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Benefits and Costs of Food Distribution Policies

The India Case

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ABSTRACT

BENEFITS AND COSTS OF FOOD DISTRIBUTION POLICIES: THE INDIA CASE

This paper analyzes some of the characteristics and the main consequences of the food distribution policies followed by the Indian Government and provides a quantification and a cost benefit analysis of their effects on: (i) consumers, (ii) producers, and (iii) the government budget.

Despite a leakage of the benefits to unintended beneficiaries and procurement and distribution costs, the analysis shows that even a moderate concern with the nutritional status of the poor makes the schemes a worthy economic and social intervention, although it is possible that other policies would achieve the same effects more efficiently. However, there appears to be little scope for expanding the distribution system beyond its present size unless substantial gains can be made either by extending it to the rural areas or by cutting its costs.

BENEFITS AND COSTS OF FOOD DISTRIBUTION POLICIES: THE INDIA CASE

Table of Contents

	<u>Page No.</u>
I. Introduction	1
II. Some Basic Characteristics of Indian Food (Distribution) Policies	3
III. Price and Income Effects of the Food Distribution Program ..	7
IV. Consumption and Market Prices With and Without Intervention.	10
V. Estimation of Social Gains	14
VI. Net Government Cost/Revenues	18
(a) Import Costs	20
(b) Marketing and Administrative Costs	21
VII. Estimation of Costs and Benefits	26
VIII. Assumptions and Limitations of the Study	33
IX. Conclusions	35
APPENDIX	37
BIBLIOGRAPHY	43

PREFACE

The benefit-cost analysis is made for the year 1974 for three reasons. It was a year of unusually high world prices for grain so that consumers benefited substantially from the ban on private exports of food grains that has been in effect for more than a decade. Producers surplus loss was correspondingly large. Second, substantial quantities of grain were distributed through the ration system. Third, the N.S.S. Sample Survey on Consumer Expenditures for the year 1973-74 was used in an earlier study to estimate private and social demand elasticities for India as well as the numbers of undernourished and the nutritional gap. These estimates were essential for the estimation of social gains.

However, procurement policies have changed in a major way since 1974. Upto 1977, food distributed through ration shops was partly procured from farmers and millers at a price below the open market price. Surplus areas were cordoned off and private inter-state movement of grain was greatly restricted in order to facilitate the Government's procurement operations. In 1977 however, food zones were abolished and procurement is no longer compulsory as a matter of routine. This situation has continued and procurement prices have become essentially support prices at harvest time.

The control over external trade that characterized the period up to 1974 however continues, making possible a diversion between domestic and international prices. Procurement prices for rice have remained below international prices since 1974, while wheat procurement prices have on occasions been higher than international prices.

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BENEFITS AND COSTS OF FOOD DISTRIBUTION POLICIES: THE INDIA CASE

by

Pasquale L. Scandizzo and Gurushri Swamy 1/

I. Introduction

1.01 The views held by economists on food distribution schemes in developing countries are often slightly contemptuous. While it is admitted that political considerations make the abolition of the schemes a practical impossibility, it is maintained that food distribution policies (i) are harmful to agricultural producers, (ii) reach only a small number of the malnourished while mainly benefiting government bureaucrats and the urban middle class, (iii) are a source of inefficiency and corruption, and therefore (iv) have large administrative costs.

1.02 As for similar strong tenets of conventional wisdom, it is difficult to find quantitative studies supporting these views. While the inefficiency of the schemes is often the object of anecdotes documenting special cases, no comprehensive cost benefit analysis has been presented, to our knowledge, even for the largest programs.

1.03 The reason why the evidence on food distribution remains non-quantitative is basically threefold. First, it is difficult to measure the impact of the schemes on the intended beneficiaries. Second, while food procurement costs may be easy to measure, opportunity costs, administrative inefficiencies and leakages are difficult to systematically quantify. Finally, methodologies to estimate the benefits of the schemes are only now becoming available and are only slowly being applied to the evaluation of social projects.

1.04 The price and income effects of food distribution programs, particularly large ones, are complex and difficult to identify except in a general equilibrium framework. Indeed, these programs are often a combination of a number of policies, which include trade policies, domestic procurement, and rationing of food. The last cannot be studied in isolation, because although it is the centerpiece of the system, it is supported by and exists within a larger set of policies affecting food consumption and production in general. These policies create large transfers between producers and consumers and substantial government outlays, all of which need to be evaluated.

1.05 This paper provides a cost-benefit analysis of food distribution policies in India based on the Social Demand Framework developed by Scandizzo and Knudsen.^{1/} In essence this framework suggests that there is a special value that society as a whole attaches to increased food consumption of those who are likely to be malnourished. This value is reflected in a shadow price for calories which is (a) higher than the market price and (b) is higher the greater the extent of malnutrition in the society. The consumers' surplus gain of the malnourished which results from either the general or the specific (to the target group) income and price effects of food distribution policies can then be evaluated with reference to this shadow price as a "social" surplus.

1.06 The evaluation is made for the year 1974. This year was selected because of three reasons. It was a year of unusually high world prices for foodgrains so that consumers benefited substantially from the export ban on foodgrains (see 2 below) while producers surplus loss was large. Second, substantial quantities of foodgrains were distributed through the ration system. Third, the N.S.S. Sample Survey on Consumer Expenditures for the year 1973-74

^{1/}1. P.L. Scandizzo and O. Knudsen (1980).

is at the base of the Scandizzo/Knudsen estimates of private and social demand elasticities which are used to estimate the social gains in this paper.

II. Some Basic Characteristics of Indian Food (Distribution) Policies

2.01 Since independence, India has maintained a ban on private exports of foodgrains. Although the government can export food on its own account or specially license some private exports, Table 1 shows that such exports have been small. Whether grain exports would be larger in the absence of the export ban is not very clear. T.W. Schultz ^{1/} shows that between 1961 and 1972, the domestic price of rice (wholesale price of coarse variety of rice in Sambalpur, Orissa converted to US\$ at the unofficial black-market rate) was, on average, 50% of the border price of rice where the latter is the unit value of Indian rice imports. (Clearly, the latter is a C.I.F. price, and the relevant price for Indian farmers would be lower by the unit value of international freight and insurance charges, and the unit cost of transportation within the country.) During the same period, the domestic price of wheat (wholesale price of Moga wheat in Punjab) was almost equal to the world price i.e. to the C.I.F. unit cost of Indian wheat imports. He argues that without government intervention and controls in trade and production, India would have increased production (and presumably exports) of rice.

2.02 However, this evidence on prices is insufficient to settle the question. First, as pointed out above, the C.I.F. unit cost of imports of rice needs to be adjusted for the international and domestic freight charges to make the price comparable to domestic price. The freight charges for transporting wheat from Canada and the US to India is quoted to be \$16.4 per ton in 1972-73, i.e. about 18.3% of the F.O.B. unit value of wheat imports into India.^{2/} If this rate could be applied to the price of rice imports,

^{1/} T.W. Schultz (ed) (1978).

^{2/} FAO Trade Yearbook, Vol. 31, 1977.

Table 1
INTERNATIONAL TRADE IN CEREALS

	Exports		Imports		
	Total Cereals	Rice	Total Cereals	Rice	Wheat
	(million metric tons)				
1961	0.001	0.001	3.495	0.384	3.092
1962	0.001	0.001	3.640	0.390	3.250
1963	0.003	0.003	4.556	0.483	4.073
1964	0.003	0.003	6.226	0.645	5.621
1965	0.005	0.003	7.462	0.783	6.583
1966	0.009	0.002	10.358	0.787	7.784
1967	0.007	0.004	8.678	0.453	6.348
1968	0.006	0.003	5.694	0.446	4.766
1969	0.026	0.015	3.872	0.487	3.090
1970	0.052	0.027	3.631	0.206	3.425
1971	0.027	0.016	2.054	0.240	3.425
1972	0.027	0.015	0.445	0.131	0.314
1973	0.024	0.018	3.614	-	2.414
1974	0.045	0.041	4.874	-	4.203
1975	0.020	0.019	7.407	0.130	7.016
1976	0.043	0.038	6.483	0.117	5.832
1977	0.120	0.019	1.031	0.125	0.859
1978	0.972	0.245	0.396	0.071	0.321
1979	1.186	0.492	0.434	0.107	0.317

Source: Bulletin on Food Statistics, Government of India publication, various issues, and Food and Agriculture Organization, Trade Yearbook, Vol. 33.

then the opportunity cost of not exporting rice would be reduced by 18.3% and the domestic (wholesale) price of rice would, on average, have been 70% of the world price, and not 50% as quoted by T.W. Schultz, (and the domestic price of wheat would be higher than the world price).

