

## Chapter IX

### Rice Exports and Food Security - An Econometric Model

#### 9.0 Introduction:

A large proportion of India's population does not have regular and assured access to adequate quantities of food. Per capita food consumption is not only low but also has been declining since 1950. Given the large output fluctuations, arising out of the vagaries of weather, and the low price elasticity of demand for foodgrains in the country, prices tend to fluctuate considerably from year to year. Government intervention in India is intended to reduce the impact of these fluctuations on vulnerable sections of the population by supplying foodgrains at subsidised prices. While government interventions have succeeded, to a large extent, in averting large-scale famines in the Independent India, the problem of hunger still persists "since the production of foodgrains as a whole has stagnated in per capita terms, output fluctuations are clearly relevant to price movements in a period characterised by a growth, albeit modest, in real incomes per capita" (Krishnaji, 1990:15).

To reduce the food inflationary tendencies in the economy, arising out of output fluctuations, the government has adopted stock building operations from internal procurement of the grain. However, the stock management, instead of stabilising the supplies, has contributed to the food inflation and to the disadvantage of the consumer.

Foodgrain stocks are increasing with the government even as per capita consumption in the aggregate terms actually declined, because the good harvests of late-seventies and early-eighties have been utilised for stock building than checking the inflationary tendencies and improving the levels of availability (Krishnaji, *Ibid.*). This rise in cereal prices resulted in, according to some economists, falling per capita consumption of cereals. Some others argue that falling per capita consumption levels are mainly due to the shifting of preferences from cereals to non-cereals (Radhakrishna and Ravi, 1990).

Moreover, from mid-1991 trade liberalisation and agro-export promotion measures are initiated under the Structural Adjustment Programmes (SAP). Reliance on external markets, instead of domestic market, for clearing the excess stocks may give rise to inflationary tendencies in the economy further. Though India has achieved moderate success in combating transitory food insecurity caused by crop failures it failed in combating chronic food insecurity. An unbridled export of foodgrains, without improving the levels of living, has the potential to affect the poor with the rise in domestic prices in the process. "The strategy adopted in the mid-sixties to achieve self-sufficiency in foodgrains seems to have aggravated chronic food insecurity in the less endowed regions" (Radhakrishna and Hanumantha Rao, 1994).

In this context, it is important to examine the implications of rice exports on domestic rice prices and availabilities. In this chapter, we would examine the nature of government intervention, trends in output and prices, review of received literature and finally the formulation and estimation of an econometric model. This chapter is divided into three sections. Nature and objectives of government operations in Indian foodgrain markets are discussed in section 9.1. Section 9.2 examines the trends in rice and cereal prices. Section 9.3 reviews the empirical literature on determination of domestic rice prices. In Section 9.4 we present the model specification, estimation and results of price formation of rice in dual market framework.

### **9.1 Government Operations in India's Foodgrain Economy:**

The need for evolving a comprehensive food policy in India was felt for the first time after the Bengal Famine of 1943 and following the recommendations of the Food Policy Committee, 1943 (GOI, 1944). Since then the government has been an active partner in the management of the country's food economy. Government intervention in the foodgrain market can be viewed broadly from four angles. First, there is a system of public procurement of foodgrain and support prices. Secondly, the state manages food stocks for distribution and buffer stock operations. Thirdly, there is a state guided system of delivery of cheap food through net work of fair price shops (FPS) known as public

distribution system. Fourthly, government intervenes in trade both internal and external viz., legal controls on hoarding and other aspects of internal trade and restrictions on external trade. Let us examine the objectives and nature of government intervention in India's foodgrain sector.

In a situation of food shortages foodgrain prices rise. Since the purchasing power differs across regions, there is every possibility of the grain moving from surplus to deficit producing regions. High prices may prevail throughout the country, if private trade movements are not regulated. This would result in distress to the vulnerable sections of population. Public distribution of foodgrains to these vulnerable sections would assume prominence because during the periods of scarcity, one is not sure that market mechanism and private trade would function effectively in distributing the available supplies equally across the regions without excessive rise in prices. Thus it is recognised that 'poverty considerations' compelled India to sustain publicly sponsored foodgrain procurement, storage and distribution.

