2.00	2.00
May	1977	0.5	1.5	2.0	0	2.0	2.0	2.00	2.00

Notes: + An additional 0.5 measure of rice was sold to residents in certain urban areas in rice deficit districts at Rs. 2.00 per measure.

Mea. = 1 measure = 2 pounds

NITP = Non-income-taxpayers, ITP = Income taxpayers

Source: Food Commissioner's Department. (Various years).

Administration report.

Gavan, J.D. and Chandrasekera, I.S. (1979). The impact of public food grain distribution on food consumption and welfare in Sri Lanka.

Ministry of Agricultural Development and Research. (1981).

Agricultural statistics of Sri Lanka, 1951/52-1980/81.

Table 2: **Per Capita Consumption of Rationed Rice and Per Capita Consumption of All Rice, 1953-1977**

Year	Rationed Rice (kg)	All Rice (kg)	Rationed Rice as a Proportion of All Rice (%)
1953	45.52	76.36	60
1954	57.11	94.30	61
1955	68.43	93.12	73
1956	72.36	93.23	78
1957	74.19	92.85	80
1958	75.96	96.39	79
1959	79.84	98.91	81
1960	81.85	101.75	80
1961	81.73	99.22	82
1962	80.43	96.38	83
1963	84.21	102.96	82
1964	83.52	98.19	85
1965	85.30	93.08	92
1966	81.45	92.27	88
1967	52.60	87.83	60
1968	41.85	86.67	48
1969	43.22	89.53	48
1970	51.27	92.87	55
1971	69.07	93.03	74
1972	60.95	87.76	69
1973	51.80	82.04	63
1974	41.81	86.26	48
1975	45.60	80.72	56
1976	44.60	81.73	55
1977	50.13	91.67	55

Source: Rationed rice: Food Commissioner's Department (various years), Administrative Report. Rice outside the ration: estimated from data given in Department of Census and Statistics (various years), Statistical Abstract of Ceylon (Sri Lanka) and Central Bank of Ceylon (Sri Lanka) (various years), Annual Report.

The price of rationed rice varied according to the fluctuations in the price of imported rice, while the quantity issued for the ration varied according to government purchases from domestic farmers and the quantity imported. The reductions in the quantity and increases in the price of rationed rice were sensitive political issues during 1953-1977, leading to downfall of several governments. Although the rationing scheme was started as a temporary relief measure during the Second World War, it was soon to become taken for granted by the majority of population.

The rice rationing scheme was heralded as a success in maintaining the nutritional standards of the Sri Lankan population; in functioning as an effective income transfer mechanism to consumers; in increasing consumer welfare; and together with free education and free health services, in contributing to admirable physical quality of life (Edirisinghe, 1982; Edirisinghe and Poleman, 1976; Gavan and Chandrasekera, 1979; Sirisena, 1986; Gunawardana, 1987).

However, mounting consumer subsidies and administrative costs of the non-targeted rationing scheme were a severe drain on the government budget. For instance, Gavan and Chandrasekera (1979) estimated the annual average consumer subsidy on all food items under ration during 1965-1976 at 165 million Rupees (imported rice valued at official exchange rate) and at 858 million Rupees (imported rice valued at premium 'Foreign Exchange Entitlement Certificates' rate). Thorebecke and Svejnar (1987) estimated the annual average consumer subsidy involved in the rationing scheme during 1961-1977 at 368 million Rupees (imported rice valued at official exchange rate). Gunawardana (1987) estimated the annual average real net cost of rationed rice to taxpayers during 1952-1978 at 264 million Rupees (imported rice valued at the average of official and 'black market premium' exchange rates). As a proportion of total government real expenditure, the real net cost of rationed rice to taxpayers varied from 5.1 per cent in 1958 to 21.9 per cent in 1974. The huge consumer subsidies involved in the rationing scheme were viewed by some as being detrimental to economic growth and employment in Sri Lanka (Snodgrass, 1966; Karunatilake, 1975; Mahalingasivam, 1978). These considerations led the government to dismantle the universal and non-targeted rationing scheme in 1978.