2.03 While this may constitute a sizeable incentive, we must also consider the problems of different varieties of rice. The unit value of rice imports (the total quantity imported has been small as can be seen in Table 1) reflects the price of Burmese NSMS (Ngasein Small Mill Specials) variety and the price of Thai par-boiled rice, and the 45% broken variety.^{1/} Although comparable varieties are grown in India, the world price of these varieties may underestimate the effective opportunity cost for Indian farmers since rice exports from India, to the extent allowed, have been of high quality rice.

2.04 Along with an export ban, India has imported on government account, quantities of wheat (and some rice) in deficit years (see Table 1). A substantial quantity of these imports (particularly of wheat) were on concessionary terms during the 1960s, and data for the early 1970s shows that even during 1970-72, concessionary imports and gifts (from the US and Europe) formed 70% of total imports. Nevertheless, in 1974 (which is the year of our study) only 3% of imports were on a concessionary basis.

2.05 The central and most state governments have also organized a system of public food distribution through ration shops and fair-price shops. These shops have sold limited quantities of rice and wheat (and until recently, sugar) at prices below the open market price. Some of the relevant data are given in Table 2. The system has operated largely in big metropolitan

/1 V.A. Sukhatme (1977).

Table 2: IMPORTS AND PUBLIC DISTRIBUTION OF FOODGRAINS IN INDIA

Year	Procurement	Imports	Public Distribution	Imports as % Distribution	Per Capita Availability	% of Foodgrain Consumption Contributed by the Public Distribution System
	(mil. ton)	(mil. ton)	(mil. ton)		(grms/day)	
1951	3.82	4.80	7.99	60.0	367	N.A.
1956	0.04	1.44	2.08	66.7	417	3.32
1961	0.54	3.64	3.98	87.9	468	5.26
1962	0.48	3.64	4.37	83.2	462	5.71
1963	0.75	4.56	5.18	88.0	442	6.92
1964	1.43	6.27	8.67	72.3	453	11.05
1965	4.03	7.46	10.05	74.0	526	11.92
1966	4.01	10.36	14.09	73.5	410	17.83
1967	4.46	8.67	13.17	65.8	401	19.17
1968	6.81	5.69	10.22	55.6	460	11.77
1969	6.38	3.87	9.39	41.2	446	10.96
1970	6.71	3.63	8.84	41.0	457	9.88
1971	8.86	2.05	7.82	26.2	470	8.29
1972	7.67	0.45	10.48	4.2	467	10.89
1973	8.42	3.61	11.40	31.6	424	12.80
1974	5.68	4.87	10.79	45.0	453	10.90
1975	9.56	7.41	11.25	66.0	408	12.50
1976	12.85	6.52	9.17	71.0	457	9.00
1977	9.96	0.55	11.74	0.04	437	11.81
1978 /1	11.00	0.95	9.90	0.0	473	9.09

/1 Provisional

Source: Bulletin on Food Statistics, various issues.

and urban areas. Apart from location which favors urban and small-town consumers, there have been no attempts to target food towards low income consumers. The regional distribution of the quantity rationed suggests further that deficit and politically sensitive states received priority, ceteris paribus, over politically stable and/or surplus states.^{1/}

2.06 The quantity distributed was partly procured from farmers and millers at a price which is below the open market price. In order to facilitate this procurement, the country's surplus states and districts were cordoned off to prevent inter-state private movement of grain. This measure depressed the open market price in the surplus areas, and facilitated procurement operations. Imports have also been channeled through the public food distribution system, i.e., imported grain has not been sold directly on the open market.

2.07 Procurement prices are fixed by the central government on the basis of recommendations made by the Agricultural Price Commission which is influenced not only by the costs of production but also by the political strength of the farmers' lobby.^{2/} Issue prices are presumably administered welfare prices, but in recent years they have been set too low to cover the

/1 For detailed description, see G. Swamy, AGREP Division Working Paper 1979. In recent years, there have been attempts by state governments to locate ration shops in rural areas and even in surplus states and supply adequate quantities of grain to them.

/2 Although the procurement price fixed by the commission is mandatory for the states, it has been pointed out that many states actually paid a much higher price to the farmers. In the year 1973-74, the average price paid to farmers of wheat was 3% higher than the recommended price, while the price paid for rice is computed to be 12% higher. It is difficult to assess the reliability of these figures, since different varieties for rice have different recommended prices, and the paddy-rice conversion ratios are also different. See R. Krishna and G.S. Raychoudhri (April 1980).

costs of procurement and distribution so that the central government finances a substantial subsidy to consumers, particularly of wheat.^{1/}

III. Price and Income Effects of the Food Distribution Program

3.01 The food distribution program can be interpreted as equivalent to a cash subsidy to urban consumers of a value $(P - P_d)Q_R$ where P is the open market price, P_d is the ration price (which has been typically set at 66% of the open market price) and Q_R is the quantity distributed. Because the income transfer occurs through food, it has been suggested by at least one empirical study^{2/} that a form of food illusion occurs which induces an increase in consumption over and above the increase that would be produced by a cash subsidy. However, for the purposes of this paper, we assume that the marginal propensity to consume out of food income is the same as out of cash income.

3.02 In addition to the income transfer which benefits only those consumers who receive the rationed food (and would, ceteris paribus, raise domestic prices) there is a general price decline for all consumers because imports (which are also distributed through the ration shops) add to domestic supply.

3.03 The effect of the food distribution policies on producers' prices and their welfare cannot be unequivocally predicted. While the income transfer raises demand and prices, ceteris paribus, the export ban and imports reduce them. On the other hand, at any open market price, the compulsory procuring of

/1 For details see G. Swamy (1979). The subsidy from the central government has been paid to the Food Corporation of India, which handles imports, procurement and distribution (to states) of grain for the central government. In addition, state governments operate their own Civil Supplies Corporations; the latter have not been known to receive financial assistance from the state government.

/2 Shubh Kumar (1979).

a certain fraction of the production at a price which is below the open market price reduces the (weighted) average producers price that farmers face.

Producers' welfare is also reduced by a loss in income since procurement is essentially a tax on their production.^{1/} A reduction in their income reduces their demand for food, thus affecting consumer prices.

3.04 The basic relationships representing the way the different variables interact are put together in a simple mathematical model relating the effects of procurement, imports and distribution on the open market price of grain, and on the weighted average producers' price that farmers face. The model, which is described in the Appendix, is used to predict these prices in the presence of an export and import ban on private transactions that permits domestic prices to differ from world prices. The model's predictions are then used to evaluate the effects of the export ban and the food distribution system. ^{2/}

3.05 In general, the model shows that both open market prices and producers' revenues are likely to be depressed by the government policies, even though this is not necessarily the case in every year and for other countries. The income effects of the rationing system, however, are multiple

/1 It can be seen that procurement of a fraction λ of supply at price $P_c < P$ where P is the market price is equivalent to a tax of $(P - \pi)S(\pi)$ where $\pi = \lambda P_c + (1 - \lambda)P$ and $S(\pi)$ is total supply.

/2 T.N. Srinivasan and M.S. Alhuwalia (mimeo), have modeled the effect of procurement and/or distribution on producers' prices. In spirit and basic formulation, our model is similar. However, their model does not specifically consider imports and emphasizes the differential effects on surplus states (where most of the procurement was made) and deficit states (where most of the grain was distributed with little or no procurement). Because of restrictions on inter-state movement of grain, market prices varied among states as well. Admittedly our assumption of a single market price for grain is a simplification and the distributive impact of both procurement and distribution among states is assumed away. Nevertheless, the major relationships and broad magnitudes are brought out even with this level of aggregation.

and intricate and much less easy to predict. While the distributed grain creates an income transfer to urban consumers, procurement taxes rural residents' incomes and their consumption falls, thus offsetting the former effect. Imports depress prices for all consumers and producers, but increased procurement tends to raise the open market price. The net effect on rural incomes is also difficult to predict, since it depends: (i) on the effect on the open market price, (ii) on the quantity procured, and (iii) on the impact on employment and supply. Nevertheless, for a wide range of "typical" parameters the effect tends to be negative under the circumstances considered.