The procurement operations came into existence with the Bengal famine of 1943. In 1950 Government of India appointed the Foodgrains Procurement Committee under the chairmanship of Tirumal Rao. The Committee recommended "that a uniform system of procurement must be established which gives a monopoly of grain to government at the first point of marketing" (GOI, 1950). The Committee called this system as 'monopoly procurement'. States are free to determine specific procurement methods. Since the state governments have changed the procurement methods frequently, there is no uniformity in procurement methods over a period of time, or at a given period of time. There are different methods of procurement which include compulsory levy on producers, millers or traders, monopoly purchases, and pre-emptive purchase in the market (Appendix Table 9.1).

The procurement operations were facilitated through restrictions on movement of foodgrain by private trade, particularly of rice and wheat from one region to another. These restrictions are mainly intended to check undue rise in prices in surplus regions and thereby to help the procurement effort. The zoning restrictions varied over time for different regions and for crops, particularly rice and wheat. However, most of the zonal restrictions were abolished since 1977. Single state zones existed for some time and regional zones consisting of a few states were created later. In some cases, the state governments have imposed restrictions on inter-district movement. When the government have enough stocks to meet the public distribution requirements, the food zones were dismantled and free market was allowed to function. The Food Corporation of India (FCI) is the largest agency involved in foodgrain operations on behalf of the Government of India. In addition to procurement, FCI is also involved in storage, marketing and distribution of foodgrains. In addition to FCI, other agencies engaged in procurement operation in various states are the State Food and Civil Supplies and Departments, the State Food and Civil Supplies Corporation and the State Co-operative marketing federation. After meeting the state's minimum requirements the foodgrain procured by these agencies are handed over to the FCI for the central pool. Until, recently, the FCI was the only agency authorised for inter-state movement of foodgrains. The minimum support prices for rice and wheat are set by the Central government in every season on the basis of the recommendations of Agricultural Costs and Prices (CACP) and it buys all the grain offered for sale at these prices. Support prices become floor prices in periods of bumper harvests. For rice and wheat, there was a clear distinction between support price and procurement price. However, this distinction between these prices had begun get blurred since 1973. CACP fixes procurement price on the basis of several criteria viz., cost-plus pricing, principles of parity, over all price situation, etc.

In 1993-94, 14.5 million tonnes of rice, 13 million tonnes of wheat were procured which constituted 20 and 46 per cent of the respective production levels in that year. Rice and wheat accounted for the entire procurement and the bulk of procurement came from Punjab. Procurement of these two crops together has increased from about 9 million

tonnes in 1971 to 28 million tonnes in 1993. Share of rice in total procurement has increased from 39 per cent in 1971 to 52 per cent in 1993 while share of wheat has fallen from 57 per cent to 46 per cent for the same period. The proportion of rice production has also increased from 8 per cent to 20 per cent during 1971- 1993 while for wheat it has fallen from 57 per cent to 46 per cent (Table 9.1.1 and 9.1.2). The amount of rice distributed through public distribution system has exceeded the quantum of procurement until 1983 and the reversed happened after that as a result foodgrain stocks with the FCI have increased and amounted to 23 million tonnes in 1993 (Table 9.1.1).

**Table 9.1.1**

**Quantum of Procurement of Rice, Wheat and Total Foodgrains, Public Distribution Sales (PDS) of Rice and Total Closing Stocks with FCI (Million Tonnes)**

Year	Procurement			PDS Sales Rice	Stocks Rice	Total Stocks
	Rice	Wheat	Foodgrains			
1971	3.5	5.1	8.9	3.2	2.4	7.6
1972	2.6	5.0	7.7	3.7	1.4	3.3
1973	3.5	4.5	8.4	3.2	1.4	2.6
1974	3.5	1.9	5.7	3.8	1.4	2.8
1975	5.0	4.1	9.6	3.2	2.8	7.9
1976	6.0	6.6	12.9	3.6	5.7	18.2
1977	4.7	5.2	10.0	4.6	5.6	17.2
1978	5.6	5.5	11.1	3.2	8.0	17.1
1979	5.7	8.0	13.8	4.1	9.1	17.4
1980	5.2	5.9	11.2	6.1	6.6	11.6
1981	6.2	6.6	13.0	6.4	6.2	11.4
1982	7.5	7.7	15.4	7.5	5.4	12.6
1983	7.2	8.3	15.6	7.9	4.7	15.4
1984	9.3	9.3	18.7	6.7	7.8	22.5
1985	9.6	10.4	20.1	7.2	9.9	25.0
1986	9.1	10.5	19.7	8.5	9.5	23.6
1987	7.7	7.9	15.7	9.8	6.4	14.0
1988	7.3	6.6	14.1	9.7	4.6	9.4
1989	9.9	8.9	18.9	8.7	6.1	12.1
1990	12.8	11.1	24.2	9.0	9.5	18.9
1991	11.7	7.8	19.6	11.3	9.3	14.7
1993	14.5	12.8	28.0	10.5	12.0	23.1

Source: *Bulletin on Food Statistics*, Dept of Food and Agriculture, GOI, Various Issues, CMIE, 1996.