Targeted Rice rationing and Food Stamp Schemes

The targeting of the rationing scheme was effected in March 1978 when price subsidies and the ration were limited to households earning 300 Rupees or less per month - approximately 50 per cent of the total population. In September 1979, the rationing scheme was replaced with a 'food stamp scheme'. Under the new scheme the eligible households were given free food stamps which enabled them to purchase rice, wheat flour, bread, sugar, pulses, powdered milk and condensed milk. The households with five or less members were eligible to receive food stamps if their monthly income was less than 300 Rupees. The income limit was raised by 60 Rupees for each additional member. The value of the stamps per month depended on the age of the members of the eligible household: 25 Rupees for children aged 8 years and below; 20 Rupees for children over 8 and below 12; and 15 Rupees for persons aged 12 years and above (Abeysekera, 1982; Edirisinghe, 1987; Mateus, 1983). In 1987, the government made a change to the eligibility criterion; only two members of a household receive food stamps if the household income falls in the range of 600-700 Rupees per month. Despite this, the proportion of the total population receiving food stamps has remained around 50 per cent since the inception of the scheme (Bhalla, 1991).

Rice was the major commodity sold under the food stamp scheme. The proportion of food stamps spent on rice ranged between 70 and 90 per cent of total 'stamp expenditure', and the recipients with lower incomes spent a higher proportion of stamps on rice than those with higher incomes (Ministry of Plan Implementation, 1981). Although there were no price subsidies for rice sold under the food stamp scheme, the price of rice sold for stamps was lower than in the open market because of quality differentials in the two market segments.

The quantity of rice purchased by consumers under the targeted rationing and food stamp schemes declined from 524,047 tonnes in 1978 to 276,000 tonnes in 1989. In effect, the public sector handled about 19 to 47 per cent of the total rice absorption (defined as total marketable surplus of rice produced in the country plus imports) during 1978-1989. Thus, during this period the public sector still provided a significant part of rice consumed by the low-income households. Taking the target population as 50 per cent of the total

population, the per capita quantity of rice purchased by consumers under the targeted rationing and food stamp schemes declined from 73.86 kg in 1978 to 32.84 kg in 1989. The estimates of per capita consumption of rice in these years are 115.01 kg and 101.41 kg, respectively.

According to some writers, because of the declining value of the food stamps, and in the absence of price subsidies on rice, rice consumption of the low income consumers have declined since the withdrawal of the rationing scheme (Edirisinghe, 1987; Gooneratne and Gunawardana, 1983; Peoples Bank, 1982; Sahn, 1987). However, Sirisena (1986: 87) contends that "the increased domestic rice production and the resultant slower increase in the price of rice seemed to have mitigated the adverse effects of withdrawing the Ration scheme". Income transfers to low income consumers in the form of free food stamps spent on rice still represented a sizeable proportion of government expenditure, varying between about 2 per cent in 1984 to about 6 per cent in 1982 (Gunawardana, 1987). Mateus (1983) concluded that the food stamps scheme for rice represents a 'spectacular' improvement in the social benefit/cost ratio (42.8 for the year 1980; calculated as the percentage ratio of changes in consumer surplus and producer surplus over treasury costs) over the benefit/cost ratio (4.4 for the year 1970) of the earlier rice rationing scheme.

Further economic reforms initiated in 1989 and 1994 have resulted in significant changes in the food subsidy schemes. In 1989, the cash value of food stamps was doubled and the food stamp scheme was better targeted to cover only the families entitled to assistance under the *Janasaviya* scheme. This scheme was a poverty alleviation program which aimed at providing direct income transfers for 50 per cent of the (poor) population over a two year period during which the recipients were expected to develop necessary skills for self employment (Gunawardana and Somaratne, 1996). There are no records of rice issues under the food stamp scheme after 1991, and since that year the public rice distribution schemes in Sri Lanka has effectively ended. The present government introduced a generalised wheat flour subsidy in 1994, thus deviating from the concept of targeted subsidy schemes. This resulted in the distortions of relative prices among wheat flour, rice and other food crops, apart from creating a huge burden on the government budget. Therefore, in 1995 the wheat flour subsidy was partially removed.

III. ANALYTICAL FRAMEWORK

In this section, a model of the open market demand for rice is developed and empirical procedures are specified, in order to analyse separately the effects of the *non-targeted rationing scheme (1953-1977)* and the *targeted rationing and food stamp schemes (1978-1989)* on the open market demand and total consumption of rice in Sri Lanka.

The Model

Open market demand for rice is modelled here for a 'representative' utility maximising consumer. The following assumptions are made for the purpose of the analysis: the consumer is a 'price taker' in the markets for rice and other commodities; the consumer obtains all of the concessional issues of rice as well as purchases rice in the open market (however, no particular order of purchases is assumed); the consumer does not re-sell concessional rice, ration coupons or the food stamps; rationing is 'effective' for the consumer, meaning that rice is rationed at a lower level than the quantity that the consumer would purchase in the open market at the given price of rice. [When rationing is effective for all individuals in a population, rationing is said to be 'completely effective' (Tobin, 1952)].