IV. Consumption and Market Prices With and Without Intervention

4.01 Table 3 shows the values of the parameters for evaluating the model presented in the Appendix. The model is used to predict the hypothetical market price that would have prevailed in the absence of imports, distribution and procurement. While most of these parameters have one observable value for the year, the income elasticities and the budget shares, particularly for the rural sector, have to be chosen carefully. This is because the effect on price of the income transfer between rural producers and urban consumers depends quite critically on which income classes in the rural areas finance the transfer and which in urban areas receive it, so that the corresponding income elasticities (and budget shares) are quite important.

4.02 We have assumed in this paper that all urban consumers receive the food ration and that therefore it is appropriate to use an average (urban) income elasticity and budget share. However, on the procurement side, it is not very clear whether an average elasticity (and budget share) is appropriate. This is because the organization of the procurement system tends to concentrate on the larger and richer farmers.

Table 3

(OBSERVED) QUANTITY AND PRICE DATA FOR 1974 AND THE ASSUMED PARAMETERS OF THE MODEL

θ	= quantity distributed	10.8 million metric tons
D	= total demand for grain	96.8 million metric tons
β	= θ/D	.1116
α	= S/D	0.9463
S_c	= quantity procured	*5.68 million metric tons
λ	= S_c/S , where S = supply	.062
m_u	= the budget share of food in urban areas	0.68
m_r	= the budget share of food in rural areas	0.75 (0.62)
η_{ry}	= rural income elasticity for calories	0.50 (0.43)
η_{uy}	= urban income elasticity for calories	0.45
η_p	= average price elasticity for calories	-0.38
η_s	= supply elasticity	0.2
t_d	= $\frac{P-P_d}{P}$	0.37
t_c	= $\frac{P-P_c}{P}$	0.42
t_π	= $\frac{P-\pi}{P}$, where $\pi = \lambda P_c + (1-\lambda) P$	0.026

- Note
- (a) All quantity data refer to the calendar year 1974.
 - (b) Budget shares from N.S.S. Sample Survey on Consumer Expenditure 1973-74.
 - (c) Income and price elasticities from the calorie demand equation in O. Knudsen and Scandizzo "Nutrition and Food Needs in Developing Countries" 1979, adjusted for rural-urban differences.
 - (d) Information on (a) the ratio of procurement price to market price and (b) the ratio of issue price to procurement price are used to derive t_d , t_c and t_π : Source: F. H. Sanderson and S. Roy, Food Trends and Prospects in India, 1979 and Agricultural Prices Commission, India, "Report on Price Policy for Kharif and Rabi Cereals, 1978.

4.03 Although the methods of procurement have varied from state to state, the principal means of procuring rice has been through a levy on the millers of rice.^{1/} (A graded levy on farmers has been used by five states, but none of these have contributed substantially to total procurement.) In effect therefore, this does not affect farmers who grow largely for self-consumption and/or mill their own paddy with traditional means. Again, the principle means of procuring wheat has been through open market purchases and is unlikely to have affected all the farmers.

4.04 It is for this reason that two alternative values for the budget share and income elasticity of rural consumers are given in Table 3. The first is a set of values implying the assumption that all rural producers finance the transfer. The second (in parenthesis) is a set of low income elasticity and budget share based on the assumption that only the richer farmers suffer an income loss.

4.05 That the model used is quite sensitive to these assumptions can be seen in Table 4 showing consumption and supply levels (in cereal equivalents) consistent with two hypothetical prices and at the world price. If we assume average elasticities for the rural population, absence of intervention would, it appears, raise the market price but would not affect total consumption much (136.4 million tons of cereal equivalents compared to 137 million tons with intervention). This is because while urban consumers face both a price increase as well as a loss in income, rural consumers would have an increase in income large enough to offset all the other price and income effects.

4.06 On the other hand, if we assume that the rural income loss is financed only by the wealthy farmers, the ensuing hypothetical market price would be lower

/1 See G. Swamy (1979) for details - pp. 14-18.

Table 4: SENSITIVITY ANALYSIS OF PRICES, CONSUMPTION AND SUPPLY

	Price US\$	Consumption		Supply million tons	Exports and Changes in Stocks
		(i)	(ii)		
P_w = World Price	328	132.9 (93.9)	125.8 (88.9)	138.3 (97.7)	5.4 (3.8)
(i) P_{OH}^1 = Hypothetical open market price, without intervention, based on average rural elasticity	307			136.4 (96.4)	136.4 (96.4)
(ii) P_{OH}^2 Hypothetical open market price without intervention, based on low rural elasticity	283			133.9 (94.6)	133.9 (94.6)
P_0 = Open Market price with intervention	250			137.0 (96.8)	131.8 (91.6)

All quantities are in terms of calorie equivalent of 3.5 million calories per ton.
 Figures in parenthesis are the quantities of grain consumed/supplied.

Notes: (a) The consumption of 1.37 million tons is with food distribution and export ban. The consumption of calories is estimated by O. Knudsen and P. Scandizzo and includes an adjustment for non-grain sources of calories. Domestic supply at this price is consumption minus imports and changes in stocks.

(b) The hypothetical price is estimated as

$$P_{OH} = \frac{P_0}{1 - \frac{dP}{P}}$$

where $\frac{dP}{P}$ is estimated from expressions (8) and (9) in the model (see Appendix). The domestic supply P_{OH} equals supply at P_0 plus the increase in supply because of the higher price that would have prevailed. By definition, supply equals demand at P_{OH} .

(c) The world price P_w is the (weighted) average of the rice and wheat price (FOB) for two years, i.e. 1973 and 1974. The weights are 0.6 and 0.4 for rice and wheat respectively, and approximate the developing countries' share in world exports. The rice price refers to the Thai 5% broken variety, while the wheat price refers to US No. 1 Soft Red Winter Wheat. Source: Commodity Price Forecasts, World Bank.

(\\$283) and it would entail a definite decline in total consumption. The urban consumers would lose their income transfer and would reduce consumption while the corresponding increase in rural consumption would be small because of the smaller income elasticity and budget share of the richer farmers.

4.07 Consumption at world prices also differs since the effect of the removal of the export ban would result in a different percentage increase in prices and hence consumption depending on whether the hypothetical price is lower or higher. Exports would also be different, being substantially larger if we assume that the procured grain comes largely from rich consumers.

V. Estimation of Social Gains

5.01 Cost benefit evaluation of trade policies has traditionally been cast in terms of partial equilibrium welfare analysis. For example, in a recent paper, Lutz and Scandizzo^{1/} measure the welfare gains (losses) of producers and consumers from price policies in several developing countries. The measurements are made under the two-fold assumption that (i) the same weight can be assigned to the increase in consumption (or consumer surplus) of the poor and of the rich and (ii) that the only effects of the program are of partial equilibrium nature, i.e., no consequences occur other than the first round increase in prices and incomes due to the direct effect of the policies.

5.02 Within the partial equilibrium framework, an alternative and widely used method of evaluation of food distribution and other social programs is based on the cost effectiveness criterion. In the context of food distribution, this methodology measures the fiscal cost of increasing the consumption

/1 Lutz and Scandizzo (1979).

of malnourished individual(s) by a unit amount.^{1/} While this method is more sensitive to increases in the welfare of the poor, it implicitly assumes that the incremental benefits from increasing the consumption of the target group are constant, i.e., the benefits are not related to either the degree of malnutrition or the decline in malnutrition achieved.

5.03 As such, the methodology is unable to specify the optimal scale of nutrition interventions, except in the normative sense that a country should alleviate malnutrition in all its target population by the full amount of the deficit. Typically, however, most countries operate under various constraints on expenditures and considerations of losses in producer incentives further limit the possibilities of alleviating malnutrition. The evaluation of the scale of these programs must therefore be made in this context, in order to establish an optimal size for the program or policy.

5.04 The social demand framework developed by Harberger and more recently, by Scandizzo and Knudsen,^{2/} is an attempt to overcome these limitations. In this approach, an increase in consumption of the malnourished is considered a social externality originating from the fact that society as a whole attaches value to the fulfillment of a "basic need" standard by all its members. When applied to food, such an externality is reflected in a shadow price of calories whose value increases with the extent of malnutrition. The consumers' surplus gain of the malnourished is then evaluated with reference to this shadow price and is a "social surplus". The marginal benefits can thus be seen to decline as malnutrition declines; and the optimal scale of the nutrition programs can be identified as one in which benefits equal costs.

