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CAUSALITIES AND COST EFFECTIVENESS OF PUBLIC RICE PROCUREMENT IN BANGLADESH

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I Introduction and Objectives of the Study

Bangladesh maintains a battery of interventions in grain markets, which run up very significant budgetary and economic costs. Indeed, the following ingredients of an intervention regime found elsewhere in Asia are also to be found in Bangladesh: (a) a public foodgrain "procurement" program, ostensibely to "support" farmgate prices; (b) monetized ration distribution for "priority" segments of the population; (c) in-kind distribution, mainly for those supposedly vulnerable; (d) open-market operations designed to contain seasonal price swings; (e) national security; (f) until recently, a monopoly on foreign trade in foodgrains; (g) a large department to oversee procurement, storage, transportation, distribution financial and quality control.[1] In an average year during the 1980s, the deficit on food operations (before transferring resources to Annual Development Plan (ADP)) averaged TK. 2.8 billion (bn) per year. The corresponding number during the second half of the 1980s was a staggering Tk. 4.0 bn. In 1989/90 and then again in 1990/91, a severe imbalance yawned between outlays and receipts, rivetting policy interest on mending the malaise with the food interventions. Analytical efforts, at IFPRI and elsewhere, had began to point to significant cost-ineffectiveness by the PFDS in mediating subsidies (Ahmed,1992), in holding price-stabilizing stocks (Goletti et al., 1991), as also to other interventions that have probably had their day (Haggblade, 1993). It is in this setting that this paper attempts to probe the price effects and costeffectiveness of Bangladesh's public rice procurement in terms of the following.

(a) Does the public procurement program have any independent and upward effect on harvest season prices? If yes, how significant is such an effect on its own?

(b) How costeffective is this program ?

[1]With a strength of roughly 10,000 employees, storage capacity on the order of 1.8 million metric ton, and a very large credit accommodation, the Directorate of Food is a large operation. Despite a considerable roll-back in more recent years, the PFDS remains a major source of budgetary expense.

The answers to these questions are germane to the cost-effectiveness of the procurement program. On present form, the relevant literature has addressed these questions mainly descriptively (see below). It is the aim of this paper to tackle the problem using a multivariate behavioral analysis of the effects, as well as causes, of rice procurement. Before we deal with its causalities, we might want to look briefly at its structure.

The Structure of Public Procurement Program

Domestic procurement of rice is a relatively small source for the public distribution of foodgrains in Bangladesh. Historically, this has accounted for about 20% of the PFDS throughput per year during the 1980s. The other sources are (i) grains imported throught food-aid channels; (ii) grains imported by the government with its own resources.

Domestic foodgrain procurement system is implemented by the Directorate of Food (DOF), in the Ministry of Food, which intervenes within the guidelines and financial limits set by the government in rice and wheat markets during grain harvests by purchasing. The financial accounting and inventory controls surrounding the DOF's food operations including domestic procurement have been found wanting, and are currently on the mend in the wake of the efforts of an FAO-assisted activity (GOB/FAO, 1989), and will not be touched upon here. The program mainly aims to procure foodgrain for the ration system. Its backers argue that it is also to maintain a fairly regime of price-support operations characterized by a pre-declared "procurement price" for foodgrains at harvest time, when prices may sag.

Five essential features characterize this system: (i) the announcement, usually prior to the planting/sowing of each grain crop, of a certain price at which the DOF offers to buy grains of acceptable quality, subject to an overall quality target; (ii) the fact that about nine-tenths of the rice procurement takes the form of paddy purchased from the traders and, more recently, contract millers, the farmers rarely selling directly to the DOF and thus receiving the "procurement price"; (iii) operation of the system in all years regardless of whether the crop is likely to be above - or below-trend; (iv) the operation of grain purchasing centres in all parts of the country during and after the harvest; (v) the fact that

quite a number of ways do typically exist to enhance the financial efficiency of procurement operations.[2]

Quantity targets are set as much for financial planning as for logistical planning purposes (such as lining up transport and storage capacity). No cap is set for the quantity that an individual farmer or trader has to bring to be eligible. The government only buys fair average quality (FAQ) grain, that translates into a 14% moisture content. However, it is generally agreed that much of the rice procured enters the godowns at a higher moisture content (World Bank, 1992, vol. II, p. 121). To understand the implications of this for imperatives of stock turnover, especially during the wet season, as also for the effects of the grains in public stocks due to the procurement program itself on the market's expectation of future rice prices, we need to look briefly at the present configuration of storage facilities.

Operation of the system

Because recourse to imports was widely perceived as criticcal to both price-stabilizing and security-promoting food interventions, the configuration of storage facilities, with supply routes to match, was designed to facilitate the arrival and the subsequent distribution along a south-to-north axis (John-Evans,1986; World Bank, 1992). The DOF currently operates 4 silos, 12 Central Storage Depots and 621 Local Storage Depots throughout the country. Except for the 4 silos, all these facilities also double up as purchasing points during the procurement season. However, existing storage capacity in the Rajshahi division is around 370,000 MT, which is far smaller than what it can procure in 1989/90, for instance. Over the 1980s, mainly foreign assistance has been directed to the contruction of a large number of storage depots, many in foodgrain-deficit districts. However, the storage capacity in these depots impart a price-support capacity to the procurement program only if adequate forward planning of movements exists in the system. However, the system performance on that score has also been wanting (World Bank, 1992, p. 119). In addition, on the order of 450 temporary purchase centres (TPCs) operated during the aman season during each of the years in the quinquennium to

[2]During 1992/93 procurement season, the government for the first time circumscribed procurement to the five greater districts of the usually grain-surplus Rajshahi division, located in the North-West part of the country.

1991/92. Considerably fewer TPCs operate during the boro and aus seasons, due to wet weather.

There were about 1050 procurement points, which works out to 2.28 procurement points per thana or 53 villages per purchasing point. Each procurement point must theoretically serve an average of about 53 square miles. The geographic coverage of the procurement system as of the late 1980s is larger than that prevailing a decade ago.[3].

The Determination of the Procurement Price

The procurement price is set at a level sufficient not only to ensure the coverage of input costs but also generate a fair return on the output.[4] In essence, this approach has been a average cost based approach, with a generous allowance for land rent.[5]

In the light of this structural presentation, it may now be apt to report a brief review of the literature.

Review of the literature

In the mid-1970s, when Bangladesh was yet to forge a big push forward with rice high-yield-varieties (HYVs), the need to maintain "incentive prices" was widely perceived to be imperative. Adverse shocks to rice output were commonplace, and imports were naturally looked to as active elements of managing the aftershocks. The perception was that in a normal year the procurement program probably ameliorated the seasonal price slippage, and in an above-average year, it raised both the seasonal as well as the annual average price. If, in a bad year, import requirements were statically calculated to redress the supply shortfall commensurate with some putative per capita requirement, regardless of a target price or of the capacity of the population to pay, then markets could be destabilized if the imports at issue were distributed through generalized public marketing. Increases in supplies through imports could be seen likely to reduce market prices by more

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[3]See World Bank, 1979, pp. 57-58 for this evidence.

[4]Up until 1981/82, the price set was also in part to correspond to an appropriate rice-jute price parity. Ever since, intercrop parity was discarded in favor of a cost-of-production based approach.

[5]For a discussion of the prevailing basis of procurement price setting, see Ahmed et al, 1993.

than could an equivalent increase in domestic production. Procurement would have to be especially large in years of production shortfalls. Such an argument implies that procurement raised prices.

As time went by, analysts began to empirically address the market outcome of rice procuremnt (Ahmed et al, 1980; Rahman and Mahmud, 1988; Ahmed, 1981; Osmani and Quasem, 1990). For example, it was found that (a) farmers accounted for about 2% of public procurement; (b) and that there was collusion between the procurement functionaries and the traders (Ahmed et al. 1980). Also, procurement centres were too few and the financial coverage too limited to ensure the farmer uninhibited access to the program, and to ensure that the traders are obliged to treat the support price as the effective floor price.

The consensus prevailing up until the middle of 1980's was that the procurement program in Bangladesh did not fare very successfully by the criterion that an intervention to ensure incentive prices should at least hold them within a reasonable difference from the incentive price in a year of good harvest (Osmani and Quasem, 1990). It was pointed out that in two out of three good harvest years between 1975/76 and 1983/84, grower's price in the market remained substantially below the guranteed price, even though the volume of procurement was also the highest in these years.