Notes :@ procurement price of paddy (common) for the agricultural year (July-June).  
 Production figures relate to agricultural year.  
 Quantum of procurement, closing stocks, and PDS sales relate to calendar year (January-December).  
 From 1991-92 the term procurement price is renamed as minimum support price.

**Table 9.1.2**  
**Shares of Rice and Wheat Procurement in Total Foodgrain Procurement**  
**and the Proportion of Rice and Wheat Procurement in Production (%)**

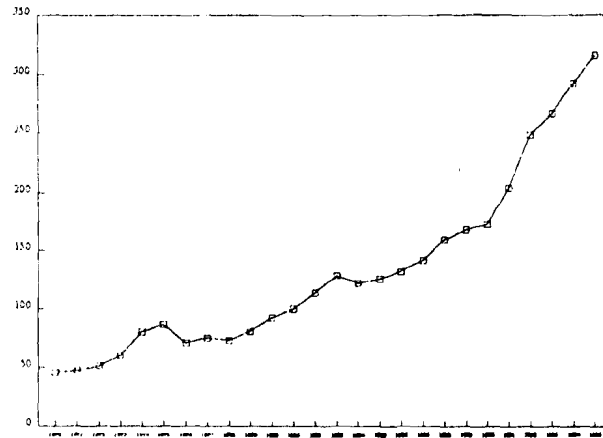
Year	Share in Total Procurement			Proportion of Procurement	
	Rice	Wheat	Total	Rice	Wheat
1971	39.1	57.4	96.5	8.2	57.4
1972	33.2	65.4	98.7	5.9	65.4
1973	41.1	53.8	94.9	8.8	53.8
1974	61.6	33.5	95.0	7.9	33.5
1975	52.7	42.9	95.6	12.7	42.9
1976	46.7	51.5	98.2	12.3	51.5
1977	46.7	51.9	98.6	11.1	51.9
1978	50.0	49.3	99.3	10.5	49.3
1979	41.3	57.8	99.1	10.6	57.8
1980	46.6	52.5	99.1	12.3	52.5
1981	47.8	50.8	98.5	11.6	50.8
1982	48.5	50.1	98.6	14.0	50.1
1983	46.3	53.1	99.4	15.3	53.1
1984	49.7	49.7	99.5	15.5	49.7
1985	47.6	51.5	99.1	16.4	51.5
1986	46.3	53.4	99.7	14.3	53.4
1987	49.3	50.2	99.5	12.8	50.2
1988	52.2	46.6	98.8	12.9	46.6
1989	52.3	47.3	99.5	14.0	47.3
1990	52.9	45.7	98.6	17.4	45.7
1991	59.6	39.5	99.1	15.7	39.5
1993	51.7	45.8	97.6	19.9	45.8