/1 Reutlinger and Selowsky (1976) and Selowsky (1980).

/2 Scandizzo and Knudsen (1979).

5.05 The basis of the Scandizzo-Knudsen approach, which is the one that we follow in this paper's analysis, is the definition of an aggregate social demand function for food as the sum at any one price of two quantities: (i) the recommended (calorie) intake for the people that would consume below it and (ii) private demand for the people that would choose, at the given price, to consumer the recommended intake or more.

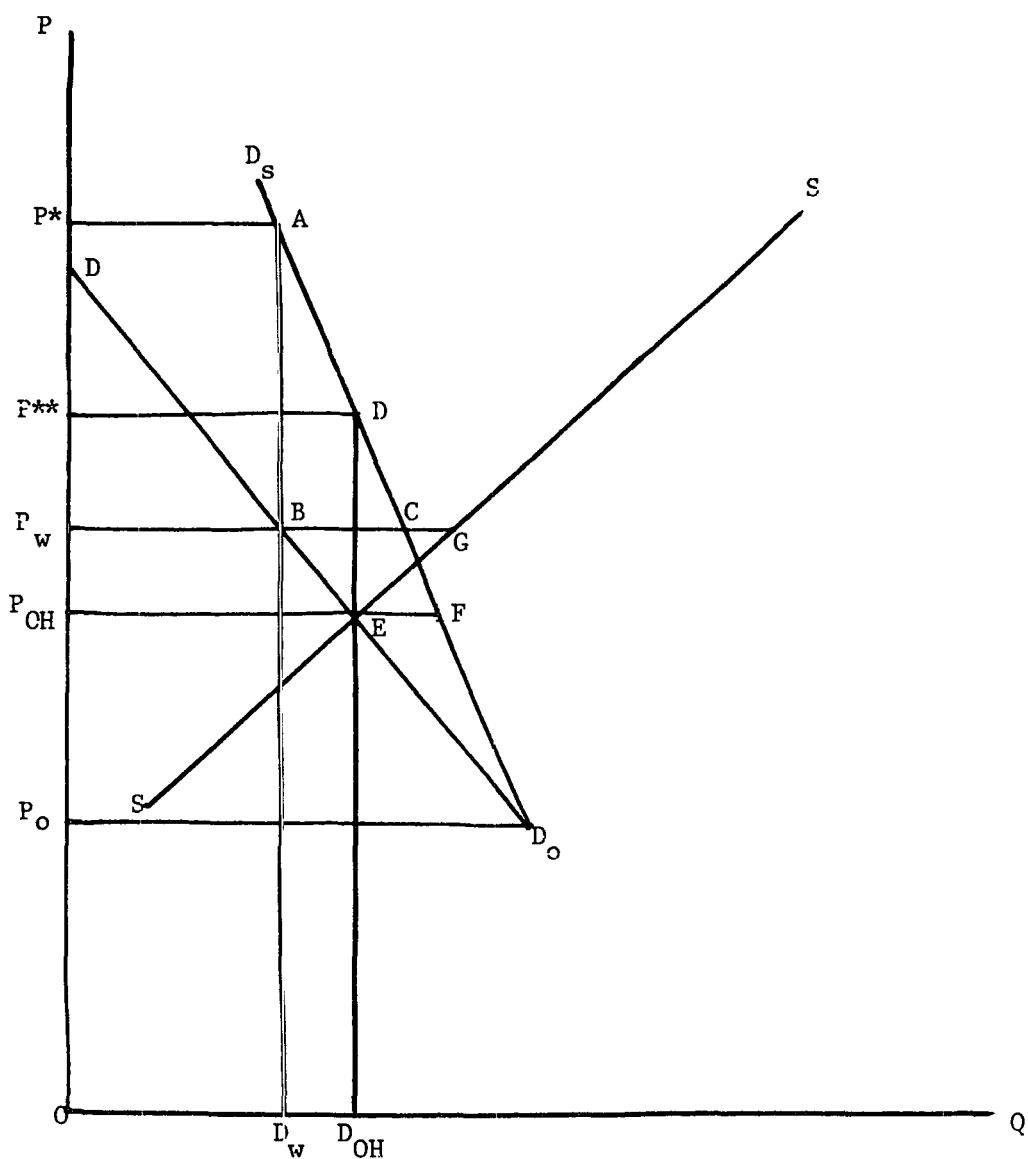
5.06 Given the definition, the social demand schedule can be used to obtain, for any given quantity, a measurement of a social willingness to pay, or a social price. Scandizzo and Knudsen show that this is the price that would prevail if all the malnourished (or the people who are so defined by virtue of a social standard) were given an amount sufficient to meet the social standard and then removed from the market. The price that the rest of the people would pay for the remaining quantity to clear the market is the social price as it embodies the implicit tax necessary to make possible the attainment of the norm.

5.07 Figure 1 shows in simplified terms how this approach can be used to evaluate the consequences of the Indian export ban. In the figure social demand D_s is represented by a line indicating a higher level of demand at each price above P_o than shown by the private demand schedule DD_o . The two demand functions, however, converge at D_o , P_o since at this point price is sufficiently low that everybody would demand at least the amount required by the social standard. Naturally, as price gets closer to this convergence point, the two demand functions also tend to be progressively closer to one another.

5.08 The export ban policy is equivalent to a prohibitive export tax and has the consequence of lowering domestic price to P_{OH} below world prices P_w . In terms of the social demand, this implies an increase in "social" consumers'

Figure 1

SOCIAL GAINS FROM THE EXPORT BAN POLICY



surplus equal to the difference between the two triangles ABC and DEF, and an increase in "private" consumers' surplus equal to the trapezoid $BE P_{OH} P_w$.

Producers' surplus loss due to the fall in prices (or the implicit export tax) is the area under the supply function equal to $GEP_{OH} P_w$.

5.09 Figure 2 illustrates the basis for quantifying gains and losses from food distribution cum procurement policies. Because of the design of the scheme, the food distribution program basically creates an income transfer to urban consumers, financed partly by the rural producers, and partly through imports. Because of this transfer to the urban consumers, there is a shift to the right in aggregate private demand. As for social demand, it will also shift to the right since part of the transfer goes to the well-nourished (in urban areas) and social demand is defined as the private demand of the rich (well-nourished) plus the requirements of the poor.

5.10 Under the above considerations, social gain is defined as the difference between the social gain achievable from fulfilling the social standard for all consumers at price P_{OH} and consumption level Q_{OH} on the one hand and the social gain that remains to be achieved after the intervention, i.e., at price level P and consumption level Q . Because part of the food distributed comes from imports, food distribution has an effect both on the income of the direct beneficiaries and on the open market price, which is reduced from P_{OH} to P .

