Welfare Effects of Selected Food-grain Policies in India

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Abstract

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  Government's policy interventions in the market for food-grains affect supply as well as demand. In this paper, the welfare effects of certain food-grain policies are analysed while taking into account the interdependence of the various sectors in the economy. Adequate structure is built into the model in order to study the effects of a dual price structure on farmers' supply response, and also the effects of public distribution schemes on the aggregate demand for food-grains. Policy implications are derived by computing the market clearing prices and their movement under alternative assumptions regarding the nature of the market.

Introduction

In this study the implications of the following policy interventions of the government are studied:
- compulsory procurement of food-grains from farmers at a price lower than the market price;
- distribution of food-grains at a concessional price to consumers through the public distribution scheme (PDS); and
- policies relating to the disposal of excessive food stocks.

Government policies toward agriculture since independence have focussed on (a) increasing domestic production through input subsidies, providing irrigation facilities, etc.; and (b) providing food subsidies to consumers through PDS, famine-relief, food-for work programmes, and so on. The history of price controls and other food policies in India is well documented in Chopra (1981). The present system of public distribution of food-grains started during the

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period of the Second World War. The PDS has, in the main, three sources of food-grain supply, i.e., domestic procurement, imports and depletion of inventories. The central and state governments, along with various supporting organisations, carry out the functions of procurement, transportation, storage and distribution of food-grains. The procurement and sale prices of food-grains from the central pool are determined by the Department of Food based on the recommendations of the Commission for Agricultural Costs and Prices.

In order to protect the poor who suffer the most due to price fluctuations and provide them with at least the subsistence level of consumption, the government distributes a part of the total supply through the PDS at a concessional price.

It will be of interest to policy makers to know what impact the procurement policy has on farmers' supply response and what effects the PDS has on the distribution of food-grains. The present model has been designed to answer such questions. The effects of various policies are examined using different simulations. Policy implications can be derived by computing the market clearing prices and their movement under alternative assumptions regarding the nature of the market.

For the policy simulation exercises, a general equilibrium model with eleven sectors[1] has been used. A brief description of the model follows. The economy is divided into eleven sectors. For each sector, we have estimated demand and supply functions using time-series data for the period 1960-61 to 1980-81. The balance between demand and supply is achieved either through a price mechanism or a rationing mechanism. The balancing prices or rationing parameters are computed using a fixed-point algorithm. The sectoral classification is presented in the Appendix.

Government's policy controls (direct or indirect) affect the demand, supply and the generation and distribution of incomes. A change in the procurement price, for example, leads to changes in the supply of food-grains and the incomes of farmers. The general equilibrium models take into account the interdependence of sectors and hence they are useful tools for the study of total changes due to any policy change.

The plan of this paper is as follows. In Section 1, the effects of government procurement policy on the aggregate supply of food-grains is enunciated. In Section 2, the welfare effects of the public distribution scheme and the distributional implications are described. In Section 3, the focus is on the evaluation of the alternative options open to the government for the disposal of surplus foodstocks. Finally, in Section 4, the various results obtained are summarized.

1. Effects of procurement policy on the supply of food-grains

Does the government procurement policy depress prices received by farmers? This is an empirical question. A price lower than the market price is paid

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[1]For a more detailed description of the model refer to Chetty et al. (1986).

by farmers for the government's purchases of food-grains. Therefore, it appears that farmers may be financing the food subsidy involved in the public distribution scheme. But this may not necessarily decrease farmers' profits, since the price on the open market may increase to such an extent that the weighted average price may be greater than the price prevailing prior to government intervention.