Given these assumptions, the consumer maximises utility (U) from the quantity of open market rice (Q_o), rice issued by the government in the concessional market (Q_c) and other commodities (Q_z), subject to the price of rice in the open market (P_o), prices of other commodities (P_z), quantity of rice issued in the concessional market (Q_c) and consumer income less the expenditure on concessional rice (Y^*). That is:

$$\text{Max } U = U(Q_o, Q_c, Q_z) \quad (1)$$

$$\text{s.t.: } P_o, Q_c, P_z \text{ and } Y^*.$$

where, $Y^* = Y - P_c(Q_c)$; Y is total consumer income and P_c is the price of rice sold in the concessional market.

Food prepared from wheat flour (mainly bread) is the main substitute for rice, and hence P_z (prices of other commodities) are represented by P_w (price of wheat flour). Assume that the prices of rice, wheat flour and other commodities always change in the same proportion. Then, using the *composite commodity theorem* (see Henderson and Quandt,

(1980, pp. 48-49), the representative consumer's demand function for open market rice can be specified as:

$$Q_0 = f(P_0, P_w, Q_C, Y^*) \quad (2)$$

Empirical Procedures

The empirical form of the demand equation to be estimated is specified as:

$$Q_0 = \alpha + \beta_1 P_0 + \beta_2 P_w + \beta_3 Q_C + \beta_4 Q_{C_T} + \beta_5 Y^* + \epsilon \quad (3)$$

where, Q_0 is per capita quantity of rice demanded in the open market (in kg), P_0 is the real retail price of rice in the open market (Rs per kg), P_w is the real retail price of wheat flour (Rs per kg), Q_C is per capita quantity of rice issued to consumers under the *non-targeted rationing scheme* (in kg; from 1953 to 1977), Q_{C_T} is per capita quantity of rice issued to consumers under the *targeted rationing and food stamp schemes* (in kg; from 1978 to 1989), and Y^* is per capita real income less per capita expenditure on rice bought in the concessional market. The prices of rice and wheat flour are deflated by the Colombo Consumer Non-Food Price Index (1952 = 100).

Subject to the assumption that rationing is completely effective, Ahmed (1979), Chellaraj and Brorsen (1988), and Chellaraj, Brorsen and Farris (1992) also included concessional issues (ration) in open (commercial) market demand functions in their empirical estimations. The per capita income variable (Y^*) excludes the per capita expenditure on concessional rice consumed. The exclusion is necessary to avoid duplication of income which enters the demand functions in the form of expenditure on concessional rice in the presence of rationing and price subsidies (Tobin and Hourhakker, 1951; Latham, 1980).

The parameters to be estimated in equation (3) are as follows: α is the intercept, β_1, \dots, β_5 are partial slope coefficients associated with the respective independent variables, and ϵ is the error term. The following hypotheses are formed in relation to the signs of slope coefficients:

$\beta_1 < 0$; $\beta_2 > 0$; $\beta_3 < 0$; $\beta_4 < 0$; and $\beta_5 > 0$ if open market rice is a normal good, and $\beta_5 < 0$ if it is an inferior good.

If each unit of rice issued in the concessional market leads to one less unit being purchased in the open market, then $\beta_3; \beta_4 = -1$, and there will not be an increase in the total consumption of rice as a result of concessional issues of rice. At the other extreme, if $\beta_3; \beta_4 = 0$, there will be no replacement of the quantity demanded in the open market by the concessional issues of rice, and all issues will be an addition to the total consumption of rice.

In between these two extremes, if $\beta_3; \beta_4 < 1$ (*expressed in absolute values*), this indicates that the quantity of rice demanded in the open market is reduced to the extent of the magnitude of $\beta_3; \beta_4$. Following Chellaraj, Brorsen and Farris (1992), such reduction in the quantity of rice demanded in the open market is termed "*leakage*", and taking QC_R as an example the average leakage (L) at a given price is calculated as:

$$L = \beta_3 \times (QC_R^*) \quad (4)$$

where QC_R^* is the average quantity of concessional issues of rice during the period under study.

The average percentage leakage (L^*) through the public distribution system is calculated as:

$$L^* = (L / QC_R^*) \times 100 \quad (5)$$

or, simply as: $\beta_3 \times 100$.