This "consensus" was, arguably, a little controvertible. Arguably, public procurement is highly specific, both seasonally and regionally. This is partly about the geography of the appearance of marketable surpluses. Only a handful of Bangladesh's greater districts register surpluses over and above "requirements" on a consistent basis. These locate a disproportionate share of the country's rice milling capacity. These are the districts that have strong commercial interest in feeding off a large institutional buyer(Chowdhury, 1992). A lion's share of the country's procurement is sourced from four out of twenty one greater districts, all of them in the Rajshahi division. If harvests imply relative seasonal collapse in prices in key assembly markets, the public imperative to provide incentive price also implies a corresponding geographical mandate. It is arguable, therefore, that the program could be impacting upon harvest prices in the small number of surplus-generating districts in the way envisaged by its backers without nation-wide harvest prices being able

to pick up the difference (Chowdhury, 1987). In principle, procurement program aims to make statements about market prices and intervention quantities in a disaggregated framework. Second, harvest-season grain prices are impacted upon by a host of other seasonal, expectational and commercial variables, some seeking to put upward, and some downward, pressures. A statement about the effect of public procurement on harvest prices is about its net, independent effect, while controlling for other variables that simultaneously impact on rice prices. Because the degree of market integration, at once over seasons, space and form, is increasing over time (Ahmed and Bernard, 1988; Goletti and Farid, 1993), the price formation is also becoming more and more sensitive to the individual effects of a fairly large list of variables. By drawing sustenance from a simple comparison between averages for three variables, viz. production, procurement and the difference between harvest price and procurement price, the stylized assessment in the literature of the price effects of procurement is not, analytically, well-grounded.

A review of analytical models of rice price models in Bangladesh

More recently, IFPRI and others have estimated models of the foodgrain sector in Bangladesh, designed to light upon the price determination in an institutionally and policy relevant way. Since seasonalities and regional specialization weigh heavily in this context, IFPRI and its collaborators have put together a disaggregated data base. For rice, these multivariate models allow testing of the effects of market supply on its prices. In recognition of the two-tier pricing regime --- one driven by market price and the other by the prevailing regime of administered prices (see Ahmed, 1979) --- market supply was defined in these models as net production plus public offtake minus procurement. Almost invariably, these models show that prices relate negatively with supply (Goletti et al., 1991; Ahmed et al., 1993; Chowdhury, 1993c). Because procurement is a small component embedded within market supply, independent effect of procurement on price cannot usually be read off this coefficient. These models do however strongly establish the result that foodgrain markets are full of plausible synergies. One of these makes the point that, in a simultaneous-equation context, rice procurement invariably responds negatively to market price, but positively to the procurement price. Evidence from elsewhere too suggests that, amid a two-tier market place, producers (and also consumers) switch back and forth between a public conduit and the private marketing chain depending on which is better value for money (Raj Krishna and Chibber, 1983). The stereotype of agents

typically on the lookout for keener prices is lent some solid support by the data in the South Asian context. The determination of rice procurement as endogenous to a process of the deteraination of price is grounded in a citable theory, and has been reported by a number of authors (Shahabuddin, 1992; Ahmed et al. 1993).

The DOF carries an excessive amount of rolling stocks (World Bank, 1992). IFPRI research has shown that public rice stocks powerfully dampens rice price, by depressing expectations of future prices. It would be nice to estimate the coefficients of the public stock and rice procurement variables on price as part of the same framework, and then carry out counter-factual simulations tracing the implications for price of different combinations of rolling stock-rice procurement.

The rest of this paper is structured as follows. Section II elaborates upon the analytic methods, the choice of the model specifications, and the sources and limitations of the data. Section III presents the results of the empirical exercise of the procurement program, and reports on estimates of cost effectiveness of the program.

II Methods and the Data

The model

As would be expected of any model concerned with the deterrmination of rice price, this model is about the process through which supply and demand for rice interact. Geographical overtones and harvest seasonalities weigh heavily in this context. While we concentrate on events over a period of just a small number of years, note that especially the supply side to the rice markets has had to them a longer history. Institutions, policies and regulatory frameworks within which the decisions of rice producers would perforce have to take place steadily liberalized "market access".[6] Under some plausible conditions, such liberalization would, by fostering a positive varietal and yield response for rice, translate into more rapid commercialization of the rice economy. If the latter promotes an increasingly labor-intensive marketing of rice, with the farmers retaining priority over traders, then the oft-quoted evidence about the nominal priority of traders over the farmers in the act of procurement itself need no longer materially implicate price *incentives* in customary ways. There is some evidence for believing that the commercialization of the rice market has indeed fostered just such a structural change (Chowdhury, 1992; Chowdhury, 1994). Hence we should be expecting that the impact of the public procurement on rice prices may be quantitatively different more recently than in the past. It is at this juncture that it becomes imperative to present an interpretive account of the policy and institutional changes bearing upon rice economy in particular during the period under study. It is to this that we now turn.

An Interpretive Chronology of Important Rice Market Developments: 1988-1993

1. July 1988. The government waives peremptorily the standardization requirement on imported irrigation equipment, thus creating significant space for cheap technology to the relative exclusion of other more expensive sources (Guisselquist, 1992).

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[6]To give one example, Chinese diesel-operated irrigation pumpsets were available from 1988 onwards at 60% of even the subsidized price of roughly comparable shallow tubewell pumpsets distributed by Bangladesh Agricultural Development Corporation, a parastatal (Guisselquist, 1992). This is the order of "price break", to which the waiver of a standardization requirement (see below), that previously screened out cheaper brands from nontraditional sources, gave access to the farmers. Even when unit cost of irrigation has not always fallen due to such policy change, the access to irrigation did still often improve (see MOA, 1992-93 Census of Minor Irrigation in Bangladesh, Feb. 1994).

2. *March 1989.* Direct sales of urea by parastatal fertilizer factories to private traders was allowed for the first time, enabling a rapidly increasing number of private traders to move large quantities of urea across the country (Samad et al. 1989). Previously, wholesale urea trade was a parastatal monopoly.

3. *July 1989.* Direct sale to private traders from ships at Chittagong and Chalna ports with a discount of Tk. 400 per ton was introduced (Samad et al. 1989).

4. *1989.* The Ministry of Food resolved that national food policy should make resolute efforts to have on hand foodgrain stock of 1.5 million metric tons (MMT) as on July 1 of every year and 1.2 MMT as on Nov. 15 of every year. Towards this end, the government forged a new "procurement" program termed "Millgate Purchase" (MP). The idea was to procure milled rice from prequalified contractor-mills at a cost-plus basis that pivots around the "procurement price" (PP).[7] For a marketing agent, access to a MP contract readily implied secure access to large implicit credit subsidies (Chowdhury, 1994). Also, the PP easily exceeded the going price during procurement season, due to the generous rental provision. These conditions coupled with favorable milling ratio stipulated in the MP contract made the MP a lucrative vein to tap. Rice procurement rose during 1989/90 to 1991/92 to record levels.

5. *1989.* The government instituted Palli Rationing, whose brief was to distribute subsidized foodgrain (at 25% subsidies) to "eligible households" in rural areas. Unlike what it substituted, the PR was accepted as a priority claimant on the distribution indent, and soon became the single most important public distribution channel for rice. Significantly for rice prices, the PR was extremely poorly targeted and "leaked" heavily (Ahmed, 1992). It distributed rice during all months, including harvest ones.

6. *1989/90.* The government procures record quantities of rice during both aman and boro seasons. Millgate Purchase (MP), which was highly profitable to the contractors, distorts incentives in rice milling and trade. Whereas previously all millers and traders had to compete in one national rice market to earn their keep and grow, the MP had created

[7]For a description the MP, see Ahmed et al. 1993, and Chowdhury, 1992.

strong incentives to feed off a "rent-prone", centralized regime with a big-ticket procurement budget. Procurement price (PP) of paddy was Tk. 220/md.

7. *March 1991.* Diesel prices were doubled from Tk. 7.3/litre. This had implications for irrigation costs.