## Section 9.2: Trends in Rice Prices

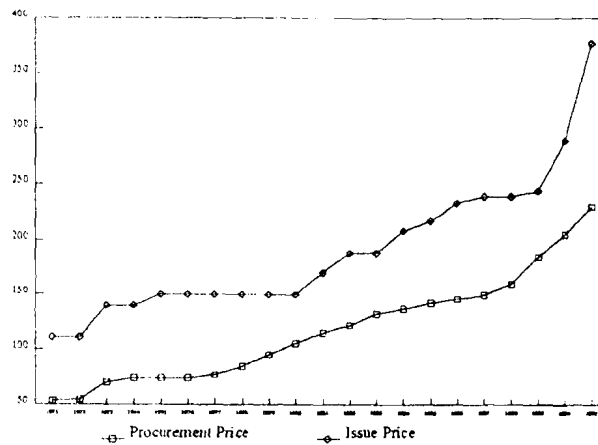
Foodgrain prices in general and rice prices in particular have been increasing at a rate higher than production. They exhibited a staircase type of movement remaining steady when production is rising, and increasing when production shortfalls occur (Fig 9.1). This is mainly because "during years of good harvest the surpluses have gone into stock building and not been used for bringing down prices in accordance with normal market functioning" (Krishnaji, 1988:62). This is evident from the coefficient of variation of per capita production and availability of rice and cereals (Table 9.2.2). This demonstrates that the stocks have not been used in stabilising the fluctuations in domestic production. It is generally believed that whenever there is a procurement, the open market price goes up to enable the farmer to receive the weighted price for his total sales which is not less than what he would have received in the absence of procurement. In the case of Andhra Pradesh, Radhakrishna and Indrakant (1988) have shown that procurement of 1 million tonne of rice for buffer stocks would increase the open market price by 25 per cent and the weighted price by 10 per cent; on the other hand, procurement of 1 million tonne and its distribution through PDS would increase the open market price by 4 per cent but the weighted price would remain the same.

Not only the open market prices, but also the procurement and issue prices exhibited similar patterns. Movements in procurement prices exhibited a downward rigidity in the sense that they have been either kept stable or revised upwards irrespective of production levels. Since the procurement price has been an assured support price, market price movements closely followed those of the former (Fig 9.2).

**Fig 9.1: Trends in Wholesale Rice Price Index (1981-82=100)**



**Fig 9.2: Trends in Issue and Procurement Prices (Rs/Qtl)**



**Table 9.2.1**  
**Per Capita Net Production, Net Availability, and Wholesale Price Index of Rice and Total Cereals**

Year	Net Availability		Wholesale Price Index		Procurement Price (Rs/Quintal)	Issue Price
	Rice (Grams/day)	Cereals	Rice (1981-82=100)	Cereals		
1971	192.6	417.6	46.7	47.4	53.1	111.0
1972	197.8	419.1	50.8	52.3	54.2	111.0
1973	172.0	380.5	59.7	60.4	70.0	140.0
1974	190.4	410.4	79.2	83.6	74.0	140.0
1975	158.9	365.8	85.3	87.1	74.0	150.0
1976	187.2	373.8	70.2	71.1	74.0	150.0
1977	168.8	386.3	74.1	75.6	77.0	150.0
1978	196.2	422.5	72.1	74.2	85.0	150.0
1979	200.3	431.8	79.5	78.4	95.0	150.0
1980	166.1	379.5	91.4	88.9	105.0	150.0
1981	197.8	417.3	100.0	100.0	115.0	170.0
1982	192.9	415.6	113.5	109.0	122.0	188.0
1983	169.8	397.8	128.7	121.3	132.0	188.0
1984	197.8	437.8	122.2	115.6	137.0	208.0
1985	189.0	415.6	125.3	119.7	142.0	217.0
1986	212.3	434.2	132.1	128.3	146.0	233.0
1987	206.3	435.4	141.2	134.9	150.0	239.0
1988	188.5	411.8	159.1	152.2	160.0	239.0
1989	215.6	452.6	167.7	161.0	185.0	244.0
1990	212.6	432.6	172.6	162.5	205.0	289.0
1991	227.3	471.2	203.2	197.5	230.0	377.0

Source: *Bulletin on Food Statistics*, Various issues *Index Numbers of Wholesale Prices in India*: Office of the Economic Advisor, Ministry of Industry, GOI, Various Issues.

Notes : Net Availability=Net Production + Net Imports + Change in Government Stocks

**Table 9.2.2**  
**Fluctuations in Production and Availability**

Commodity Statistic		Net Production	Net Availability
Rice	Mean	183.2	192.4
	C.V.(%)	9.7	9.0
Cereals	Mean	416.2	414.7
	C.V.(%)	9.9	6.3

Note: C.V. refers to the coefficient of variation

### 9.3 Review of Literature on Market Price Determination of Foodgrains in India:

Mellor and Dar (1968) explained variations in the index of all-India foodgrain prices in terms of excess demand<sup>1</sup> during the last two years and money supply with the public during the current period. For subsequent years, it was adjusted for changes in population and per capita income<sup>2</sup>. This formulation explained 83 per cent of the variation