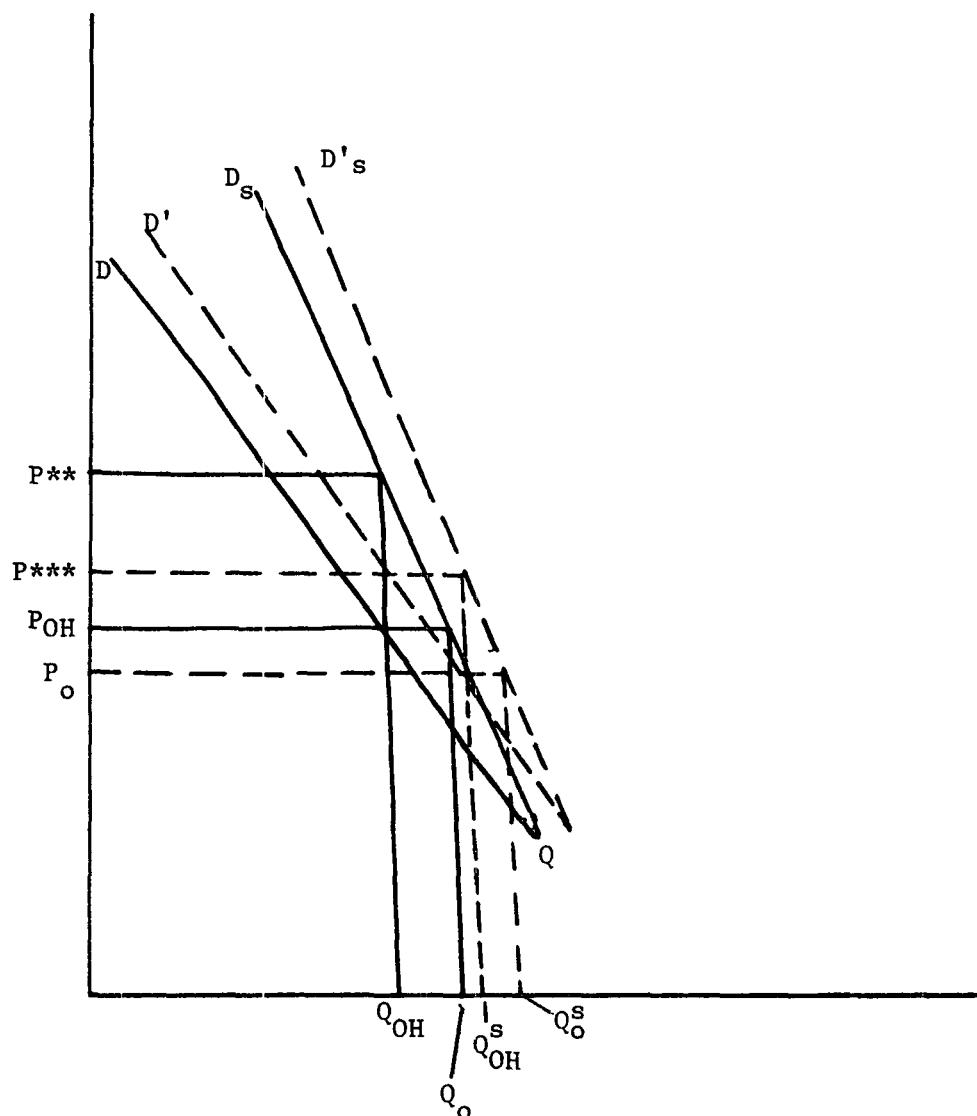
VI. Net Government Costs/Revenues

6.01 The structure of financial costs and revenues for the food distribution system can be written as

$$\begin{bmatrix} \text{Procurement} \\ \text{and} \\ \text{Import Costs} \end{bmatrix} + \begin{bmatrix} \text{Marketing} \\ \text{and} \\ \text{Administrative Costs} \end{bmatrix} - \begin{bmatrix} \text{Revenue from} \\ \text{Sale of} \\ \text{Ration Grain} \end{bmatrix} = \begin{bmatrix} \text{Financial} \\ \text{Subsidy from} \\ \text{Government} \end{bmatrix}$$

Figure 2

SOCIAL GAINS FROM FOOD-DISTRIBUTION SCHEME



Given fixed procurement and issue prices, procurement costs and revenue from sale are determined exogenously. Import costs are also given. This expression shows that net financial costs depend on whether, given these costs and revenues, the system has been able to cover its marketing and distribution costs. The excess of these costs over the margins provided is the net fiscal cost financed by a government subsidy.

6.02 In 1973-74, the central government gave a subsidy amounting to \$310.5 million to the Food Corporation of India, which handles imports, procurement and distribution of foodgrain for the central government. Most state governments also procure and distribute grains within their states, and are constrained to procure the grain at centrally determined rates. These state civil supply corporations, however, have operated, generally, to cover their distribution costs and have not received a government subsidy. The net government costs of the whole system can therefore be taken to be the amount of the central government subsidy.

6.03 In the following pages, we attempt to look more closely at the two major components of fiscal costs: (i) import cost and (ii) marketing and administrative cost.

(a) Import Costs

6.04 As explained elsewhere, India imported 4.9 million tons of grain in 1973-74, only 3% of which was on concessional terms. However 1.8 million tons of wheat were obtained as a barter-loan from the USSR with an agreement to return the grain in some subsequent period. Table 5 shows the details of quantity and approximate CIF value.

Table 5: IMPORTS OF GRAIN IN 1974

		Quantity (million tons)	Approximate CIF Value (Rs) Million	
		(1)	(2)	(3)
Wheat				
Commercial	US	1.92	2,671.6	
	Argentina	0.08	124.4	
	Canada	0.13	409.4	
	Australia	0.15	240.2	
	USSR /1	1.57	497.5	
	USSR /2	0.21	-	2,689.58 /3
Gift		0.15	33.5	
Milo	Commercial	0.67	653.7	
	TOTAL	4.87	4,630.4	

/1 This quantity was obtained on FOB basis and only the cost of freight is given in column 2.

/2 This quantity was obtained on CIF basis and hence no value is imputed in column 2.

/3 Total imputed value of Russian imports.

SOURCE: Bulletin on Food Statistics, Government of India, 1974.

6.05 As can be seen from the table, the barter loan from Russia was treated in a peculiar way. Since a part of the loan came on an FOB basis, only the cost of freight is quoted as the C and F value. For the small part of the loan that came on CIF basis, no value is attached to it.

6.06 It is clear therefore that in an economic sense, the value of imports as given in column (2) of the table is an underestimate, although in a purely financial sense, this is the value of foreign exchange actually paid. If we impute to the Russian wheat imports the same value as for other imports, the total value of the imports bill would be \$842.3 million which implies a unit of value of imports of \$171.9 per metric ton.

(b) Marketing and Administrative Costs

6.07 As expected, these costs are the most difficult to quantify partly because sufficiently detailed data are not available and partly because the food distribution system consists of not one but several corporations. As we have mentioned before, the Food Corporation of India (FCI) is a body which handles

imports of food (and fertilizer) for the government of India, and in addition procures domestic grain for the central government. While FCI stores and distributes centrally procured grain to state governments, most state governments also operate their own civil supply corporations which procure grain and distribute it within their states.

6.08 The reasons for this complex structure are several. Since the original procurement and imports were largely in wheat, the Food Corporation of India (FCI) was set up as the only authority. Even today, most wheat is procured by the FCI and distributed to state governments. However over time, rice procurement increased and both the FCI and the state governments have been involved in these operations.

Table 6: FINANCIAL COSTS OF THE FOOD DISTRIBUTION SYSTEM

		1973-74 (\$ million)
<u>I. Costs</u>		
<u>Import Costs</u>	(i) at world prices	1,592.5
	(ii) official estimates adjusted for the Russian Barter Loan	842.3
	(iii) official estimates	571.7
<u>Domestic Procurement Costs</u>		818.9
<u>Total Costs</u>	(i)	2,411.4
	(ii)	1,661.2
	(iii)	1,390.6
<u>II. Revenues</u>		
From sale of rationed grain		1,698.8
From central government subsidy		310.5
<u>III. Implicit Administrative + Marketing Costs</u>		
Revenue - Procurement costs - Official import costs		619.0
<u>IV. Administrative + Marketing Cost per Kilogram of Grain Distributed</u>		
At the shadow exchange rate = 1.2 the official rate		\$63 per ton

6.09 As a consequence, there are two sets of institutions operating, and their marketing and administrative costs are probably different as well.^{1/} In neither case are detailed and comparable data available. We have therefore used the definition of total costs given in paragraph 6.01 to arrive at an indirect estimate of administrative and marketing costs. Since we know the actual procurement/import costs as well as revenue from sale and the amount of the financial subsidy, the administrative and marketing costs are derived as a residual.

6.10 As Table 6 shows, estimates of administrative and marketing costs (obtained as a residual as explained in para. 6.01) is \$63 per ton of grain which is computed from import costs as reported in the government accounts, since these presumably are the actual costs paid out. If imports are valued at a higher price than at the same unit marketing and administrative costs, and the same issue price, the central government subsidy would have to be larger i.e. \$1331.4 (at world prices) and \$581.2 million (with government Russian imports valued commercially), compared to the actual subsidy of \$310.5 million.

/1 In surplus states, a part of the quantity procured is supplied to the central pool managed by the Food Corporation of India, and the rest is distributed within the state. The Center then allocates its pool (and imports) to deficit states which may either be totally deficit or may need central supplies to supplement their own procurement efforts. To the extent that the states contribute to the central pool, the central government bears the procurement costs. To the extent that state governments receive grain from the central pool, and procure for their own distribution, they bear the costs. Conversely, the issue-price of the central government is the price at which it supplies grain to state governments, the latter then add to the issue price a margin to cover the retailing costs. In states which do not receive grain from central stocks, all procurement, marketing and administrative costs are borne by the state government. The central government subsidy to the Food Corporation of India therefore covers the deficit that this corporation incurs on its operations including supply of grain to state governments. The state governments on the other hand appear to have been covering their costs fully, i.e., the retailing costs on grain obtained from the central pool as well as all marketing and administrative costs on the grain they themselves procure and distribute have been passed on to the consumer. There is then some criticism of the FCI on the grounds that its unit costs are higher than those of the state civil supply corporations or those of private trade. The FCI's salary-structure is also known to be more renumerative.