8. *Dec. 1991.* The government suspends PR. In the wake of this, rice offtakes have stayed soft, aggravating the tendency of public rice stocks to swell. PP was raised to Tk. 240, even though the single most important distribution channel had been terminated.

April 1992. Aman output, 1991/90, is one of the highest on record. Much of the increment was recorded by the upland districts in the North West, that had probably seized a competitive edge upon the rest of the country in terms of "access" to the now cheaper irrigation technology.

May-June 1992. The government raised PP further to Tk. 245 a md. Everyone overestimated the loss to 1992 boro rice associated with an unprecedented drought in March-April 1992, by wide margins, giving currency to the notion that, after a default of several seasons, the time of profitable speculation in rice and paddy stocks had returned, albeit perhaps of a short-run nature. Increase of PP to Tk. 245 had rendered MP even more remunerative. This led to MP contractor's mounting a paddy buying binge early in 1992 boro season, in an effort to put together a strategic stockpile, in anticipation of a long and lucrative boro procurement seaosn.

July 14, 1992. The government declared a suspension of the MP; there was no place to store more rice. Overnight, the paddy stocks garnered with a view to feeding off the MP become ripe for dumping. Millers and traders reached for sell buttons, as prices headed downward. Production of boro in what typically were deficit districts made relatively sharp gains, drying up demand for speculative stocks garnered in the surplus North-West. On a large scale investors in rice and paddy stock ran up uncustomarily large operating losses in 1992.

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It is in this policy and market setting that public rice procurement was conducted during the period of our interest.[8]

Table 1 reports on some salients transitional aspects of Bangladesh's rice economy. First, rice production, private commercialization both accelerated from about 1988/98. *Prima facie* evidence suggests that market reforms by accelerating the pace of irrigation development and the diffusion of the high yielding varieties (HYVs) has strongly contributed. The government has procured a growing share of private market supply, itself growing at a trend rate of 6% per year. While rice offtake as a percentage of rice availability has clearly risen in the period after 1988/89, public rice inventories at the end of marketing year (i.e. at end-October) have sharply risen in this quadrennium.

Wholesale real rice price began to slip from 1988/89 under the impact of shifting supplies. The ratio between rice's procurement price and market price shrink during this same period. Nominal protection coefficient, computed on the basis of import parity prices (IPP), also began to fall from 1988/89. It is at the juncture that the government decided to accelerate the scale of both public procurement and issue of rice availability, government rice stocks during the period from 1988/89 onward plainly doubled or more as compared with the period theretofore. Rice imports during this recent period have been negligible. The sharp gains in public rice stocks since 1988/89 coincides with, indeed is to be attributed to, rapid increases in the scale of public rice procurement.

[8]For a justification of why we choose the quinquennium to June, 1992 to be our period of interest, see below.

Table 1 — Production, Commercialization, Public Interventions, Bangladesh Rice Economy

(000 MT; three year MAs)

Year	Rice production	Rice marketed surplus	Merketed surpluses as % of production	Procure-ment	Public procurement as % of market supply	Offtake	Availability	Rice offtake as % of availability	End of Oct. public rice stock	Nominal protection coefficient of rice
1982/83	14118	5353	38	203	3.8	515.98	13190	3.92	350	0.97
1983/84	14448	5597	39	150	2.7	439.92	13250	3.32	243	1.14
1984/85	14723	5847	40	171	2.9	365.16	13423	2.72	265	1.11
1985/86	15039	6139	41	165	2.7	335.96	13655	2.47	262	1.21
1986/87	15386	6511	42	218	3.4	329.34	13899	2.37	297	1.19
1987/88	15637	6909	44	262	3.8	400.40	14219	2.80	373	1.22
1988/89	16437	7661	47	523	6.8	505.82	14583	3.44	506	1.08
1989/90	17167	8381	49	670	8.0	716.00	15535	4.56	621	0.99
1990/91	17986	9127	51	861	9.4	795.33	16004	4.95	549	0.96
1991/92	18159	9579	53	648	6.8	736.33	16554	4.46	472	0.92

Source: Estimated by the author from BBS, DGF, IFPRI Farm Survey, 1989/90

Notes: Rice marketed surplus is estimated using linear approximation based on a curve-fitting exercise and data obtained from a number of sources. See Chowdhury, 1994, Table 6. The symbol MAs denote moving averages.

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Table 2 — The Geography of Rice Production and Procurement Gains, 1980s

(Figures in 000,Mt)

Year	Rajshahi division		Khulna division		Dhaka division		Chittagong division		Bangladesh	
	Production	Procurement as a % of Production	Production	Procurement as a % of Production	Production	Procurement as a % of Production	Production	Procurement as a % of Production	Production	Procurement as a % of Production
3 - Years Moving Average (Aman)										
1981/82	2441.3	5.8	1623.4	1.8	1744.2	1.5	1850.4	1.8	7659.3	3.0
1982/83	2475.6	3.2	1650.6	0.4	1705.6	0.3	1818.8	0.3	7650.7	1.3
1983/84	2532.9	2.7	1768.2	0.3	1639.4	0.3	1883.2	0.3	7823.7	1.1
1984/85	2617.7	3.4	1914.1	0.3	1663.2	0.1	1941.6	0.2	8136.6	1.2
1985/86	2598.3	2.7	1960.6	0.2	1703.6	0.1	1984.0	0.1	8246.6	1.0
1986/87	2491.4	2.5	1975.8	0.2	1691.7	0.0	2007.5	0.1	8166.4	0.8
1987/88	2378.3	1.7	1857.0	0.0	1457.9	0.0	1911.1	0.1	7604.4	0.6
1988/89	2580.0	5.5	1997.2	0.3	1379.1	0.3	1959.8	0.1	7916.1	2.0
1989/90	2940.5	6.4	2085.4	0.3	1360.7	0.3	2021.7	0.1	8408.4	2.4
1990/91	3241.1	9.0	2299.0	0.7	1523.5	0.4	2149.1	0.1	9212.7	3.4
3 - Years Moving Average (Boro)										
1981/82	439.9	13.7	219.6	1.9	1259.5	4.9	1190.5	3.9	3109.5	5.5
1982/83	559.4	8.0	235.2	0.2	1346.7	2.1	1207.9	1.6	3349.2	2.8
1983/84	651.8	6.4	278.4	0.2	1414.7	0.9	1256.6	0.5	3601.6	1.7
1984/85	809.1	6.0	268.5	0.1	1355.6	0.6	1210.1	0.3	3643.2	1.7
1985/86	958.2	7.0	278.5	0.2	1425.5	0.5	1201.0	0.5	3863.3	2.2
1986/87	1176.8	9.9	281.7	0.4	1489.5	0.6	1189.2	1.0	4137.2	3.4
1987/88	1370.2	12.3	406.8	0.9	1757.0	0.8	1323.3	1.1	4857.3	4.1
1988/89	1584.9	17.7	529.7	1.5	1992.9	1.2	1469.8	1.0	5577.3	5.9
1989/90	1748.8	22.0	630.5	2.2	2168.5	1.3	1571.4	0.6	6119.3	7.2
1990/91	1873.0	25.9	663.8	2.6	2237.3	1.5	1669.5	0.6	6443.6	8.5

Source: Computed by author using BBS data

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The Analytical Framework

In equilibrium, we posit that demand for rice equates supply for each market,

$$D_t = S_t \tag{1}$$

This is a district-level model, and the reasons for this choice are presented below.

In this district level model, market supply derives from net production plus net distribution from the PFDS plus net "imports" from other districts. Or,

$$S_{i,t} = q_{i,t} + O_{i,t} - G_{i,t} + X_{i,t} \tag{1}$$

where $q_{i,t}$ = production at time t

$O_{i,t}$ = offtake, monetized plus others

$G_{i,t}$ = procurement

$X_{i,t}$ = net exports to other districts

Rice demand equals consumption demand and storage demand. Or,

$$D_t = C_t + \Delta I_t \tag{2}$$

Equation 1 implies that supply of rice during any time interval will either go into consumption or be part of demand for stocks

$$S_t = C_t + \Delta I_t \tag{3}$$

where S = supply during period t

C = consumption

ΔI = $I_{t+1} - I_t$ = changes in private stock of rice.[9]

[9] $\Delta I = \Delta FI + \Delta TI$, where ΔFI = onfarm stock (from production) and ΔTI = trade stocks. We assume that farmers and traders display the same causal behavior in matters of rice stock.This equation may not be empirically valid (see Chowdhury, 1993c), but to admit this here would impracticable, due to data limitations. Farm stocks are the primary, motherlode, version of Bangladesh's rice stock (Chowdhury, 1992). Because very little rice is imported, farm stocks eventuate into trade stocks as market season progresses.