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<sup>1</sup>In this framework, demand for foodgrains in 1949-50 was taken as equal to the actual supply of foodgrains in 1949-50. Supply was estimated as sum of the net production, imports and changes in government stocks of foodgrains.

$$D_t = L_t [Q(1 + (kY/Y))^b]$$

Where  $D_t$  = Aggregate Real Demand for the foodgrains in period  $t$

$L_t$  = Population in period  $t$

$Q$  = Per capita consumption of foodgrains in 1949-50

$Y$  = Per capita income in 1949-50

$kY$  = Change in per capita real income by period  $t$

$b$  = Income elasticity of demand for foodgrains, which was taken 0.5 from the projections of NCAER for long term projections of demand and supply of selected agricultural commodities for 1960-61 to 1975-76.

in foodgrain prices with significant coefficients. The coefficient of excess demand variable in (t-2) period, turned out to be greater than in (t-1) period.

Divatia and Pani (1968) used a Nerlovian type of expectation model to explain price variations for the period 1951-52 to 1966-67. The price variations according to them are due to the expected level of stocks of goods or the difference between the stocks of commodities held and stocks desired to be held during any period. Their model comprised of five equations. However, due to the non-availability of data on some of the variables of the model, the system of equations were reduced to a single equation, which had only observable variables. The explanatory variables included in the model are supply of cereals available for consumption in the current and previous year, real income of the non-agricultural sector, total monetary resources with public, lagged cereal prices and a dummy to represent the government intervention in the cereal sector since 1962-63. Supply of cereals was measured as total cereals plus imports. The results show that the elasticity of cereal prices with respect to its lagged year's supply was much higher than the current year's supply. Only the coefficients of lagged supply and lagged prices are statistically significant.

NCAER study (1969) examined wheat price variations in terms of money supply with public and per capita availability of wheat from domestic production. The model explained 86 per cent variation in cereal prices with all coefficients statistically significant.

Thamarajakshi (1970a) and (1970b) explained variations in rice and wheat prices for the period 1952-53 to 1967-68 in terms of per capita availability, money supply with public. Various alternative specifications were tried. Only money supply turned out to be significant. Variables like per capita availability were not significant even at 10 per cent level in both the equations.

Ray (1972) used determinants like gross per capita availability in the current and previous period and money supply to explain variations in prices for the period 1952 to

1968. In the case of wheat, per capita availability is calculated from domestic production only. This equation explained 94 per cent variations in prices with all variables statistically significant at 5 per cent level.

The above studies do not take into account government intervention explicitly or implicitly. It was Krishnaji (1972) who introduced government intervention in the explanation of wheat price movements. Wheat price variations are explained in terms of excess demand and the government intervention, in terms of support operations and imposition of zoning, through the dummy variables. Three dummies in all, two for zoning (large and single state zoning) and one for support operations were created. Issues through public distribution system is used as a proxy for excess demand. The hypothesis underlying this proxy is that in case of excess demand in the open market, pressure on public distribution system would mount-up resulting in an increased off-take, and vice versa. This equation is estimated for the period 1951-52 to 1971-72. Dummy variables, which represent the large and single state zoning, found to be insignificant.

Gulati (1987) in contrast to Krishnaji took closing stocks as a proxy for excess demand. Wheat price equation is specified as a function of closing stocks (proxy for excess demand), procurement price and zonal restrictions. The hypothesis in this study is that the procurement price actually paid sets a floor to the open market price. When excess demand develops in the market, there will be pressure on the public distribution system for more issues and hence the government stocks at the end of the year depleted and vice versa. No distinction is made between the large and single-state zoning. This equation is estimated for the period 1965-66 to 1981-82. Adjusted price index is used instead of Economic Advisors wholesale price index to represent price variable. This variable is obtained by purging the centres that quote issue prices. Nearly 94 per cent of the variation in wheat prices is explained by this formulation. Procurement price of wheat is found to have strongest impact on open wheat prices with an elasticity of 1.33. All the coefficients are statistically significant at 1 per cent level except zoning. Gulati (1990) estimated a similar equation for rice also. Procurement price found to have the strongest

impact on rice prices with an elasticity greater than unity. Impact of procurement price of rice on open market rice price is greater than the impact of wheat procurement price on open market wheat prices. The coefficient of closing stocks of rice is significant only at 10 per cent level.