The extent of increase in total consumption of rice (ΔD) due to public distribution is shown by:

$$\Delta D = 1 - \beta_3 \quad (6)$$

Here, the absolute magnitude of β_3 is included.

The average increase in total consumption (ΔD^*) is calculated as:

$$\Delta D^* = (1 - \beta_3) \times QC_R^* \quad (7)$$

The average percentage increase in total consumption (ΔD^{**}) is then calculated as:

$$\Delta D^{**} = (\Delta D^* / QC_R^*) \times 100 \quad (8)$$

or, simply as: $(1 - \beta_3) \times 100$.

The leakage (L) and the addition to total consumption (ΔD^*) for each year in the period under study can be calculated using equations (4) and (7) respectively, replacing QC_R^* in each equation with QC_R^1 (concessional issues of rice in each year).

Data

Data used in the empirical estimation of the demand equation for the period 1953 to 1989 are presented in Table 3.³

The quantity transacted in the open market includes the quantity of own produce consumed by farm families. This is unavoidable because separate data on open market rice transactions are not available. Thus, the *per capita* quantity of rice in the open market was estimated as follows:

$$Q_o = [QT - (S + W + QSG)] / POP \quad (9)$$

where, Q_o is the quantity of rice in the open market, QT is the total output of rice, S is the estimated quantity retained for seed by farmers, W is the estimated waste (on-farm and off-farm), QSG is the quantity sold to the government by farmers, and POP is the total population.

Although the rice issues in the concessional market are automatically adjusted to stocks held by the government, open market quantity cannot be adjusted to changes in privately held stocks since data are not available in this regard.

³The data series used in the estimation (presented in Table 3) were constructed from data obtained from the following sources: Central Bank of Ceylon (various years; 1989); Department of Census and Statistics (various years); Food Commissioner's Department (various years); Gavan and Chandrasekera (1979); Goldman and Timmer (1982); and the Ministry of Agricultural Development and Research (1981).

Table 3: **Data Used in the Estimation: Demand for Rice in the Open market in Sri Lanka, 1953-89**

Year	Q_0	P_0	P_w	QC_R	QC_F	Y^*
1953	30.84	1.06	0.48	45.52		496.26
1954	37.19	1.02	0.56	57.11		525.93
1955	24.70	0.93	0.53	68.43		570.44
1956	20.88	0.91	0.51	72.36		534.36
1957	18.66	0.89	0.51	74.19		509.54
1958	20.43	0.87	0.49	75.96		519.44
1959	19.07	0.86	0.48	79.84		551.00
1960	19.90	0.85	0.47	81.85		564.94
1961	17.49	0.81	0.49	81.73		572.40
1962	15.95	0.79	0.54	80.43		566.67
1963	18.75	0.77	0.48	84.21		566.94
1964	14.67	0.79	0.42	83.52		577.20
1965	7.77	0.79	0.42	85.30		576.62
1966	10.82	0.82	0.47	81.45		580.60
1967	35.23	1.05	0.61	52.60		610.61
1968	44.82	1.09	0.60	41.85		679.63
1969	46.31	1.00	0.54	43.21		670.32
1970	41.59	0.96	0.52	51.27		667.20
1971	23.96	0.91	0.50	69.07		637.21
1972	26.81	0.83	0.47	60.95		633.94
1973	30.24	1.13	0.65	51.80		679.21
1974	44.44	1.81	1.08	41.81		767.80
1975	35.13	1.76	1.29	45.59		790.47
1976	37.13	1.69	0.98	44.60		851.33
1977	41.54	1.65	0.78	50.13		1186.80
1978	41.15	1.49	0.90		73.86	1220.40
1979	47.94	1.61	1.16		73.98	1322.30
1980	70.95	1.66	1.74		37.34	1289.20
1981	77.30	1.85	1.75		21.23	1346.90
1982	75.65	1.84	1.55		21.18	1426.00
1983	75.46	1.64	1.54		18.19	1517.80
1984	79.18	1.61	1.48		21.55	1586.50
1985	89.48	1.64	1.11		22.73	1639.00
1986	83.24	1.50	1.25		21.59	1681.90
1987	70.01	1.51	1.30		29.95	1675.30
1988	79.39	1.42	1.26		25.80	1701.20
1989	68.57	1.65	1.38		32.84	1707.90

Variable definitions: *dependent variable:* Q_0 : per capita quantity of rice demanded in the open market (kg); *independent variables:* P_0 : real retail price of rice in the open market (Rs/kg); P_w : real retail price of wheat flour (Rs/kg); QC_R : per capita quantity of rice issued under non-targeted rationing scheme, 1953-1977 (kg); QC_F : per capita quantity of rice issued under targeted rationing and food stamp schemes, 1978-1989 (kg); Y^* : per capita real income less per capita expenditure on rice bought in the concessional market (Rs). Note: The target population is taken as 50 per cent of the total population in calculating QC_F for the period 1978 to 1989.