I_t = Carryin of rice

I_{t+1} = Carryout of rice

Demand Considerations

For the period at hand, we have firsthand estimates for neither consumption nor changes in private stock. Given that we are dealing here with a panel data for five years and by district, this is not surprising. Following Goletti et al. 1992, consumption has to be treated relative to underlying variables, like rice price and district income.[10] That is,

$$C_{i,t} = C(P_{i,t}, Y_{i,t}, P^w_{i,t}) \tag{4}$$

where $P^w_{i,t}$ = price of wheat

Changes in private stocks are treated relative to two variables, both expectational. The first is public rice stocks. It has been shown, separately, that public rice stocks are a major determinant of rices future prices (Golletti et al., 1992; Ahmed et al., 1993; Chowdhury 1990). The second is about changes in preharvest private storages as a result of expectation regarding prospective harvest shortfall (as a proxy for severity of future scarcity). This idea draws upon the anticipatory price hypothesis (Working, 1958; Bouis, 1983) as applied to Bangladesh (Montgomery 1983; Ravallion, 1987). It will be conceded readily that, while this last approximation is not ideally suited, its outright exclusion would have been even more difficult to justify.

This discussion implies the following relationship

$$\Delta I_t = I(GI_{t-1}, E_{t-1}(Q_t)) \tag{5}$$

where GI = public rice stocks

$E_{t-1}(Q_t)$ = expectation regarding the size of harvest at time t as of period t-1 (also denoted CROPEXPN interchangeably).

[10]Presently, we omit wheat prices as another underlying variable: the underlying wheat price data are not available with sufficient disaggregation.

While GI and Q are available from the Bangladesh Bureau of Statistics, and the DOF, the third variable, following Montgomery (1983) is measured by the rate of price increase during lean periods prior to the two major harvests. More specifically, this is about the proportionate change in prices in the ten weeks' period to the middle of October, and to the middle of April, respectively.[11]

Besides these two, public rice procurement, PROC, is another demand side variable, which has to be included in the model.

Supply considerations

Supply side in the model is hypothesized as being dependent upon three influences viz. the size of harvest, the proportion of rice acreage allocated to high-yield-variety (HYV) strains, and rice offtakes. As crops are harvested, marketings begin in earnest, as farms buy into non-rice necessities or hire casual laborer to prepare land for succeeding crop. Size of harvests by inducing seasonal spurts in farm marketing is likely to augment market supplies and relate inversely to prices. Also, given the size of the harvest, the proportion of HYV rice acreage should also correspond to the scope of marketing: the higher the share of the HYV, the greater is the intensity of cash costs in its production, and the greater is farmers' compulsions to market. We should expect indicators of farm technological development to have a negative coefficient in the price equation. Finally, in theory, public offtake is likely to relate negatively to price. The supply side of the model is expressed as follows:

$$S_t = S(Q_t, HYV_t, PROC_t) \qquad (6)$$

where Q = rice production,
HYV = % of HYV in rice acreage
PROC = public rice procurement offtake

[11]This variable, by assumption, takes nonzero values for the two cardinal harvest seasons. For the other two, it takes the value of zero. The resulting coefficient is rather like that on a dummy variable, meant to capture intercept differences between harvest
and other seasons.

The above considerations suggest that we may write

$$PR_t = f_1 (Y_t, Q_t, HYV_t, GI_t, PROC_t, SURDEF) \quad (7)$$

where SURDEF = a dummy variable taking the value of 1 for districts generating rice surpluses from own production, and 0 otherwise

The dummy SURDEF is posited because surplus districts locate a disproportionate share of the country's assembly markets, where prices are expected to be lower than in deficit regions.[12]

Rice procurement

Public rice procurement is determined endogenously in this modelas a function of predetermined variables, for example production and the like. We think procurement endogeneity is warranted on both theoretical and statistical grounds. One can argue that, upto a point, public procurement translates into movements in seasonal demand which is additional to, and not an alternative to, private demand. This is plausible, because even in districts with consistent rice surpluses, farmers' marketing of rice at the height of the harvest season is larger than what the DOF can "procure" during any particular season. Secondly, government purchases, backed by large and secure creidt lines enjoyed by the DOF, have funneled significant seasonal liquidity (Rahman, 1994). Onlending on the basis of "hands on" reciprocity implies a strongly participatory credit relations (Chowdhury, 1993; Chowdhury 1994). This may likely induce some "multiplier" effects, some of which may provide some return-feedback to procurement.

It may be helpful to sharply distinguish between the overall procurement quantity "targeted" by the Ministry of Food, and the quantity it in fact procures. The setting of the former is, by common consent, a largely administrative act, as it is dependent on past

[12]To introduce Q and PROC as determinants of rice price may call for an explanation. It may be asked, are the effects of Q and PROC on prices not to be equivalent percentage-wise? Why are we then not to aggregate the two variables in one in the price equation? The reply is that, as is well-known, the quality of grain that are publicly procured is usually of different moisture content from privately marketed grain. This makes a case for treating Q and PROC seperately in the text.

levels typically achieved, storage or infrastructural constraints, or a "political balancing act". The latter may well be treated endogenous, in theory.

Therefore, we postulate that

$$PROC_t = f_2 (Q_t, HYV_t, GI_t, PROC_{t-1}, T, Y_t, E_{t-1}(Q_t), OFF_{t-1}, PP, SURDEF)^{13} \quad (8)$$

where PROC = rice procurement

The one variable that is missing from the above specification is the geographical coverage of the procurement program. This variable could be evaluated by the number of LSDs, CSDs and temporary purchase centres (TPCs) per thousand population. This was however omitted mainly because the relevant data were not available for the entire period at issue.

Ration offtake equation

We hypothesize that the determination of rice ration offtake is endogenous too. A number of other authors have pointed out a significant price response in ration offtakes (Chowdhury, 1990; Shahabuddin, 1992). Ration offtake should correspond to incomes. If the rice ration system is "means-tested", we should expect income to have a negative coefficient. If the rice ration system has significant inequity, or significant urban bias, built into it, income would likely have a positive coefficient in it. ROFF is expected to have a negative coefficient with respect to issue price (IP): increases in IP, given the market price, should, by making access to market supplies more attractive, lower public issue. It is likely to have a positive coefficient with respect to market price (PR), for the opposite reason. Public rice stock (GI) is hypothesized to have a positive coefficient in the ROFF equation: the higher is the public stocks, the greater is the payoff in releasing storage capacity which, in turn, requires an increasing of rice offtake.

[13]All results of the model are found to be robust when we include procurement price (PP) as an additional exogenous variable in the model. Results are available from the author. We have only IP in the present model version because of reason of statistical imperative. This being a presentation of results mainly of operational, as distinct from academic research, viewpoint, the robustness of policy implication may be given priority over theoretical purity.

A lagged term is posited in deference to the possibility of partial adjustment. This should not be hard to take: the rationing system is not without its commercialization. Delivery Orders (DOs) used to be regularly traded on "commercial" bases in major cities (Haggblade et al. 1993) at discount rates, which are related to market-based outcomes. Therefore, it is plausible to postulate the presence of constraints (liquidity, informational inertia, etc.) that may keep agent from achieving profit-maximizing bid for DOs, for example.

The following function describes the ration equation

$$OFF_t = f_3 (Y_t, IP_t, PR_t, GI_t, OFF_{t-1}, SURDEF) \quad (9)$$

We assume the model to be linear in parameters.

Specification of variable measurements

All of the price variables in this model are expressed in nominal terms. Because the absence of money illusion is only a postulate and not a necessary description of reality, the absence of money illusion is too strong a proposition to be known a priori and imposed on the data (Leamer and Stern, 1970, pp. 45-47). There is no empirical demonstration known to this author of the absence of money-illusion on the part of Bangladeshi consumers (Pitt, 1983).