Bhujanga Rao (1987) estimated a reduced form price equation which includes ratio of money supply to gross domestic product (GDP), opening stocks to public distribution, average costs, yield, and production credit to agriculture. The study dichotomises the period 1961-62 through 1982-83 into two sub-periods 1961-62 and 1970-71 through 1982-83. This is to identify the importance of input costs and technology arising due to the green revolution in the later period. During the first period, money supply to GDP ratio turns out to be most important variable in the explanation of foodgrain prices, whereas the stock variable to public distribution is relatively more important in the second period. Since the 1970s the influence of cost of production is stronger on foodgrain prices.

Bhujanga Rao (1994) specified price equation as a function of public distribution, real bank credit per unit of output, procurement prices of foodgrains, economy-wide excess demand pressures and price expectations. The results show that the stock variable shows negative elasticity of rice prices with respect to stocks while ratio of money supply to GDP is positive. Similar results have appeared even for wheat.

In macro-ecometric models some authors have examined the variations in both foodgrain and food article prices. Marwah (1972), Pandit (1973), Pani (1984), and Krishna Murty (1984) have chosen the following explanatory variables: net availability of foodgrains, income, monetary expansion and prices of relative commodities. These studies reveal that the supply of foodgrains has a negative impact on foodgrain prices, while income, money supply, and prices of raw materials all have a positive effect.

#### **9.4 Specification and Estimation of the Model:**

In the empirical literature the price equation for agricultural commodities is

determined as a reduced form of complete commodity model where demand is specified as a declining function of price and supply is an increasing function and a reduced form price equation is derived using the market clearing mechanism. In the framework of excess demand, prices are functions of excess demand viz., demand-supply gap and equilibrium prices are attained when demand is equal to supply. In our model of domestic price formulation, in addition to demand and supply equations, price equation is explicitly specified in a dual market framework due to the interaction of the operations of the government and the functioning of the open market.

The model used to analyse the domestic rice price movements takes into account (1) demand equation for rice (2) the actual quantity of rice supplied to the open market (3) Price equation for rice (4) Procurement equation for rice (5) Offtake from public distribution system for rice (6) Change in private stocks for rice (7) Change in government stocks for rice.

#### Demand Equation:

On the demand side, economic theory suggests that demand for any commodity is a function of income, price of the commodity, and prices of the other related commodities.

We specified an aggregate demand function, in which demand for rice is made to depend on real disposable income, relative rice price, and relative price of wheat.

The demand function for rice, therefore, can be written as:

$$D_t = \alpha_1 + \alpha_2 Y_t + \alpha_3 P_{rt} \dots \dots \dots 1$$

$$\alpha_2 > 0 ; \quad \alpha_3 < 0$$

Where

$D_t$  = Per capita quantity of rice demanded in the open market

$Y_t$  = Per capita disposable income in current prices

$P_{rt}$  = wholesale rice price index

$t$  = time

$\alpha_1, \alpha_2$ , and  $\alpha_3$  are parameters.

Supply Equation:

Production is assumed to be exogenous. Quantity of rice actually supplied to the open market in period 't' is the actual quantity of rice available in the open market in period 't'. Actual quantity of rice available to the open market is

$$S_t = Q_t - Q_{pt} - E_t + \Delta IP \dots \dots \dots 2$$

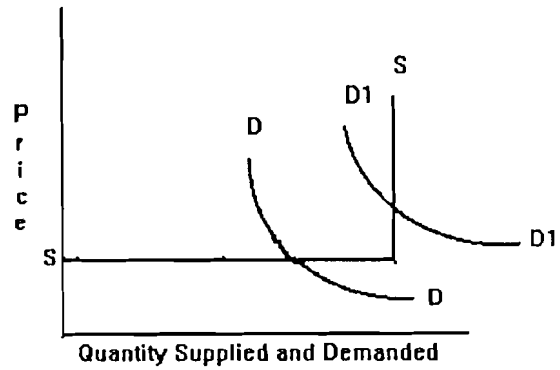
$$\Delta IP = IP_t - IP_{t-1}$$

- $S_t$  = Actual quantity of rice supplied to the open market in per capita
- $Q_t$  = Per capita net rice production
- $Q_{pt}$  = per capita quantum of rice procurement
- $E_t$  = per capita net rice exports (net of imports)
- $IP_t$  = Closing stocks with the private traders in per capita
- $IP_{t-1}$  = Opening stocks with the private traders in per capita
- t = time

Net production 'Q<sub>t</sub>' is obtained after deducting 12.5 per cent of the production for seed, feed, and wastage. Some proportion of net production is taken away by the government for public distribution through compulsory procurement. Some percentage of it would meet the international demand and some percentage as speculative stocks of the traders. The actual quantity available to the open market in period t is thus equal to the left out part of the current production plus stocks with the private traders.