This can be explained with the help of a diagram, as in Chetty and Jha (1983). In Fig. 1, the curves labelled S and D denote respectively the aggregate supply and the aggregate demand functions under free-market conditions – that is, with no government intervention. The equilibrium price is p^0 and the corresponding output is Q^0. Now, if the farmers are required to supply a fraction θ of their output at the procurement price $\bar{p}$, what will the new supply curve be? If the open market price is p^1 then the farmer effectively receives a price $p^1_\theta = \theta\bar{p} + (1-\theta)p^1$. Thus at the open market price p^1, the supply of output is obtained by finding the weighted average price p^1_θ and then determining the corresponding output from the S curve. It can be noted that when the open market price is $\bar{p}$, the weighted average price is equal to $\bar{p}$. Thus, the supply curve under the dual pricing policy and the supply curve under free-market conditions will intersect at $(\bar{p}, Q^s)$. If the open-market price is above $\bar{p}$, the
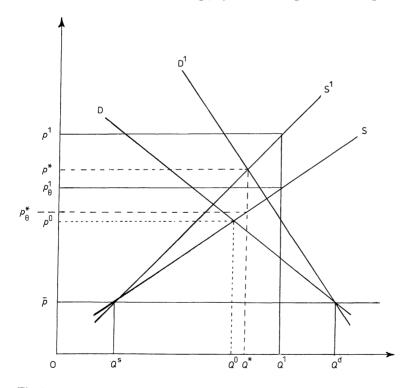

Fig. 1.

supply under dual pricing will be less than the supply under free-market conditions. Thus the supply curve under dual pricing, S^1, is obtained by suitably rotating the curve S around the point $(\bar{p}, Q^s)$.

The aggregate-demand curve under dual pricing can be similarly obtained. Let the open-market price be p^1. With dual pricing, consumers obtain an income subsidy of $D(p^1-\bar{p})$ where D is the total ration quota. Assuming food-grains to be normal goods, this will lead to an increase in aggregate demand. If the open market price is also $\bar{p}$, then this effect is zero. This means that demand curves under dual pricing and free-market conditions will intersect at $(\bar{p}, Q^d)$. For open-market prices greater than $\bar{p}$, the demand curve under dual pricing, D^1, will be to the right of D, the demand curve under free-market conditions. These curves are shown in the figure.

With the help of the curves D^1 and S^1 we obtain, under dual pricing, the equilibrium output Q^* and the weighted average price p^*_θ, respectively. Depending on the elasticities of the demand and supply curves we could either have $p^*_\theta < p^0$, $p^*_\theta = p^0$ or $p^*_\theta > p^0$. Correspondingly, $Q^* < Q^0$, $Q^* = Q^0$, or $Q^* > Q^0$. $p^*_\theta = p^0$, $Q^* = Q^0$ implies that the revenue received by the producers under dual pricing is the same as that received under free-market conditions. This means that, with dual pricing, the loss in revenue due to sales at the controlled price is exactly matched by the gain in revenue due to sales in the open market. The buyers of food-grains in the open market exactly subsidize the buyers in the ration shops. It is simply a redistribution of income from the relatively rich to the poor. In the case where $p^*_\theta > p^0$, the producers will also benefit.

Thus, equilibrium prices will have to be computed for both cases – with procurement, and without procurement. The equilibrium-weighted average price in the first case can be compared to the equilibrium price in the second case. If the former price is higher than the latter then there will not be any adverse effects on output due to the procurement policies.

For the purposes of this exercise the following features have been incorporated into the model. The food-grains sector consists of estimated demand-and-supply equations for each of the cereals rice, wheat and jowar (see Appendix). The government is assumed to procure a fixed quantity (15 million metric tonnes) of food-grains from farmers. It is assumed that 9 million t of wheat and 6 million t of rice is being procured, since other cereals form a small fraction of the total. All the exogenous values used for the simulations correspond to the year 1980–81. The procurement price is fixed at 120 (price index, 1970–71=100), which is about 70% of the open-market price. The aggregate-supply function depends on the weighted average price, among other variables.

For this set of simulations it is assumed that the entire quantity of procured food-grains is distributed through ration shops at a concessional price. For simplicity, the ration price is assumed to be equal to the procurement price. This implies that there is no effect on the government budget due to its procurement and rationing policies. In the estimated aggregate-demand equations

for both rice and wheat, the ration quantity enters as one of the explanatory variables. The situation where there is no government intervention is obtained in the model by making the ration quantity entering the demand functions equal zero, and by taking θ to be zero, when it enters the expression for the weighted average price.