IV. RESULTS AND DISCUSSION

Estimated Equation

The estimated demand equation is subjected to two types of statistical and econometric tests, that is, tests of statistical significance and diagnostic tests. Statistical significance tests include R^2 , adjusted R^2 , F and t -ratio tests. A selected set of diagnostic tests is used to evaluate the compliance of the estimates with the underlying assumptions of regression analysis. These tests are: Lagrange multiplier (LM) test of residual serial correlation, Ramsey's specification error test (RESET, F -test), the Jarque-Bera LM test of the normality of residuals, and the LM test of heteroscedasticity which is based on an auxiliary regression (see, Pesaran and Pesaran, 1991).

The demand equation was estimated using linear and log-log functional forms. The log-log functional form produced unsatisfactory results in terms of signs of the estimated coefficients and statistical/diagnostic tests. Hence, only the estimates based on the linear form are presented (see Table 4) and discussed below.

In the estimated demand equation, all the coefficients are 'correctly' signed, but the coefficient associated with the price of wheat flour (P_w) is not statistically significant at the 5 per cent level. The hypotheses in relation to the presence of serial correlation of residuals, mis-specification of functional form, non-normality and heteroscedasticity (non-constant variance of residuals) are rejected at the 5 per cent level of significance. Thus, the estimated equation is reasonably satisfactory in statistical terms.

The results highlight some important features in relation to the demand for rice in the open (commercial) market in Sri Lanka. First, the price of rice itself has a negative but statistically significant influence on the quantity of rice demanded in the open market. Second, although wheat flour can be categorised as a substitute for rice, the impact of the price of wheat flour on the quantity of rice demanded in the open market is statistically insignificant.

Table 4: **Estimated Demand Function for Rice in the Open Market
in Sri Lanka, 1953-89**

Variable	Coefficient	t value
P_o	-11.222**	-2.310
P_w	5.934	1.162
QC_R	-0.733*	-9.477
QC_T	-0.512*	-8.140
Y^*	0.018*	3.947
Constant	71.389*	7.720
R^2	0.97	
adjusted R^2	0.96	
$F_{(5,31)}$	195.63*	
<u>Diagnostics</u>		<u>prob. value</u>
Serial correlation;	$\chi^2(1)$: 0.424	0.51
Specification error:		
RESET(2);	$F_{(1,30)}$: 2.023	0.12
Non-normality;	$\chi^2(2)$: 0.775	0.68
Heteroscedasticity;	$\chi^2(1)$: 2.345	0.13

* Significant at the 1 per cent level.

** Significant at the 5 per cent level.

Variable definitions: *dependent variable:* Q_o : per capita quantity of rice demanded in the open market; *independent variables:* P_o : real retail price of rice in the open market; P_w : real retail price of wheat flour; QC_R : per capita quantity of rice issued under non-targeted rationing scheme (1953-1977); QC_T : per capita quantity of rice issued under targeted rationing and food stamp schemes (1978-1989); Y^* : per capita real income less per capita expenditure on rice bought in the concessional market.

Third, the concessional issues of rice under both the non-targeted rationing scheme and targeted rationing/food stamp schemes have a negative and statistically significant impact on the quantity of rice demanded in the open market. Fourth, consumer income has a positive and statistically significant impact on the quantity of rice demanded in the open market, indicating that open market rice is a normal good.

Price and Income Elasticities

The price elasticity of demand for open market rice, calculated at the mean values of price and quantity demanded, is -0.33 which suggests that a 10 per cent increase in the open market rice, *ceteris paribus*, decreases the quantity of rice demanded in the open market by 3.3 per cent. The cross-price elasticity of demand is 0.12 which indicates that a 10 per cent increase in the price of wheat flour, *ceteris paribus*, results in a 1.2 per cent increase in the quantity of rice demanded in the open market. Income elasticity (0.39) indicates that a 10 per cent increase in consumer income, *ceteris paribus*, leads to a 3.9 per cent increase in the quantity of rice demanded in the open market.