Price equation: Our hypothesis here is that government procurement prices set floor to the open market price and any positive deviations from this floor can be attributed to excess demand pressures in the economy.

$$P_{rt} = \beta_1 + \beta_2 X_t + \beta_3 P_{gt} \dots \dots \dots 3$$



The above hypothesis in terms of the model is:

$$\frac{P_{rt} - P_{gt}}{P_{gt}} = \beta_1 + \beta_2 X_t$$

$$\begin{aligned} & \text{if } X_t < 0 \\ & = 0 \text{ if } X_t > 0 \end{aligned}$$

$$X_t = (S_t - D_t) \dots \dots \dots 4$$

$$\text{if } S_t - D_t = 0, p_r = p_g$$

$$\text{Hence } \beta_3 = 1$$

Where

$P_r$  = price of rice in the open market

$X_t$  = excess demand

$P_g$  = Procurement price of rice

$t$  = time

$\beta_1$ ,  $\beta_2$  and  $\beta_3$  are parameters;

Procurement Equation:

Quantum of procurement depends on the availability, prices and administrative regulations imposed by the government. Availability related to the marketable surplus with the farmers, a close proxy to which can be the level of output. Higher the output higher is likely to be the volume of procurement and vice versa. Since traders' have to contribute some proportion of their output both to the central pool as well as to the state, government is the deciding authority to set procurement target which is generally based on the expected output. Government accepts grain from the traders over and above this target and it depends on the traders' choice whether to sell to the government which intern based on the procurement price relative to the open market price of rice. This ratio is likely to capture the 'substitution effect' on volume of procurement<sup>34</sup>.

$$Q_{pt} = Y_1 + Y_2 Q_t + Y_3 P_{gt} + Y_4 P_{rt} \dots \dots \dots$$

$$Y_2 > 0, Y_3 > 0, Y_4 < 0$$

Where

$Q_{pt}$  = Quantum of procurement

t = time

$Y_1, Y_2, Y_3,$  and  $Y_4$  are parameters

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<sup>3</sup> Due to the existence of high collinearity between procurement price and open market price only procurement price is taken in the equation to estimate the equation of quantum of procurement.

<sup>4</sup> Krishna and Raychaudhuri (1980) estimated wheat procurement equation for the period 1965-66 to 1975-76 by taking quantum of wheat procurement as a function of the output, and the ratio of procurement price to open market price.

Stock Equation:

This equation is private demand for speculative stocks. It is presumed that such speculative private demand is dampened by stocks of rice with the government.

$$\Delta IP = \delta_1 + \delta_2 \Delta IG \dots \dots 6$$

Where  $\Delta IG$  is change in stocks with the government.  $\delta_2 < 0$  because whenever the stocks with the government increase, the stocks with the private traders decrease with the expectation that prices are going to fall in future. This is valid only when there is excess demand or inflationary situation and may not be valid when there is excess supply and farmers are not willing to supply at low prices.

Government Stocks:

The government (through the FCI) replenishes or depletes its stocks in order to provide stability to market prices. Change in government stocks is equal to quantum of procurement minus sales from public distribution minus net exports.

$$\Delta IG = Q_{pt} - PDS_t - E_t \dots \dots \dots 7$$

Offtake from Public Distribution System (PDS):

As discussed earlier, in order to protect the poor who suffer the most due to price rise government distributes foodgrains a fixed quota per consumer at concessional prices through the fair price shops. How much government can sell through fair price shops depends on the difference between the issue price public distribution sales and the open market price. Higher the issue price in relation to open market price higher would be the Offtake. from PDS is made to depend on disposable income, issue price and open market price<sup>5</sup>.