The coefficient on the undeflated price variable may be interpreted as the response of quantity demanded (or supplied) holding all other prices, the consumer non-rice price index and incomes constant. This is the method used by Lana Hall (Hall, 1980, pp. 21-22) in a Brazilian study.[14] This is the method we use in this paper, although we do not use lagged price as indicative of price expectations.

To insist on evaluating prices in real terms would have led to a ruling out of the absence of money illusion. It is not unusual for a researcher to be reluctant to impose

[14]In Hall's study where price expectation, represented by lagged prices were determinants of acreage decisions, lagged CPI was also used for consistency, and may be interpreted as relating to inflationary expectations, and affecting decisions accordingly.

such an assumption on the data (see Lana Hall, 1982, for an example).[15] The second reason is that there is no easily accessible deflator for rice prices that recommends itself compellingly (see the exchange between Chowdhury (1992, 1993) and Osmani (1993).[16] Neither rural cost-of-living index, nor the index of wholesale prices of manufacturers, nor the implicit GDP deflators is beyond some measure of criticism. An additional problem is that only the former is available for only a handful of centrally-located districts, while the data used here related to the twenty greater districts. Finally, our model is disaggregated on sub-annual lines. The process of the formation of inflationary expectation for such subannual periods, of between two and four months each, is not understood well enough to be imposed on the data.

Model versions with the price equation estimated with an annual time trend was behaviorally more empty than versions without the trend variable: in the former some theoretically plausible variable pales into insignificance when time is in, implying that over time there is structural change to reckon with. This means that time preference is a less potent facet of behavior in the rice economy, than the time-dependence of some aspect of that behavior. This is not surprising in that during the period under review, rice prices even in nominal terms have been declining. In the light of all this, to use undeflated price variable, following it all (1982), is the procedure adopted in the following.

All quantity variables are measured in per capita terms.

The model is closed by the following identity defined using public rice stock

$\Delta GI_{t+1} = PROC_t + NMVMNT_t - OFF_t - LOSS_t$

Where NMVMNT = net movement of rice on public account into the district at issue

[15]Hall's paper, published in the American Journal of Agricultural Economics, was about Brazilian economy related to a period when the rate of inflation in consumer prices averaged 50% per year or more. In that country, wage contracts, even returns to bank deposits were indexed on account of inflation.

[16]It is tempting to use the implicit GDP deflator as one alternative, but rice production is a very large proportion of the output emanating from the *nonservice* parts of the Bangladesh economy. The evaluation of the services output in Bangladesh economy involves a large margin of subjectivism. Therefore, the concept of some average "price" of services output of the economy is equally nebulous. Therefore, the commodity weights underlying the implicit GDP deflator closely correspond to the goods producing sectors of the economy. Rice as a sector looms very importantly in that context.

The above can be rewritten as

$$GI_{t+1} = GI_t + PROC_t + NMVMNT_t - OFF_t - LOSS_t \quad (10)$$

We thus have a system of four equations in four unknowns, namely PR, PROC, OFF, GI. The equations we estimate are given by (7), (8),(9) and (10). Each behavioral equation with at least one endogenous variable in it is over identified. The residuals are correlated (7) and (9). For statistical reasons, PROC is estimated as a reduced form albeit as a part of the same system.[17] Also, OFF is omitted from eqn. (7), again for statistical reasons. However, the results did not change when the model was reestimated with OFF in eqn. (7).

Expected signs of various coefficients have already been outlined.

Estimation

This system is estimated using Three Stage Least Squares (3SLS). All variables in the model that are not endogenous, as also ROFF and RPROC lagged by one interval, are used as instruments.

Data

Rice price is measured using wholesale prices reported by the DOF for each of Bangladesh sixty four new districts. From weekly data, monthly and then interval-wide averages were computed. Ideally, our context waited upon farmgate prices. Unfortunately, the latter were not available in the disaggregation needed. Two alternatives to using farmgate prices were available. As well as the one source associated with the DGF, the other was the Directorate of Agricultural Marketing (DAM). We choose the DGF price data set because this is the more representative of rural markets, while the DAM data set more representative of urban markets (Goletti et al. 1993).

[17]The model's basic simulation outputs a significantly lower root mean squarred error when the PROC equation is estimated as part of the system. The alternative considered was to estimate PROC as a single-equation outside the model, and dot he base run using the ensuing single-equation coefficients.

Data on district-level rice production, proportion of rice area undre HYVs, incomes, population, and CPI (rural cost-of-living index, nonfood items) were obtained from the BBS. All public-intervention quantities were sourced from data files maintained and updated by the Situation Room in the Food Planning and Monitoring Unit (FPMU), in the Ministry of Food. Data are aggregated/averaged for twenty greater districts, adding up to a sample size of 400 seasonal observations (20 x 5 x 4 = 400). Because two of the variables are lagged by one period, the number of observations at issue is reduced to 380 for the overall period.

III Results and Discussion

The results are presented in the following order. First, it is argued that, if price effects of rice procurement program have to be evaluated, there is a remit to go beyond a single-equation model of price determination. Secondly, we report the coefficients of the system of equations estimated. Thirdly, the model is validated. Finally, we estimate a measure of costeffectiveness of the procurement program.

A comparison between Table 1 and 2 suggests that a single-equation model, with PROC nested in it, of rice price determination runs into simultaneity bias: while in a single-equation model, PROC plays no part in influencing price, in a simultaneous-equation model it plays an intuitively plausible and significant role. This effect is reasonably robust, whether we look at all twenty districts or at a smaller subsample of districts (results available with author). Intuitively, this significant influence is probably due to the fact that both prices and, albeit to a lessor degree, procurement have "structural" as well as "transitional" components. The unscrambling of demand effects from supply leads to a better understanding of the relationship of the underlying structural components in the two variables. For the overall period studied here, procurement program has an independent and positive effect on rural rice prices. This is not to say that the operation of the program has become any more "farmer-friendly" than in the past. The point of the matter is that this has been a period of an accelerating commercialization of farm surpluses and of increasingly keen marketing performance, while farmers were the pricemakers without even leaving his farmyard (Chowdhury, 1992). The fact that, given such a reorientation of the marketing system, procurement program can mattter to prices, would not be hard to take. Besides, this has been a quinquennium with a declining price trend. government purchase by adding to aggregate demand did, as expected, raise prices. However, the effect remains small.

The context can take a little more elaborate discussion of the implications of the individual coefficients of the rice system estimated, taking rice price equation first.

All the coefficients in this equation are intuitively signed, and except three all others are highly significant. Incomes and public procurement by shifting demand raise

price. Increases in lean-season prices by signalling future scarcities and by inducing more precautionary storage during the interval immediately preceding the harvest lowers prices during the harvest seasons, perhaps due to decisions to release such stocks. On the other hand, the appearance of harvest, the HYVs, public rice stocks all have significantly negative coefficients.

Rice procurement is significantly influenced in the by rice production, and the extent of HYV adoption. Lagged adjustment in rice procurement is pervasive: similar results were also reported by Shahabuddin (1992).

The estimated offtake equation performs much better than procurement. Several results are noteable. First, rice rationing system is egregiously "inequitable": the higher are averages incomes, the higher is per capita ration issue.[18] The two coefficients on the two prices --- administered and market --- testify compellingly to bargain-hunting by the average, admittedly nonpoor, ration user. Public stocks by raising rice offtake significantly suggest a responsiveness to storage capacity as a logistic consideration, possibly for contemporaneous procurement. Lagged adjustment is significantly positive also in this case, although this is less so than for the procurement activities.

Model validation

Following earlier literature, we validate the model by estimating Theil's Inequality Coefficient (TIC) (Theil, 1961).[19] Table 3 reports TICs for two samples of the underlying districts.

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[18]This assessment of the rationing echoes those due to Ahmed (1979) and Chowdhury (1988).

[19]Theil Inequality Coefficient is estimated using the formula:

$$T.I.C = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(PV-AV)^2}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(PV)^2} + \sqrt{\frac{1}{n}\sum_{i=1}^{n}(AV)^2}}$$

PV	=	Predicted value
AV	=	Actual value
n	=	sample size

Estimated TIC for price is reasonably low. It is lower still when the sample is reduced to a more homogeneous collection. At least for purposes of a reasonably informed pricing policy discussion, this low TIC prompts the empirical observation that the model is valid. The TICs are much higher for the procurement and ration offtake variable, but that is endemic in this type of models in Bangladesh. For procurement variable at least, the model performance is better than in other models.