Six different weather conditions – using hypothetical values for the rainfall indices – have been assumed, and for each of these scenarios equilibrium prices have been computed for two situations, i.e. with and without dual pricing.

The results (see Table 1) reveal that the weighted average price under the procurement policy is greater than the open-market price in the absence of procurement policy. This is true for both rice and wheat, and for all the weather conditions assumed. This leads to the conclusion that farmers really do not have disincentives to produce more under the dual-pricing policy adopted by the government. Similar results were obtained in earlier studies. For example,

TABLE 1

Effects on prices due to procurement policy

	Prices under different weather conditions					
	(1)	(2)	(3)	(4)	(5)	(6)
Rice						
with procurement	178.0	150.7	171.8	166.0	160.6	155.5
without procurement	170.4	142.5	164.1	158.2	152.6	147.4
Wheat						
with procurement	190.8	175.6	186.9	183.3	179.9	178.0
without procurement	175.1	159.4	171.1	167.4	163.9	161.9

Prices quoted in the 'with procurement' case refer to the weighted average price received by the producers and those quoted in the 'without procurement' case refer to the open-market price.

The six different weather conditions correspond to the different rainfall-index values given in the table below:

Rainfall scenario	Rainfall index		
	Rice	Wheat	Jowar
1	70	50	100
2	120	160	150
3	80	75	110
4	90	100	120
5	100	125	130
6	110	140	140

in a study by Subbarao (1977) it has been shown that farmers were compensated for the lower price through a 'sufficient' rise in the open-market price.

From the preceding results, one can also infer the following. Insofar as small farmers are excluded from levy obligations, they can benefit more than large farmers from a higher (higher than the weighted average price which large farmers receive) open-market price. But their benefits are limited to the quantities of their marketed surplus.

2. Welfare effects of the public distribution scheme

Using the computed equilibrium prices the welfare effects of the dual pricing policy on the various income classes in both rural and urban areas can be assessed.

Providing a ration quota (D) at a price ($\bar{p}$) lower than the equilibrium open-market price (p^1) means an income subsidy of $D(p^1-\bar{p})$ for a consumer who buys at least as much as the ration quota. But then, an increase in the open-market price due to the PDS will mean some loss to the consumer, assuming that his/her total demand remains unchanged after the introduction of the dual-pricing policy. This loss is given by the expression $(p^1-p)x$, where x is the total demand and p the open-market price in the absence of the dual-pricing policy. The net effect may be a loss or gain, depending upon the amount he/she consumes. The net monetary benefit can be calculated using the following expression:

$$D(p^1-\bar{p}) - (p^1-p)x$$

This expression is derived as follows. Let an individual's utility function at price p and income m be given by the indirect utility function $V(p, m)$. If the open-market price under rationing is p^1, the utility of the individual is given by $V(p^1, m+D(p^1-\bar{p}))$ if total consumption is at least D. The change in utility dV is given as:

$$dV = \frac{\partial V}{\partial p}dp + \frac{\partial V}{\partial m}dm$$

$$\approx \lambda[-(p^1-p)x + D(p^1-\bar{p})]$$

where λ is the marginal utility of money, and x total demand. Assuming λ to be equal to unity we obtain the expression:

$$dV = D(p^1-\bar{p}) - (p^1-p)x$$

Based on the NSS (28th round) consumption data relating to the year 1973–74, and using the preceding equation, the net benefits accruing to the different expenditure groups have been calculated (see Table 2).