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<sup>5</sup>George (1979) specified issues of wheat from PDS for Kerala for 1970-71 to 1975-76 as a function of monthly sales of rice through fair price shops, monthly open market prices of rice, ratio of ration wheat price to ration rice price and ratio of taponica price to ration wheat price. He also estimated (1983) for all-India monthly wheat offtake for January 1968 to December

$$PDS_t = \epsilon_1 + \epsilon_2 P_{st} + \epsilon_3 P_t + \epsilon_4 Y_t \dots \dots \dots 8$$

Where  $PDS_t$  and  $P_{st}$  are quantum of offtake from public distribution system and issue price of rice respectively.

$$\epsilon_2 < 0, \quad \epsilon_3 > 0, \quad \epsilon_4 > 0$$

Substituting equations (1), (2), (4), (5), (6), (7) and (8) in equation (3) we obtain a reduced form price equation as:

$$P_{rt} = \pi_1 + \pi_2 Q_t + \pi_3 P_{gt} + \pi_4 P_{st} + \pi_5 E_t + \pi_6 Y_t$$

$$\pi_2 < 0, \pi_3 > 0, \pi_4 > 0, \pi_5 > 0, \pi_6 > 0$$

Due to the non-availability of data on private stocks correct estimation of supply is rendered difficult. This forced us to estimate only the reduced form price equation and some of the structural equations such as procurement and offtake from public distribution system. Estimation is carried out for the period 1971-72 to 1991-92 using ordinary least squares estimation. The data are obtained from the Bulletin on Food Statistics, Ministry of Agriculture, Government of India and National Accounts Statistics. The official wholesale rice price index is used as price variable<sup>6</sup>. The results are shown in Table 9.3.1

Results on price equation demonstrate that except disposable income, all other coefficients are found to be significant and have the expected signs. Procurement price has shown the strongest impact on market price movements with the elasticity close to unity. The elasticity of market price with respect to per capita availability is found to be - 0.39. The coefficient of Issue prices is turned out to be insignificant but with a positive sign. Balakrishna and Swamy (1995) hypothesised that a change in issue price produces

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1976 using ration price of wheat, ration price of rice and ratio between monthly wholesale price index of wheat and ration price of wheat.

<sup>6</sup> The official wholesale price index of rice used in this study is an average of the free market price and controlled prices and however this complication is ignored in this study.

a change in open market price in the same direction. The insignificance of issue price coefficient might be either due to the limitations of the issue price data or the existence of high collinearity between procurement price and issue price. We have taken central issue prices which are defective because issue prices vary across states. Exports are found to have significant impact on prices though the elasticity turned out to be very small. This might be because India was not an exporter of rice for most of the years during the period of our analysis.

**Table 9.4.1**  
**Parameter Estimates of Reduced Form Rice Price Equation**

Variable	Coefficient	t-Value	Elasticity	R <sup>2</sup>	D.W
Q <sub>t</sub>	-656.73	-2.76	-0.394	0.98	2.01
P <sub>gt</sub>	0.91	5.37	0.993		
P <sub>st</sub>	0.23	1.67	0.392		
E <sub>t</sub>	9323.12	2.66	0.007		
Y <sub>t</sub>	-0.0074	-0.46	-0.108		
Constant	46.45	2.44			

**Table 9.4.2**  
**Parameter Estimates of Equations of Procurement and PDS for Rice**

Equation	Coefficient	t-value	Elasticity	R <sup>2</sup>	D.W
Q <sub>pt</sub>	-0.0644 Q <sub>t</sub>	-1.05	-0.436	0.63	1.43
	0.0001 P <sub>gt</sub>	5.38	0.565		
PDS <sub>t</sub>	-0.000014 P <sub>st</sub>	-0.79	-0.305	0.74	1.24
	0.000081 P <sub>rt</sub>	2.15	1.014		
	-0.0000001 Y <sub>t</sub>	-0.20	-0.135		

Table 9.3.2 gives the results on equations of procurement and public distribution. In the procurement equation, procurement price is found to have significant impact on quantum of procurement; whereas in PDS sales equation, open market price is not only highly significant but also pds sales are highly elastic with the elasticity greater than unity.

The above analysis clearly points out the impact of government intervention on market prices of rice in India. The stock building operations, which were intended to reduce the market fluctuations arising out of output fluctuations, are the outcome of increasing government procurement operations associated with rising procurement prices. If these stocks are exported, instead of selling them in the domestic market, food security of vulnerable sections would be under threat as a result of rise in domestic rice prices. This is evident from the existing empirical literature on the effects of availability on domestic prices where the price flexibility coefficient was found to be greater than unity (Ray, 1972).