Responsiveness of price to exogenous variables

Model results allow a comparison between the elasticities of rice price with respect to explanatory variables in the system (Table 4).[20] It suffices for present purposes to highlight the following findings. First, no variable is more potent in raising rice price as incomes growth. Second, the procurement program does have a small effect on prices. But gains in the public rice stocks are more than twice as potent in distabilizing market prices as rice procurement: note the responsiveness of price to public rice stocks. Public procurement, is working at cross purposes with public rice stocks policy. This is happening because, private traders' stocks are displaced by 44 percent (Chowdhury, 1993, Table 4) for each doubling of public rice stocks.

Rice production and the diffusion of the high yielding varieties exert more poweful downward pressures on market prices than the procurement program can ever come close to offsetting. But note that incomes growth, unaided by procurement program at that, can almost exactly offset the price depressing effects of production and technological change. This highlights that price policy has its overlaps with the overall growth strategy. By empowering people in general and poor people in particular with incomes, hopefully through productive employment, public policy can go some length towards achieving the imperatives of output price policies while avoiding the excessively wasteful forms of rice procurement, such as the MP as practised in Bangladesh.

Policy reform versus price effects of procurement

The interpretive account of the policy changes in the period following 1988 finds a fairly compelling sequel in certain aspects to the results in Table 2. For instance, the

[20]Note that underlying observation intervals are of uneven duration. But that is true of Shahabuddin model, too, and does not affect the results at issue.

model we estimate describes the triennium to June 1992 much better than it does the two-year interval previous to it. Rice procurement is effective in proppping up prices in this second period, while in the first it is ineffectual. Rice production has rapidly increased in this subperiod (World Bank, 1993), most probably due to reforms to irrigation access particularly. Much of the production gains have been concentrated in the districts in the Rajshahi Division (Chowdhury, et al. 1994). Production gains, coupled with administrative "mandates", have driven procurement levels to ahistorically high levels. However, rapid gains in commercialization and growing public rice stocks associated with secularly devindling unit rice offtakes implied steady *declines* in long-run trend prices. The markets could do with all the help they could get from anything that added to demand. Public procurement, with a large budget and financed by credit extended by nationalized commercial banks (NCBs), on a suddenly-accelerated scale, naturally met that bill of expediency well. By allowing a "buying spree" on the crest of subsidized credit, procurement program was having an independent positive price effect in the second subperiod.[21]

The point is not so much that public rice procurement has acquired belatedly some cutting edge in matters of price support, which should be obvious enough given the massive bill footed, as that recent agricultural reforms have favorably impacted on rice-sector's production performance.

Cost effectiveness of the Procurement Program

One plausible measure of cost effectiveness is cost benefit ratio (CBR) of rice procurement. CBR is equal to the percentage change in fiscal subsidy (due to rice operations sustained by public procurement) required to elicit an one percent change in rice prices. As it turns out, fiscal subsidy due to procurement --- let us call this SUBPROC --- depends not only on exogenously-determined administered prices but also on endogenously-determined procurement and offtake quantities. Ideally, fiscal subsidy outcome arising from the distribution of procured rice may be seen to be endogenously determined, as an accounting relation. Unfortunately, the requisite data is not on hand to deal with this. In any case, we do have a fall back comparative impotency of rice

[21]This effect is so strong that when the data for both periods are pooled, the coefficient of procurement on prices for the overall period is found to be highly significant.

procurement in supporting prices, a less-than-ideal estimated of the cost effectiveness may be useful, if not adequate.

The inverse of the elasticity of price with respect to procurement quantity is used in this study in lieu of CBR. On the assumption that quantity procured has a proportional relationship with fiscal subsidy, this quantity makes a statement about by what percentage would fiscal subsidy have to change in order to have a one percent change in market price. This exercise says that fiscal subsidy would have to rise by 200 percent if real rice price is to be raised by 1% over the season lasting three months (1/.005 = 200). Put differently, by securing an one off 200% increase in fiscal subsidy, the government can possibly secure an 1% increase in the real price of rice over a period of three months. Obviously, the effect of procurement on rice prices is nearly infinitesimally small. Rice procurement is a costineffective program.

Table 3 — Determinants of nominal rice price using ordinary least squares, 1987/88 - 1991/92

Independent variables	Dependent variable = rice price		
	1987/88-1988/89 (n=152)	1989/90-1991/92 (n=228)	1987/88-1991/92 (n=380)
Constant	570 (18.5)	575 (24.5)	626 (38.2)
Y	.0046 (3.3)	.026 (5.0)	.0023 (2.4)
CROPEXPN	73.8 (0.91)	-22.6 (-.38)	10.7 (.21)
GI	-4170 (-2.1)	-1589 (-2.8)	-1363 (-2.2)
HYV	44.2 (4.0)	-19.0 (-2.8)	-9.6 (-1.6)
PROC	-4033 (3.3)	384 (.76)	327 (.6)
PROD	-623 (-4.05)	-549 (-9.2)	-542 (-8.7)
SURDEF	-57.6 (-4.5)	3.31 (.65)	-1.5 (-.3)
CPI	66.9 (14.8)	53.5 (18.8)	60.7 (24.6)
$\bar{R}^2$	.70	.74	.68

Source: Estimated by the author.

Note: Figures within parentheses in this and the following table are T-statistics.

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Table 4 — Estimates of behavioral equations in rice price model, 1987/88 - 1991/92

	1987/88-1988/89 (n=152)	1989/90-1991/92 (n=228)	1987-1992 (n=380)
Rice price equation			
Constant	572.334 (17.73)	575.699 (24.611)	640 (39.7)
Y	0.005 (1.79)	0.029 (5.517)	0.003 (2.76)
CROPEXPN	64.786 (0.699)	-95.566 (-1.757)	-35.9 (-0.72)
GI	-4239.731 (-1.934)	-2431.633 (-3.724)	-2800.0 (-3.88)
HYV	43.339 (4.04)	-12.995 (-2.071)	-10.2 (-1.77)
PROC	-39915.257 (-0.898)	1649.112 (2.103)	2895.2 (3.14)
PROD	-648.577 (-3.352)	-606.113 (-10.484)	-627.4 (-9.98)
SURDEF	-56.497 (-4.03)	3.000 (0.59)	-3.45 (-0.7)
CPI	66.806 (12.826)	52.105 (18.555)	59.2 (23.8)

Table continued

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	1987/88-1988/89	1989/90-1991/92	1987-1992
Rice procurement equation			
Constant	-0.0016 (-2.034)	0.008 (0.894)	0.005 (1.0)
PROD	0.0033 (3.256)	0.024 (3.386)	0.016 (3.4)
HYV	-1.475E-08 (-0.0002)	0.0006 (0.818)	0.0005 (1.26)
GI	-0.028 (-2.177)	-0.077 (-0.944)	-0.06 (-1.0)
LPROC	0.128 (1.627)	0.691 (8.870)	0.761 (12.858)
SURDEF	0.00012 (1.398)	-0.0003 (-0.597)	-0.0002 (-0.5)
T	-4.126E-05 (-2.071)	0.0006 (2.730)	.0004 (3.25)
Y	4.296E-08 (3.705)	-5.871E-07 (-1.027)	3.8E-08 (.33)
CROPEXPN	-0.0012 (-2.288)	0.003 (0.404)	.001 (.36)
PP	2.084E-06 (2.593)	1.624E-05 (1.611)	1.1E-05 (1.8)
LOFF	0.0065 (0.672)	-0.273 (-0.702)	-0.043 (-.43)
CPI	6.275E-06 (0.0613)	-0.004 (-5.548)	-0.003 (-6.8)

Table continued

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	1987/88-1988/89	1989/90-1991/92	1987-1992
Rice offtake equation			
Constant	-0.008	-0.007	-0.009
	(-2.431)	(-7.071)	(-6.31)
Y	6.735E-07	-3.029E-07	6.104E-07
	(6.736)	(-2.264)	(10.11)
IP	-9.408E-06	-6.757E-06	-1.046E-05
	(-2.141)	(-5.393)	(-5.141)
PR	1.491E-05	1.534E-05	1.770E-05
	(2.505)	(8.476)	(6.147)
GI	0.129	0.081	0.09
	(1.395)	(6.467)	(4.027)
LOFF	0.16	0.12	0.189
	(1.953)	(1.924)	(3.768)
SURDEF	0.0005	0.0002	0.0004
	(0.863)	(1.641)	(2.108)

Source: Estimated by the author

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Table 5 — Computed Theil Inequiality Coefficients of three endogenous variables

	This study					Shahabuddin Study				
	Seasons					Seasons				
	I	II	III	IV	All	I	II	III	IV	All
PR	.024	.019	.019	.026	.022	.024	.043	.038	.035	.036
PROC	.23	.37	.31	.48	.35	.543	.359		.681	.48
OFF	.31	.27	.26	.33	.29	.24	163	.283	.254	.22

Source: Computed by the author; Shahabuddin's estimates are from Shahabuddin 1992.