6.11 Below we make an attempt to compare this estimate with what little information there is from the FCI and the state civil supply corporations. As shown in Table 7, the FCI estimates that the "handling" costs per kilogram of food distributed, which covers all the costs in Part I of the table, (but does not include retailing margins allotted to the retail seller of rationed food), amount to only Rs 129.5 (or US\$16.0) per ton. The data on the costs detailed in Part II and Part III of the table are available for the aggregate of FCI's operations which beside foodgrains, include fertilizers, sugar and some oilseeds. Even if we assume that a large part of these aggregate expenses should accrue to the foodgrain distribution system, distribution costs can be only expected to increase by another 4 or 5 dollars per ton. In comparison to the FCI accounts therefore, our estimates are high.

6.12 It must be noted that neither our estimates nor those derived from the FCI budgets include the retailing margins paid to private retailers to cover their retailing costs. The FCI's budgets do not include these costs because they only cover the expenses incurred in delivering grain to state-governments who are then expected to cover these costs themselves. It is known however that the state governments generally recover these costs (and the marketing costs on the grain they procure and distribute within their states) from the consumer with a suitable mark-up. Our estimates of these costs do not include retailing margins because the issue price of the central government does not cover them.

6.13 Table 7 also shows the percentage distribution of the FCI handling costs (Part I) among its components. These percentages are arrived at on the basis of 1974-75 estimates of the FCI since the detailed breakdown is not available for 1973-74. From those calculated percentages the largest component

Table 7

DISTRIBUTION COSTS OF THE FOOD CORPORATION OF INDIA 1973-74

	<u>Percent</u>	<u>RS Million</u>
I. <u>Handling Cost of Food Operations</u>	<u>100.0</u>	<u>1398.60</u>
(a) Freight	26.1	365.03
(b) Interest	17.6	246.15
(c) Godown-handling charges	6.7	93.71
(d) Storage charges (rent)	6.1	85.31
(e) Storage and transit losses	22.7	317.48
(f) Administrative overheads	20.8	290.31
II. <u>Procurement Charges</u>	<u>100.0</u>	<u>430.2</u>
(a) Mandi (market) fees on grain procured in government (regulated) markets		
(b) -duties and stevedoring charges	3.3	14.1
(c) Purchase/sales taxes		
(d) State government administrative charges	11.9	51.2
(e) Gunny bags, etc.	83.9	361.0
(f) Milling charges	1.0	3.9
III. <u>General Cost on all Operations</u>	<u>100.0</u>	<u>99.10</u>
(a) Repair and maintenance	8.38	8.3
(b) Electricity and fuel	2.52	2.5
(c) Insurance	0.3	0.3
(d) Travel expenses	13.82	13.7
(e) Other miscellaneous expenses	42.28	41.9
(f) Depreciation	32.69	32.4

Note: (i) The costs in II and III are the total costs for all the operations of the FCI, while I represents handling costs on grain transactions only.

(ii) Handling costs are breakdown using the published breakdown for 1974-75.

SOURCE: Food Corporation of India, Annual Report.

appears to be freight, followed closely by storage and transit losses, administrative overheads and interest payments.

VII. Estimation of Costs and Benefits

7.01 The benefits and costs from the export ban and the food distribution system can be written as

- (i) Benefits = Private Consumer Surplus Gain + Social Gains
- (ii) Costs = Producers' Surplus Loss + Net Government Costs
- (iii) Net Benefits = (i) - (ii)

7.02 Before discussing the results, it may be appropriate to describe briefly the major procedures (and assumptions) used to estimate the social prices P^* , P^{**} and P^{***} (which correspond to P_w , P_{OH} and P respectively) and the nutritional gap at these prices.

7.03 The base consumption of 137 million tons (of calorie equivalents) was estimated by Scandizzo and Knudsen, and includes the price effects of the export ban, imports and procurement and the income-transfer effects. Their results show that at a calorie requirement of 1850 calories per capita per day, the number of malnourished (in rural and urban areas) was 136.7 million in the year of the survey, 1973-74, and that the nutrition gap was about 4.6 million tons. The actual consumption of the malnourished was close to 22 million tons or 16% of consumption of the population.

7.04 The shadow price of food can be estimated simply as

$$P^* = P \left[1 + \left(\frac{\text{Nutritional Gap}}{\text{Consumption of the well-nourished}} \times \frac{1}{\text{Demand Price Elasticity of the well-nourished}} \right) \right]$$

since, as explained earlier, P^* is the price that would prevail if all the malnourished were given the requirement and then removed from the market and the consumption of the rich would decline by the amount of the nutrition gap.

7.05 The above procedure is used for estimating P^* , but as can be seen the procedure requires good estimates of the nutrition gap and the consumption of the "rich" at each stage of intervention. To do this, we use the elasticity of the number of malnourished with respect to price changes^{1/} as computed by Scandizzo and Knudsen. Hence the increases in prices as estimated by our model (Section - IV) and given in Table 4 are translated into increases in the number of malnourished. The reduction/increase in income (for urban and rural consumers respectively) implied by the removal of the ration system are also translated into equivalent price changes and the effect on the number of malnourished is estimated. At any per capita requirement, the total requirements of the malnourished is thus obtained. The difference between this and actual consumption is the nutrition gap. As a conservative assumption that will tend to underestimate social gain, consumption of the poor is assumed to be a constant proportion i.e. 16% (as obtained from the survey 1973-74) of total consumption.

7.06 Table 8, comparing selected indicators of malnutrition and welfare under alternative trade and food distribution policies, shows a number of interesting results. First, the removal of the food distribution system with a continuing export ban would cause an increase in the open market price of between 13% and 23% depending on whether the procurement tax were paid only by the "rich" farmers or proportionately shared by all producers. This is primarily because there would be no imports to depress the market prices. In

/1 This elasticity is defined as the percentage increase in the number of the people below the requirement following a percentage increase in price. See, Scandizzo and Knudsen (1979).

Table 8: SOCIAL PRICE OF CALORIES, NUTRITION GAP AND NUMBER OF MALNOURISHED UNDER ALTERNATIVE TRADE AND FOOD DISTRIBUTION POLICIES

		Price (\$US/ton)	Social Price	Consumption <u>1/</u>	Ratio of Social price to market price	Number of Malnourished (millions)	Nutrition Gap (mil. tons)
P _w = World price	=	328	577.3--521.5	125.8--132.9	1.76--1.59	249.4--232.9	26.9--22.3
P _{OH} = Price with export ban without Dist.	=	283--307	379.2--435.9	133.9--136.4	1.34--1.42	184.8--202.5	13.0--16.0
P ₀ = Open market price	=	250	280	137.0	1.12	136.7	4.6

1/ Million tons of cereal equivalent.

- Note: (a) The lower bound estimates of prices and quantities refer to the assumption that the tax (procurement) is paid only by the "rich" farmers and therefore that its removal has no direct impact on the incomes of rural malnourished. The upper bound refers to the assumption that the tax (procurement) is paid by all producers.
- (b) Social standard of caloric consumption = 1850 caloric per capita per day.

addition, the income-transfer to urban consumers would be absent. (This would be compensated by an increase in rural incomes, but our calculations show that the net effect of the removal of intervention would be an increase in prices.)

7.07 Second, aggregate consumption would only be marginally affected by the price changes and income effects of the removal of the food distribution system, and at the most, it would be reduced by 2%, reflecting the counter-balancing effects of the removal of procurement and distribution on food consumption of rural and urban consumers. But the consumption of the poor would undergo major changes, as the nutrition gap increase would exceed 200% and the increase in the number of malnourished would range between 48 and 66 million people. Reflecting these effects, the social price of calories would increase by about 35% to 56% and the premium that society would be prepared to pay for a marginal increase in the consumption of the malnourished would go up from the 12% of the present regime to about 40% above market price.

7.08 If all present policies were discontinued in favor of free trade, the increase in price would be much more substantial (31%). Consumption would decrease sizably even in the aggregate (a maximum of 8%) and the impact on the poor would likely be dramatic as the number of malnourished would increase by about 100 million people and the nutritional gap would jump fivefold as compared to the present level.