Effects of Public Distribution of Rice

According to the estimates of this study, in the case of Sri Lanka, 1 kilogramme of rice issued under the non-targeted rationing scheme, *ceteris paribus*, resulted in a 0.73 kilogram reduction of the quantity of rice demanded in the open market. This is comparable with Ahmed's (1979) finding that, in the case of Bangladesh, 1 kilogramme of rice issued to consumers under the rationing scheme led to a 0.92 kilogramme reduction of the quantity of rice demanded in the open market. In the case of Sri Lanka, 1 kilogram of rice issued under the *targeted rationing and food stamp schemes*, *ceteris paribus*, resulted in a 0.51 kilogram reduction in the quantity of rice demanded in the open market.

The results also show that from the consumers' perspective, rice issued under public food distribution schemes in Sri Lanka was *not* a perfect substitute for open market rice. This 'imperfect substitution' is also reported in the case of rice in Bangladesh (Ahmed, 1979) and Tamil Nadu, India (Chellaraj and Brorsen, 1988), and in the case of wheat in India (Chellaraj, Brorsen and Farris (1992).

The average percentage reduction in the quantity of rice demanded in the open market (the average percentage leakage) in Sri Lanka has been higher under the *non-targeted rationing scheme* during 1953-1977 (73 per cent), than under the *targeted rationing and food stamp schemes* during 1978-1989 (51 per cent). Conversely, the addition to the total consumption of rice through the public food distribution system has been greater under the *targeted rationing and food stamp schemes* (49 per cent) than under the *non-targeted rationing scheme* (27 per cent).

The estimated annual average reduction in the quantity of rice demanded in the open market as a result of concessional issues ('leakage') under the *non-targeted rationing scheme* during 1953-1977 is 346,420 tonnes. The annual average addition to the total consumption of rice from this scheme is estimated at 128,128 tonnes. The annual average 'leakage' from the *targeted rationing and food stamp schemes* during 1978-1989 is estimated at 42,065 tonnes, and the estimated annual average addition to the total consumption from these schemes is 40,416 tonnes.

V. CONCLUSION

This paper has been concerned with an analysis of the effects of public rice distribution schemes operating in Sri Lanka during the period 1953-1989 on the quantity of rice demanded in the open (commercial) market, as well as the total quantity of rice consumed in the country. To this end, a model of a representative consumer's demand for open market rice was developed and estimated. In the estimated model the price of rice in the open market has a negative and statistically significant impact, while the price of wheat flour has a positive, but insignificant, effect on the quantity of rice demanded in the open market. Consumer income has a positive and significant impact on the quantity demanded. The quantity of rice issued under the *non-targeted rationing scheme* (1953-1977) and the quantity of rice issued under the *targeted rationing and food stamp schemes* (1978-1989), both have negative and statistically significant impact on the quantity demanded in the open market.

According to the analysis, under both *non-targeted rationing scheme* and *targeted rationing and food stamp schemes* in Sri Lanka, each unit of rice issued in the concessional market has reduced the quantity of rice demanded in the open market by less than one unit. However, the concessional issues of rice under both schemes have served more to replace the quantity of rice demanded in the open market rather than to increase the total consumption of rice.

The estimates show that under the *non-targeted rationing scheme* during 1953-1977, on average, 73 per cent of the concessional issues of rice has served to replace a potential quantity that would have been demanded by consumers in the open market, while the remaining 27 per cent has served as an addition to the total quantity of rice consumed in the country. Under the *targeted rationing and food stamp schemes* during 1978-1989, however, the estimated average replacement of the quantity of open market rice due to concessional sales is 51 percent, and the addition to the total consumption of rice, especially of those on low incomes, is estimated at 49 per cent. The lower percentage 'leakage' and the larger percentage addition to the total consumption of rice under the targeted rationing and food stamp schemes suggest that the targeting of public rice distribution during 1978-1989 was fairly successful in maintaining the consumption of rice among low-income households in Sri Lanka.

The analysis in this paper was conducted at the aggregate level, that is, for the entire country. A suggested extension of this study might be to carry out separate analyses according to income groups and sectors of the country (urban, rural, estate). This would be of interest because there have been variations in the quantities of rice obtained under the rationing and food stamp schemes by different income groups and different sectors of the country (Department of Census and Statistics, 1973; Central Bank of Ceylon, 1974; 1983). However, it should be noted that such a disaggregate analysis is not possible in the case of Sri Lanka due to the lack of necessary time series data.

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