Note: The seasonal intervals are slightly different as between this study and Shahabuddin study.

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Figure 1 - Actual and Predicted Rice Price of Bangladesh

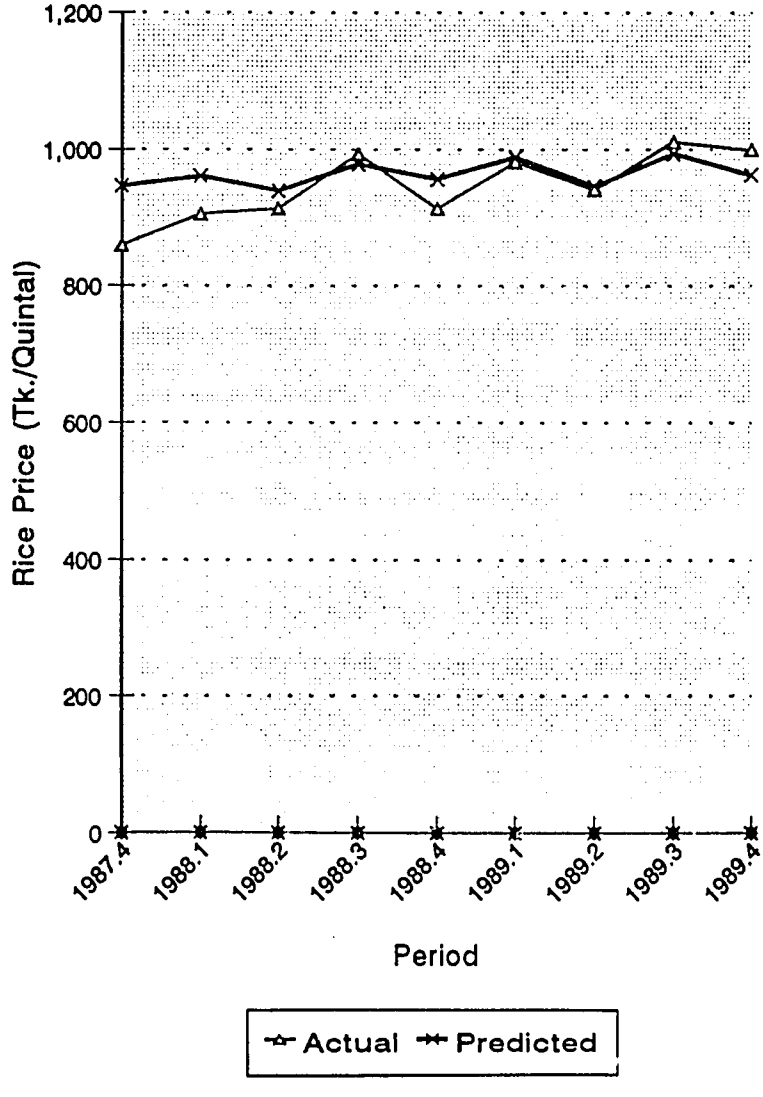

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Figure 2 - Actual and Predicted Rice Price of Bangladesh

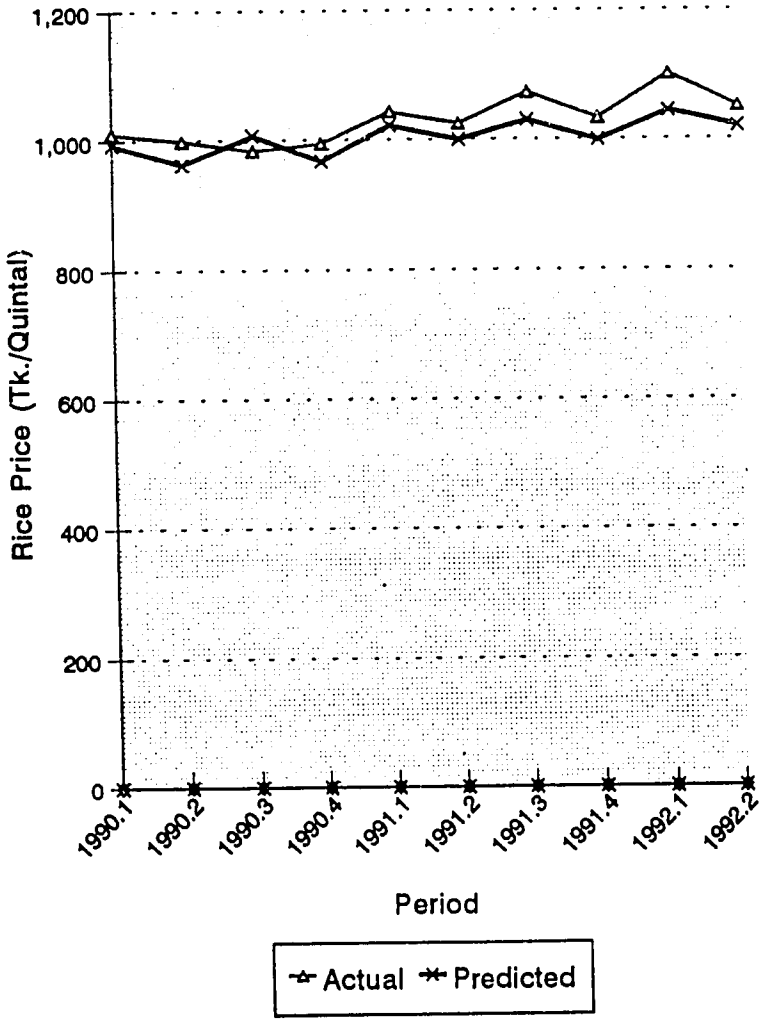

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Table 6 — Elasticities of price with respect to several behavioral and policy variables

Price elasticity with respect to	1987/88-1988/98	1989/90-1991/92	1987/88-1991/92
INC	0.023	0.12	0.015
CROPEXPN	0.002	-0.003	-0.0008
GI	-0.011	-0.014	-0.013
HYV	0.017	-0.006	-0.0046
PROC	-0.007	0.006	0.005
Q	-0.019	-0.027	-0.024

Source: Computed by the author

Notes: INC denotes per capita income; GI denotes public rice stocks; HYV denotes the proportion of rice acreage under HYVs; PROC denotes rice procurement; Q = rice output
All elasticities computed at arithmetic means; underlying coefficients are from models having CPI as a regressor in price equation.

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REFERENCE

Ahmed, A. U., 1992. "Operational Performance of the Rural Rationing Program in Bangladesh", Washington, D.C.: International Food Policy Research Institute, Food Policy in Bangladesh Working Paper No. 5.

Ahmed, J.U. et al., 1980. "Paddy Procurement System", Dept. of Cooperatives and Marketing, Bangladesh Agricultural University (mimeo.)

Ahmed, Raisuddin, 1979. *Foodgrain Sypply, distribution and Consumption Policies within a Dual Pricing Mechanism: a Case Study of Bangladesh*, Washington D.C.: IFPRI Research Report 8.

Ahmed, Raisuddin, 1981. "Foodgrain Distribution Policies within a Duel Pricing Mechanism: The Case of Bangladesh", in Mahmud, W. (Ed.), *Development Issues in an Agrarian Economy---Bangladesh*, Dhaka: Centre for Administrative Studies.