7.09 Based on these results, Table 9 and 10 present the highlights of the cost benefit analysis of the export ban and the food distribution schemes under the two extreme hypotheses on the implicit taxation of the rural poor. In both cases the export ban shows large net benefits ranging from just over a billion to two and a half billion dollars and quite attractive benefit cost ratios (1.37 to 1.4). As for the food distribution scheme, the gains are still sizable only

Table 9: BENEFITS AND COSTS OF INTERVENTION: CASE I
 (in millions of US\$)

	Export Ban	Food Distribution System	Total
Benefits			
Consumer surplus gain	5,845	5,865	11,710
Social gains	<u>2,725</u>	<u>555</u>	<u>3,280</u>
Total	8,570	6,420	14,990
Costs			
Producers' surplus loss	6,125	5,314	11,439
Government costs			
(a) At reported import costs	-0-	310	310
(b) With value imputed for Russian imports	-0-	581	581
(c) Imports valued at world prices	-0-	1,385	1,385
Net Benefits			
(a)	2,445	795	3,240
(b)	2,445	524	2,969
(c)	2,445	-279	2,166
Benefit/Cost Ratio			
(a)	1.40	1.14	1.28
(b)	1.40	1.09	1.25
(c)	1.40	0.96	1.17
Net Private Benefits			
(a)	-280	241	-39
(b)	-280	-30	-310
(c)	-280	-834	-1,114
Net Private Benefit/Cost Ratio			
(a)	0.95	1.04	1.00
(b)	0.95	0.99	0.97
(c)	0.95	0.88	0.91

Table 10: BENEFITS AND COSTS OF INTERVENTION: CASE II
 (in millions of US\$)

	Export Ban	Food Distribution System	Total
Benefits			
Consumer surplus gain	2,828	9,200	12,028
Social gains	<u>1,126</u>	<u>963</u>	<u>2,089</u>
Total	3,954	10,163	14,117
Costs			
Producers' surplus loss	2,884	8,582	11,466
Government costs			
(a) At reported import costs	-0-	310	310
(b) With value imputed for Russian imports	-0-	581	581
(c) Imports valued at world prices	-0-	1,385	1,385
Net Benefits			
(a)	1,070	1,270	2,340
(b)	1,070	1,000	2,070
(c)	1,070	196	1,266
Benefit/Cost Ratio			
(a)	1.37	1.14	1.20
(b)	1.37	1.11	1.17
(c)	1.37	1.02	1.10
Net Private Benefits			
(a)	-56	308	252
(b)	-56	-37	-93
(c)	-56	-767	-823
Private Benefit/Cost Ratio			
(a)	0.98	1.03	1.02
(b)	0.98	1.00	1.00
(c)	0.98	0.92	0.94

if the imports are evaluated at financial prices, while they tend to fade when full economic pricing is applied. Nevertheless, the net benefits are not significantly different from zero.

7.10 We can examine the sensitivity of these results vis-a-vis the system of weights used, by looking at the welfare costs implied by the programs under the assumption that only private benefits and costs matter (bottom part of Tables 9 and 10). In the case of the export ban and case II the private costs incurred are clearly negligible, because at the order of approximation implied by our estimates, they may be considered as not significantly different from zero. For the food distribution case and the total case, on the other hand, the results indicate that net private benefits would be zero or positive at reported import costs or with the value imputed for the Russian imports. Only when all imports are valued at world prices - a rather extreme assumption for India - do the net private benefits for the entire system turn heavily negative to reach about 1.1 billion dollars in the worst case. It is thus possible to conclude that, except for the case of evaluation at full opportunity cost of all food imports, even a minimal concern for the consumption of the poor would make the food distribution program attractive over the non-intervention market alternative.

7.11 As for the case where imports are valued at world prices, we can say that the social gains could be reduced to roughly 40% of what we assumed in the paper before the program benefit cost ratio would fall below one. This would imply a reduction of the social standard to less than 1,400 daily calories per consumer equivalent - a rather implausible figure if we have to admit any social concern for the nutritional well being of the poor.

7.12 The analysis presented permits also the calculation of simple indexes of cost effectiveness. Government costs are \$128 per ton of food distributed if imports are evaluated at their opportunity costs plus \$63/ton of implicit and explicit marketing/administration expenses. The latter may seem high, but they include costs such as transportation and storage of the procured and imported grain that would partly be incurred by the economy even in the absence of government intervention. Producers surplus losses amount to \$87/ton of food produced and are roughly matched by the consumers surplus (private) gains of \$88 (in case 1) and \$87 (in case 2) per ton of food consumed.

VIII. Assumptions and Limitations of the Study

8.01 Before we draw the conclusions of our study, it may be useful to summarize its main assumptions and limitations.

- (a) The cost/benefit analysis performed compares the full food distribution program with two alternatives: (i) the present regime without the export ban and (ii) complete laissez faire. These alternatives are not necessarily the best, and it is possible that other alternatives, such as food stamps or food for work would make better comparators.
- (b) All prices in the analysis are weighted averages of rice and wheat prices since these grains account for 75% of average per capita food consumption in India, and about 65% of grain production. This is a necessary approximation given the aggregated framework of the social demand analysis which is based on the concept of a social price of calories.

We assume that the relationship between the social price of calories and the actual price is reflected in the relationship between the social price of food and the actual price of food. This appears adequate for the analysis of consumer gains, because it appears unlikely that the price changes considered would cause a major shift in the composition of the food basket consumed.

- (c) However, in the analysis of producers' welfare losses, this procedure does not catch the differential impact of intervention on the price production, and exports of the two different crops. In particular, the removal of the export ban is likely to have a differential impact on rice and wheat exports and hence on total producers' surplus gains. The weighted average border price (even though it is biased slightly in favor of rice) may not represent the correct opportunity cost since the weights are arbitrary. (In fact the correct weights would be predicted by the model if a disaggregated procedure were used.) In addition, as explained in the text, there are a number of rice varieties grown and traded and the particular price used in the analysis may not be the correct one for Indian producers. For these reasons, the border price used should be viewed as an approximation to the real opportunity cost.
- (d) Imports are considered a part of the food distribution system since in India they are distributed only through the ration shops at less than the import prices. The distribution of

imported grain therefore creates an income transfer to consumers which partially offsets the depressive effect on market prices of increased supplies. It is possible however to use the basic model to simulate the effects of other scenarios (no imports and only domestic procurement, only imports and no procurement, etc.) on prices and incomes, and to compare the resulting benefit-cost ratios.

8.02 Finally, labor markets and wage determination should be explicitly modeled to give an indication as to the effects on the income of the landless when procurement raises market prices, with no parallel increase in rations, and on the long-term response of rural wages to the procurement policy.

IX. Conclusions

9.01 The results presented lend themselves to two main conclusions. First, the benefit/cost analysis performed shows that dismantling either the export ban or the food distribution system would not be a desirable option. In spite of the fact that it tends to distort prices from the competitive market values, the complex tradeoffs in the present system ultimately results in positive net social benefits for the country, if it is assumed that there is reasonable social concern for minimum food consumption of the poor.

9.02 Second, even though the Indian food distribution system appears to be justified under the present conditions, an expansion of its size would not be desirable without a substantial reduction of costs or an increase in the amount of food delivered to the poor. An expansion of the system would be desirable if: (i) eligibility requirements were more stringent and effective,

and (ii) indirect targeting were improved through location of the ration shops both in urban and rural areas. However, an expansion to rural areas would probably increase marketing and operating costs.

9.03 These qualifications notwithstanding, it seems impressive to us that such a diverse ensemble of public intervention policies may maintain attractive benefit cost ratios despite the substantial administrative difficulties, the leakages to unintended beneficiaries and the possible inefficiencies of various kinds involved.

APPENDIX

A COMPARATIVE STATIC MODEL OF THE FOOD DISTRIBUTION PROGRAM

1. The following four equation model describes the effects of procurement, imports and distribution on the open market price of grain, and on the weighted average producers' price that farmers face. The model predicts these prices in the presence of an export and import ban on private transactions which permits domestic prices to be different from world prices. The predictions from this model are then used to evaluate the effects of the export ban and the food distribution system.