It can be seen that the relatively poorer people gain while the relatively richer

TABLE 2

Net benefits due to dual pricing

Expenditure group (Rs.) per caput per month	Consumption (kg) per caput per month		Welfare gain due to PDS (Rs)		
	wheat	rice	in wheat	in rice	Total
Rural India					
0– 8	1.47	1.14	0.38	0.12	0.50
8– 11	1.58	2.65	0.35	−0.09	0.26
11– 13	1.25	3.17	0.45	−0.16	0.29
13– 21	2.35	4.19	0.12	−0.30	−0.18
21– 34	4.40	6.83	−0.50	−0.67	−1.17
34– 75	6.79	9.24	−1.21	−1.01	−2.22
75–150	9.85	10.14	−2.13	−1.14	−3.27
150–250	12.60	10.60	−2.95	−1.20	−4.15
Urban India					
0–265	5.78	6.32	−0.91	−0.60	−1.51
265–517	8.30	6.99	−1.67	−0.69	−2.36
517–724	10.00	6.38	−2.18	−0.61	−2.79
724–969	6.72	2.47	−1.19	−0.06	−1.25

Rs., Indian rupee.

people lose. This is a clear case of a transfer of income from the rich to the poor.

The main purpose of the PDS is to supply a minimum portion of the total grain supply at a concessional price to the vulnerable low-income population who would starve due to any significant increase in the price of food-grains

TABLE 3

Welfare loss when left out of PDS network

Average expenditure (Rs.) of the expenditure group	Welfare loss (Rs.)			Percentage loss
	in wheat	in rice	Total	
Rural India				
4.0	0.44	0.16	0.60	15.00
9.5	0.47	0.37	0.84	8.84
12.0	0.36	0.44	0.80	6.66
17.0	0.70	0.57	1.27	7.47
27.5	1.32	0.96	2.28	8.29
54.5	2.04	1.29	3.33	6.11
112.5	2.96	1.42	4.38	3.89
200	3.78	1.48	5.26	2.63

brought about by drought and/or inflation. However, it is mostly the urban population that benefits by this scheme. The rural areas, where a higher percentage of the population below the poverty line resides, are hardly being served.

Since the open-market price (with procurement) is higher than the price prevailing in the absence of compulsory procurement of cereals, the group which is left out of the PDS will incur definite losses. Assuming rural people are left out of the PDS, losses incurred by them have been calculated using the expression $x(p^1-p)$. As can be seen from Table 3, the relatively poorer people are affected the worst in terms of loss as a percentage of average expenditure.

3. Problem of surplus food stocks

Food stocks held by the government have been rising, and the trend is likely to continue in the coming years. The costs of carrying the stocks are also rising. To quote from the *Economic survey* (Gov. India, 1985–86): "Foodstocks reached record levels in June 1985 (29.17 million metric tonnes) and, with a good Rabi harvest, stocks are likely to remain at high levels next year...excessive foodstocks are a financial burden and reflect both a problem of distribution and, perhaps as important, a supply problem...".

The long-run solution to this problem is to devise policies to increase purchasing power through employment generation. But, in the short run, the problem of surplus stocks can be solved through effective food-subsidy programmes. Part of the stocks could be exported if possible.

Thus, in the short run, the government can be considered to have basically two options in disposing of the excessive food stocks:

(1) The supply of subsidized food (or free food) through different social welfare programmes could be increased.

(2) The government can sell the stocks in the open market.

Exporting of food-grains is not politically feasible in the light of poverty prevailing in the nation. The second option is likely to depress food-grain prices, which is not in the interest of farmers. Since food aid is targeted to the poor, who cannot afford to buy enough food to meet their requirements, the amount distributed, free of charge, would just add to the existing consumption and is therefore likely to have the least effect on prices and on production.