Ahmed, R., and Bernard, A., 1989. *Rice Price Fluctuation and an Approach to Price Stabilization in Bangladesh*, Washington, D.C.: IFPRI, Research Report No. 72.

Ahmed, R., Chowdhury, N. and Ahmed, A.U., 1993. "Determination of Procurement Price of Rice in Bangladesh", Washington, D.C.: International Food Policy Research Institute, Working Paper No. 6, Bangladesh Food Policy Project.

Bouis, H., 1983. "Seasonal Rice Price Variation in the Philippines: Measuring the Effects of Government Intervention", *Food Research Institute Studies*, Vol. 19, No. 1, pp.81-92.

Chowdhury, N., 1987. "Seasonality of Foodgrain Price and Procurement Programme in Bangladesh since Liberation: An Exploratory Study", *The Bangladesh Development Studies*, Vol. XV, No. 1, March.

Chowdhury, N., 1988. "Urban Rationing in Bangladesh: The Distribution of its Benefits", *The Bangladesh Development Studies*, Vol. XVI, No. 2, March.

Chowdhury, N., 1990. "Optimal Foodgrain Stocks for Bangladesh: Policy Issues and Some Evidence", paper presented to Workshop on Public Food Distribution and Price Stabilization held at Dhaka, January 1990, under the auspices of the Ministry of Food and IFPRI, Washington, D.C., January.

_____, 1992a. "Rice Markets in Bangladesh: A Stucy in Structure, Conduct and Performance", Dhaka: Bangladesh Food Policy Project, IFPRI, Dhaka, October.

_____, 1992b. "A Reassessment of Bangladesh's Poverty Record, 1974-1984", *The Bangladesh Development Studies*, December.

_____, 1993a. "Reassessment of Bangladesh's Poverty Record: A Future Comment on Osmani", *The Bangladesh Development Studies*, March.

BEST AVAILABLE DOCUMENT

_____, 1993b. "Credit Relations amid Bangladeshi Rice Market: where sharing is the currency", Dhaka, Bangladesh Food Policy Project, IFPRI, June (draft).

_____, 1993c. "Interactions between Private Rice Stocks and Public Stock Policy in Bangladesh: Evidence for a Crowding Out", Dhaka, Bangladesh Food Policy Project, IFPRI, June (draft).

_____, 1994. "Credit and Bangladesh's Foodgrain Market: New Evidence on Commercialization, Credit Relations and Effects of Credit Access", Dhaka, Bangladesh Food Policy Project, IFPRI, April (draft).

Chowdhury, N., Morris, M., And Meisner, C., 1994. "Comparative Advantage of Wheat in Bangladesh: Dhaka, IFPRI/CIMMYT, April (draft).

Goletti, F., Farid, N., and Rahman, S., 1993. "Preliminary Results of Comparisons between DAM and DGF Price Series for Rice", Dhaka, Bangladesh Food Policy Project, IFPRI, March (draft).

Guisselquist, D., 1992. "Giving Bangladesh's Farmer Greater Access to World Markets", paper read at World Bank, Washington, December.

Haggblade, S., 1993. "Does Price Stabilization Matter Anymone to Low-income Consumers in Bangladesh?" Dhaka: BFPP, IFPRI, August (mimeo.).

Hall, L. L., 1980. "Evaluating the Effects of P.L. 480 Wheat Imports on Brazil's Grain Sector", *American Journal of Agricultural Economics*, February.

Leamer, E. E. and Stern, R. M., 1970. *Quantitative International Economics*, Chicago: Aldine Publishing Co.

Lyton-Evans, J., "Logistic Study (on Bangladesh)", Dhaka: Ministry of Food, May 1986.

Ministry of Agriculture/Food and Agriculture Organization, "1992-93 Census of Minor Irrigation in Bangladesh", Dhaka, February 1994.

Montgomery, R., 1983. "Open Market Grain Sales as a Public Policy Instrument for Moderating Food Price Flactuations in Bangladesh", Dhaka, July (mimeo.).

Osmani, S.R., 1993. "Reasssessment of Poverty Record: A Rejoinder", The Bangladesh Development Studies, March, pp. 69-78.

Osmani, S.R., and Quasem, M. A., 1990. *Pricing and Subsidy Policy for Bangladesh Agriculture*, Dhaka: BIDS, Research Monograph # 11, February.

Rahman, A., and Mahmud, W., 1988. "Rice Market Intervention in Bangladesh", in *Evaluating Rice Market Intervention Policies: Some Asian Examples*, Manila, April.

Rahman, M., 1994. "Liberalization of Credit for Growth", Dhaka: IFPRI, January.

BEST AVAILABLE DOCUMENT

Raj Krishna and Chhibber, A., 1983. "Policy Modeling of a Dual Grain Market: The Case of Wheat in India", Washington, D.C.: International Food Policy Research Institute, May.

Ravallion, M., *Markets and Famine*, Oxford: Clarendon Press, 1987.

Samad, A., Haque, A., and Sidhu, S.S., 1989. "Low Cost Intervention Study for the Fertilizer Market of Bangladesh", Dhaka, IFDC, November.

Shahabuddin, Q., 1992. "A Disaggregated Model for Stabilization of Rice Prices in Bangladesh", *The Bangladesh Development Studies*, March.

Theil. H., 1961. *Economic Forecasts and Policy*, Amsterdam: North-Holland, 1961.

Timmer, C.P., Falcon, W., and Pearson, S., 1983. *Food Policy Analysis* Baltimore: John Hopkins.

Timmer, C.P., 1989. "Food Price Policy The Rational for Governemtn Intervention", *Food Policy*, pp. 17-27.

World Bank, Bangladesh: *Food Policy Issues*, Washington, D.C.: 1979.

World Bank, Bangladesh Food Policy Review: Adjusting to the Green Revolution, Washington, February.

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Appendix - 1

Seasonal Classifications used in this paper

The object of this appendix is to lay out the classification of the four time intervals into which, for this analysis, monthly data were arranged. It should be noted here that a season is usually longer than a month, and a number of studies using Bangladeshi data have resorted to monthly data after due aggregation.

Market price seasonalities are found to characterize Bangladesh's rice economy (Chowdhury, 1987). A plausible basis for defining seasons is arguably one that corresponds to seasonal price shifts. One such basis is as follows

		Pure seasonality factor defined on basis of market prices			
Season I :	September-October (pre-aman)	102.5	103.8		
Season II :	November-February (aman)	96.6	91.3	95.6	99.4
Season III:	March-April (pre-boro)	104.7	108.4		
Season IV :	May-August (boro/aus)	101.3	98.4	99	98.6

This basis has the advantage of sharply dividing off the year into two seasonal intervals each of high Season IV however cuts across a fiscal year: something is to be said in favor of presentation of results by the fiscal year. Further, it may well be the case that, as well as being due to the arrival of aman harvests, the prolongation of low seasonal prices in season II in the above scheme is due to the seasonal peaking of grains distributed through nonmonetized channels, e.g. the Food for Works Program (FFWP) during the dry season. More than aman harvests may be involved in this season. For these two reasons, this basis may not be an ideal one.

The isolation of the veritable seasonal troughs of price seasonality, and the peaks in private market arrivals to match is vital in this study. December and June return the troughs, and these are also the months that register higher marketing virtually

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by all classes of agents of any months (Chowdhury, 1994). Therefore, in this study we adopt the following seasonal taxonomy

Season I : July-October
Season II : November-December
Season III: January-April
Season IV : May-June.

An alternative seasonal classification was also tried, as follows

Season I : August-October
Season II : November-January
Season III: February-April
Season IV : May-July.

By statistical criteria, this classification returned significantly poorer results. The first scheme was thus retained.

Season I is assumed to accomodate the aus harvest, in August-September. Season II by assumption accommodates aman harvest. Season IV is assumed to coincide with the boro harvest. Nothing is harvested in season III. (Shahabuddin (1992) and Chowdhury (1990) employed more varietally-specific assumptions as to monthly seasonality of rice harvests, which we avoid in this study. The reason simply is that it hard to be sure how correctly the harvest assumptions of the World Bank report (1979) would describe the relaties at the greater district level. A shortcut was used instead.

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