2. Consider the following four equilibrium and/or definitional relationships:

$$N_u D_u [P, Y_u + \theta(P - P_d)] + N_r D_r (P, Y_r) = S(\pi) + I - \sigma \quad (1)$$

$$S_c + I = N_u \theta + \sigma \quad (2)$$

$$\pi S = P_c S_c^+ P(S - S_c) \quad (3)$$

$$N_r Y_r = \int_0^\pi S(t) dt \quad (4)$$

where N_u = number of urban residents

N_r = number of rural residents

Y_u = per capita (p.c.) income of urban residents

Y_r = per capita (p.c.) income of rural residents

D_u = p.c. demand for food of urban residents

D_r = p.c. demand for food of rural residents

θ = p.c. amount of food distributed in ration shops

P = open market price of food

P_d = ration shop price

P_c = procurement price

π = revenue per unit of marketed food output grossed by the
producers = $\lambda P_c + (1-\lambda)P$

λ = S_c/S

S = total market supply of food

S_c = quantity of food procured

I = quantity of food imported

σ = food stock variation

3. The first equation states the market clearing conditions, i.e., that urban demand for food, inclusive of the effect of the income transfer $\theta(P - P_d)$ (implied by the infra-marginal quantity of food distributed) plus rural demand inclusive of the effect of the procurement tax $(P - \pi)S$ equals domestic supply plus imports and changes in stocks. The second equation is an identity which shows that internal procurement plus imports equal replenishment of stocks and the amount of food distributed. This implies that imports are used to replenish stocks and stocks are varied to fill the gap between procurement and distribution. The fourth equation defines rural incomes as the rent and quasi-rent to agricultural fixed resources (including entrepreneurship). This latter definition implies, inter alia, that either labor is fully employed so that any decrease in the value of production is reflected in the wage rates or that agricultural wages are exogenous and constant.

4. Totally differentiating the system yields, after some substitution, the following system of two linear equations:

$$\left[\begin{array}{c} N_u \left[\frac{\partial D_u}{\partial P} + \frac{\partial D_u}{\partial Y_u} \theta \right] + N_r \frac{\partial D_r}{\partial P} \\ - (S - S_c) \end{array} \right] = \left[\begin{array}{c} dP \\ d\pi \end{array} \right] \quad (5)$$

$$\left[\begin{array}{c} N_u \left[1 - \frac{\partial D_u}{\partial Y_u} (P - P_d) \right] d\theta + N_u \frac{\partial D_u}{\partial Y_u} \theta dP_d - dS_c \\ - (P - P_c) dS_c + S_c dP_c \end{array} \right]$$

5. The exogenous variables are $d\theta$ = the change in the quantity of food distributed, dP_d i.e., the change in the ration prices, dS_c = change in the quantity procured and dP_c = the change in procurement price. For the purpose of this evaluation, however, we assume that $dP_c = dP_d = 0$, since these prices have remained unchanged or changed only slightly over short periods. The endogenous variables are dP i.e., change in the market price and $d\pi$ = change in the weighted average producers' price. By solving the above system, we can investigate the effect of variations in the government controlled variables on open market and producers' price.

6. Consider first the total derivative of open market price, expressed for convenience in terms of elasticities.

$$\frac{dP}{d\theta} \frac{D}{P} = \frac{(1 - \eta_{uy}^m t_d) (1 - t_\pi \eta_s)}{(\eta_p + \eta_{uy}^m \beta)(1 - t_\pi \eta_s) - \alpha(1 - \lambda) (\eta_s - \eta_{ry}^m r)} \quad (6)$$

where η_p = weighted average of urban and rural price elasticities of demand
 η_{uy} = income elasticity of urban demand
 η_{ry} = income elasticity of rural demand
 η_s = supply elasticity
 β = N_u / D i.e., the percentage of total demand being contributed by the food distribution system
 α = S/D the percentage of total demand satisfied by domestic supply
 λ = the proportion of supply procured
 m_u, m_r = urban and rural budget shares of food
 t_d = $\frac{P-P_d}{P}$ nominal rate of consumption subsidy on the rationed food
 t_π = $\frac{P-\pi}{P}$ nominal rate of production tax on output.

7. As expression (6) shows, the effect of an increase in the amount of food distributed on market prices is equivocal but it is likely to be negative for the following reasons. First, for typical values of the parameters included, the numerator will be positive if $t_\pi < 1/\eta_s$ as is likely in the short-run because of the low value of the short-run supply elasticity. Second, while the denominator may again be positive or negative, it will tend to be negative the larger the quantity procured and/or imported, and the smaller, ceteris paribus, is the supply elasticity.

8. Consider now the expression for the effect of procurement on the open market price.

$$\frac{dP}{dS_c} \frac{S_c}{P} = \frac{-\alpha [t_c (\eta_s - \eta_{ry} m_r) + (1 - t_\pi \eta_s)]}{(\eta_p + \eta_{uy} m_u \beta)(1 - t_\pi \eta_s) - \alpha(1 - \lambda) (\eta_s - m_r \eta_{ry})} \quad (7)$$

where the new variable $t_c = \frac{P - P_c}{P}$ is the nominal rate of production tax on the procured quantity.

9. If the net supply effect in rural areas is positive, i.e., $\eta_s > \eta_{ry} m_r$

and $t\pi < \frac{1}{\eta_s}$, an increase in the amount procured will tend to bring about an increase in consumer prices. The total effect of procurement, imports and distribution on consumer prices is the sum of the effect of distribution (which includes imports) i.e., expression (6) above, and the effect of domestic procurement i.e., expression (7) above. For the special initial case where $\theta = S_c = 0$ and hence $\beta = \lambda = 0$ the two expressions can be written as:

$$\left. \frac{dP}{d\theta} \frac{D}{P} \right|_{\begin{array}{l} \theta=0 \\ S_c=\lambda=0 \end{array}} = \frac{(1 - \eta_{uy} m_u t_d)}{\eta_p - \alpha (\eta_s - \eta_{ry} m_r)} \quad (8)$$

and

$$\left. \frac{dP}{dS_c} \frac{S}{P} \right|_{\begin{array}{l} \theta=0 \\ S_c=\lambda=0 \end{array}} = \frac{-\alpha [t_c (\eta_s - \eta_{ry} m_r)]}{\eta_p - \alpha (\eta_s - \eta_{ry} m_r)} \quad (9)$$

These expressions, though still equivocal, tend to be negative for typical values of the parameters involved.

10. On the whole, these expressions show that the effects of the rationing system are multiple and intricate. While the distributed grain creates an income transfer to urban consumers, procurement taxes rural residents' incomes and their consumption falls, thus offsetting the former effect. Imports depress prices for all consumers and producers, but procurement raises the open market price. The net effect on producer prices, as can be seen below, is equally intricate since this effect depends partly on the effect on the open market price and partly on the quantity procured, but it also tends to be negative for typical values of the parameters involved.

$$\left. \frac{d\pi}{d\theta} \frac{S}{P} \right|_{S_c = \theta=0} = \frac{(1 - m_u \eta_{uy} t_d)}{\eta_p - \alpha(\eta_s - \eta_{ry} m_r)} \quad (10)$$

and

$$\left. \frac{d\pi}{dS_c} \frac{S}{P} \right|_{S_c = \theta=0} = \frac{-1}{\eta_p - \alpha(\eta_s - \eta_{ry} m_r)} \quad (11)$$

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World Bank Publications of Related Interest

Adoption of Agricultural Innovations in Developing Countries: A Survey

Gershon Feder, Richard Just, and David Silberman

Reviews various studies that have provided a description of and possible explanations for farmers' responses to the adoption of technological improvements in the agricultural sector in developing countries and finds that uniform acceptance of technological change is rare and that responses differ across socio-economic groups and over time. Explores new directions for research in this area.

World Bank Staff Working Paper No. 444. February 1981. 67 pages (including footnotes).

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LC 81-47615. ISBN 0-8018-2581-4, \$25.00 (£17.50) hardcover.

Agricultural Price Policies and the Developing Countries

George Tolley, Vinod Thomas, and Chung Ming Wong

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The Johns Hopkins University Press, March 1982. 256 pages.

LC 81-15585. ISBN 0-8018-2704-3, \$25.00 (£17.50) hardcover.

Agricultural Research

(See Publications of Particular Interest, page 1.)

Agroindustrial Project Analysis

James E. Austin

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The Johns Hopkins University Press, 1981. 224 pages (including appendices, bibliography, and index). EDI Series in Economic Development.

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