In order to study the effects on the distribution of food-grains demand equations for food-grains as a whole for each of the income groups have been calibrated using price and expenditure elasticities obtained from Murty and Radhakrishna (1981). These elasticities are tabulated in Table 4. A log-linear specification is used for these calibrated equations. In order to incorporate the effects of food aid on demand, a subsidy quantity, equal to the open-market price multiplied by the quantity distributed, is added to the income of the relevant group. For example, if the food-grains are to be distributed among the three lowest income groups, then the subsidy is divided among the income

TABLE 4

Elasticities of demand for food-grains

Elasticities with respect to	Income groups									
	Rural					Urban				
	1	2	3	4	5	6	7	8	9	10
Price of food-grains (cereals)	−0.920	−0.784	−0.545	−0.205	−0.327	−0.894	−0.730	−0.357	−0.147	−0.178
Income (total expenditure)	0.973	0.895	0.767	0.443	0.323	0.962	0.748	0.490	0.135	0.154

Source: Murty and Radhakrishna (1981).
  The above income groups correspond to different per-caput expenditure levels as given below:

Income group	Monthly per-caput expenditure range in Rs. (1973–74 prices)
1 and 6	0–34
2 and 7	34–43
3 and 8	43–55
4 and 9	55–75
5 and 10	75 and above

groups in proportion to their population. This ensures per-caput food aid to be equal across the groups.

The results from the simulations (see Table 5) reveal the following:

(1) In the case of distributing food-grains (10 million t) free of charge, there is an approximately 2% decrease in the price of food-grains, and the total supply decreases by 1%.

(2) In the case of the sale of foodstocks (10 million t) in the open market, the open-market price decreases by 16%. This is mainly due to the initial increase in the total supply of food-grains in the market. This decrease in the price has an adverse effect on the supply of food-grains (total supply decreases by 8%).

Inequality in food-grain consumption is reduced in both situations 1 and 2, but the reduction is much more in case 1.

Thus, it appears from the preceding simulations that, of the two options open to the government, the first, namely the distribution of foodstocks in the form of food aid, is the better.

TABLE 5

Effects of disposing of surplus foodstocks

Policy change	Gini ratios for food-grain consumption		Percentage change in		
	Rural	Urban	Food-grain quantity	Food-grain price	GNP
No change	0.189 415	−0.036 384	–	–	–
Food aid	0.154 328	−0.062 275	−0.998	−2.28	−1.096
Sale of food-grain in the open market	0.177 037	−0.66 143	−8.330	−16.178	−6.070

GNP denotes Gross National Product.
Free food is assumed to be given to the three lowest income groups in both the rural and urban sectors.

4. Summary of the results

The findings of this study can be briefly summarized as follows.

It is found that the weighted average prices (for both rice and wheat) received by the producers in the case of dual pricing are greater than the free-market prices obtained in the case of uniform pricing. This shows farmers really do not have disincentives against producing more under the procurement policies and the public distribution scheme introduced by the government. It is also seen that the consumption inequality of food-grains is reduced due to the PDS. Thus a better distribution of food-grains can be achieved while reinforcing the growth of food-grain output.

The effect of PDS on various income groups shows that (in both rural and urban areas) the relatively poorer groups gain while the richer sections lose. This is a clear case of redistribution of income from the rich to the poor. It has also been observed that when not covered by PDS the poorer people are the worst affected.

Two alternatives have been considered in tackling the surplus-foodstocks problem in the short run: distribution of food-grains free of charge to the vulnerable sections of the population through poverty-relief programmes, public works programmes, etc., and sale of food-grains in the open market. In both these cases it was found that the distribution of food-grains improves but there is a decrease in the growth rate (real GNP). This is due to the fall in the food-grain price, the fall being greater in the latter case, and hence the decrease in the supply of food-grains is also greater. On the whole it is found that the first option is better than the second.

Acknowledgement

Appendix

Sectoral classification

The economy is divided into the following eleven sectors:
 (1) food-grains
 (2) industrial raw materials
 (3) consumer non-durables other than textiles
 (4) consumer durables
 (5) construction
 (6) plant and equipment
 (7) basic and intermediate goods
 (8) services
 (9) textiles – cotton
 (10) textiles – synthetic
 (11) bank credit

Data sources and empirical estimates

The time-series data used in the analysis is from the year 1960–61 to 1980–81. The wholesale price indices $(1970–71 = 100)$ for the various cereals have been obtained from Chandhok (1978). Weighted indices have been obtained for the substitute crops by taking the production figures as weights. The income figures were taken from the *National Accounts Statistics* (Gov. India, various years). The rainfall indices have been obtained from S.K. Ray (1983). The free-market demand used as the dependent variable in the estimated equations was derived from the figures in the *Bulletin on Food Statistics* published by the Indian Ministry of Agriculture (Gov. India, various years).

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ESTIMATED DEMAND EQUATIONS FOR CEREALS

Rice

$$S_1 = 0.49 + 0.056 \log p_1 - 0.035 \log p_2 - 0.078 \log \left(\frac{M}{P}\right) - 2.585 \text{ SD1}$$

| (3.08) | (−1.95) | (−3.73) | (−2.32) |
| [−0.554] | [−0.279] | [0.386] | [−0.206] |

$\bar{R}^2 = 0.52$; D.W. $= 1.95$

Wheat

$$S_2 = 0.158 + 0.01175 \log p_1 + 0.00647 \log p_2 - 0.034 \log \left(\frac{M}{P}\right) + 1.15 \text{ SD2}$$

| (1.514) | (1.22) | (−1.014) | (2.69) |
| [0.15] | [−0.92] | [0.567] | [0.32] |

$\bar{R}^2 = 0.71$; D.W. $= 1.614$

Jowar

$$S_3 = 0.255 - 0.03 \log p_1 + 0.0146 \log p_2 + 0.023 \log p_3 - 0.045 \log \left(\frac{M}{P}\right)$$

| (−1.79) | (0.926) | (1.72) | (−2.13) |
| [−0.89] | [0.426] | [−0.315] | [−0.323] |

$\bar{R}^2 = 0.45$; D.W. $= 1.77$

S_1, S_2, S_3 are the shares of expenditure on free-market purchase of rice wheat and jowar, respectively; p_1, p_2, p_3 are the prices and SD1, SD2 are the shares of expenditure on public distribution quantities of rice and wheat respectively. (M/P) is the total private final consumption expenditure deflated by the general price index.

( ), [ ] contain t-values and elasticities respectively.

ESTIMATED SUPPLY EQUATIONS FOR CEREALS

Rice

$$Q = -50\ 992 + 194.51P_{-1} - 162.775 \text{ SP}_{-1} + 1615.2\ \text{IR} + 270.8R$$

$$\quad\quad (4.79) \quad\quad (-3.25) \quad\quad (3.19) \quad\quad (5.61)$$

$$\quad\quad [0.496] \quad\quad [-0.428] \quad\quad [1.521] \quad\quad [0.668]$$

$\bar{R}^2 = 0.92$; D.W. $= 2.58$

Wheat

$$Q = -13\ 444 + 151.6P_{-1} - 49.58 \text{ SP}_{-1} + 404.11\ \text{IR} + 48.97R$$

$$\quad\quad (3.386) \quad\quad (-1.914) \quad\quad (3.13) \quad\quad (2.494)$$

$$\quad\quad [0.744] \quad\quad [-2.288] \quad\quad [1.017] \quad\quad [0.204]$$

$\bar{R}^2 = 0.89$; D.W. $= 2.05$

Jowar

$$Q = -886.78 + 0.379Q_{-1} + 576.631\ \text{IR} + 19.11P + 24.66R - 11.37 \text{ SP}$$

$$\quad\quad (1.366) \quad\quad (1.266) \quad\quad (1.152) \quad (1.051) \quad (-7.04)$$

$$\quad\quad\quad\quad\quad\quad [0.366] \quad\quad [0.231] \quad [0.262] \quad [-0.14]$$

$\bar{R}^2 = 0.2133$; D.W. $= 1.77$

Q is the total production (or supply) of the cereal.
P is wholesale price index of the crop.
SP is the weighted price index of the major production substitutes of the crop.
IR is the percentage of area under irrigation out of the total cropped area of the cereal.
R is the crop-specific rainfall index.
( ), [ ] contain t-values and elasticities respectively.
Subscript '-1' indicates that the variable is taken with a one-period lag.

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