Effects of subsidized wheat consumption by state in India

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ABSTRACT

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This paper reports the results of a study of the effects of the Indian government's consumer subsidies on wheat demand. Results indicate consumption of subsidized wheat is higher in urban areas than in rural areas. The public distribution of wheat in most states had little effect on demand in the commercial market, which suggests the government is effective in targeting subsidized wheat to poor consumers.

INTRODUCTION

In recent literature on food demand in developing countries it has been argued that the major reason for foodgrain consumer subsidies is that they provide cheap food for urban consumers (Hayami et al., 1982; Shaw and Singer, 1988; Becker and Morrison, 1988). In India, the Essential Commodities Act of 1955 established the Public Foodgrain Distribution System (PDS). The function of the PDS is to buy rice and wheat from farmers and distribute the grains at subsidized prices to low income consumers mostly in urban areas. In India, only in the state of Kerala are both urban and rural consumers subsidized (Kumar, 1979; George, 1978; Gwatkin, 1979).

Research is needed to improve understanding of the effects of these government subsidies in India. The purpose of this paper is to evalute the impacts of income and consumer subsidies on wheat consumption, by state, in India. The results are expected to interest policy makers in Indian central and state governments and to wheat-exporting countries such as the United States of America in identifying potential export markets.

Evidence from several studies on India show the PDS helps poorer consumers through income redistribution (Krishna and Chibber, 1983; George, 1985; Mishra, 1986; Narayana et al., 1987). Behrman and Deolalikar (1987) argued increased income did not result in improvement of the nutritional status of the population in India, but this has been disputed (Schiff and Valdes, 1990). As yet, there has been no rigorous study of the effects of food subsidy policies on demand in every state of India, and aggregate studies such as Chetty and Srinivasan's (1990) can hide the vast regional differences in India.

Studies for other developing countries indicate income levels, prices, and improvements in income distribution were significantly related to food and calorie intake in many developing countries (Pinstrup-Andersen and Caicedo, 1978; Ward and Sanders, 1980; Sahn, 1988; Strauss, 1982, 1984; Waterfield, 1985; Bogahawatte and Kailaspathy, 1986; Kennedy and Cogill, 1987, 1988; Teklu and Johnson, 1988) with a few exceptions (Musgrove, 1985; Yen and Roe, 1989). Government interventions that redistribute the available food supply by targeting consumer subsidies towards the poor can improve the nutritional status of the population (Serra-Puche and Kehoe, 1986; Edersinghe, 1987; Garcia and Pinstrup-Andersen, 1987; Bigman, 1987).

MODEL

A model in which one of the commodities is rationed was employed in the commercial market analysis (Latham, 1980). The ration constraint appears appropriate for India, since quantities of wheat and rice consumers may purchase in the fairprice shop is limited, and the price in the concessional market is normally lower than in the commercial market. Thus, consumers are assumed to consume all wheat allocated to them through the PDS. Consumers are assumed to maximize utility. Thus, the equation:

$$\text{Max } U = U\left[Q^W, Q^S, \text{ISSUES}, Q^A\right]$$

$$\text{s.t. } \overline{Y} = Y - P^F \cdot \text{ISSUES} = \text{WP } Q^W + \text{SP } Q^S + P^A Q^A \tag{1}$$

where U is utility, P^F is the price of wheat through the fairprice shops

(concessional markets), Y is income, Q^A and P^A are vectors of the quantities and prices of all other goods, respectively, WP is the retail price of wheat in the open market, SP is the retail price of the substitute (which varies from state to state), ISSUES is the quantity of wheat distributed per capita through the PDS, Q^S is the quantity of substitute demanded through the commercial market, and Q^W is the quantity of wheat consumed through the commercial market; $\bar{Y}$ is 'full income' per capita less expenditure for the rationed good (Latham, 1980), which in this case is wheat.

If prices of foodgrains and other commodities move in a parallel fashion, then using the composite good theorem, the demand function is:

$$Q^W = f_1[\text{WP}, \text{SP}, \bar{Y}, \text{ISSUES}] \tag{2}$$

Chellaraj and Brorsen (1988) specified their demand equation for rice in Tamil Nadu in a similar fashion. The quantity of wheat moving through the retail market (Q^W) is expected to be negatively related to its own price (WP) and issues of wheat through fairprice shops (ISSUES). It is expected to be positively related to the price of the substitute (SP) and to income less expenditure on rationed wheat $(\bar{Y})$ if the latter acts as a normal good and negatively related if it acts as an inferior good. Total consumption of wheat is unaffected by public distribution if the quantity issued results in an equal drop in quantity demanded at a given price. [1]

To determine the factors influencing how much grain the government chooses to provide, a regression model was estimated. Four important factors that the government is assumed to consider before distributing foodgrains through concessional fairprice shops are its opening stocks of foodgrains (wheat and rice), the previous year's availability of foodgrains in the retail market, and the percent of urban consumers. The goal of the government is to provide foodgrains at low cost to consumers, particularly in urban areas. Thus, if little grain was available the previous year the government can be expected to distribute more foodgrains. Similarly, if stocks of foodgrains are low, the government can be expected to reduce foodgrain distribution. However, the government could freely substitute between foodgrains. When rice stocks are low, it is expected to increase the distribution of wheat, and vice versa. Thus, the following model could be employed for wheat:

$$\text{ISSUES} = f_2[\text{WOS}, \text{ROS}, \text{URBAN}, \text{WCON}_{t-1}] \tag{3}$$

Wheat opening stocks (WOS) are expected to be positively related and rice opening stocks (ROS) are expected to be negatively related to wheat

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[1] A coefficient of negative one on ISSUES means that for every kilogram of wheat issued through fairprice shops, one less kilogram is purchased in the open market

distribution (ISSUES). A decrease in the consumption of wheat in the previous year (WCON$_{t-1}$) is expected to increase public distribution of wheat. Finally, urbanization (URBAN), i.e., an increase in the percentage of people living in urban areas is expected to be positively related to wheat distribution in states where it is a staple commodity, and positively or negatively related in states where it is not a staple. It could be negative if the infrastructure is poor in a predominantly rice consuming state, as rice distribution would get top priority.

DATA AND METHOD

Annual data (1956–1985) for quantity produced, procured, issued through fairprice shops, stocks, and issue prices (expressed as Rp. per q) are from the Bulletin on Food Statistics published by India's Ministry of Agriculture. The substitutes for wheat are rice in West Bengal, Uttar Pradesh, Jammu and Kashmir, and Bihar, sorghum for southern states and millet for all other states. The prices of wheat and its substitutes by state, as well as the retail price indices expressed as Rp. per q, are from Agricultural Prices in India, also published by the Ministry of Agriculture. In some states two sets of prices were given and in some states none. In the latter case, the price in a neighboring state, deflated by the price index of the state where no data were available, was used. In the other case, the average of the two prices was used. No consumption data are available, and hence the quantity consumed is calculated [2] as:

$$Q^D = Q^P - Q^G \tag{4}$$

where Q^D is quantity demanded (available) in the commercial market, Q^P is quantity produced, and Q^G is quantity procured by the government. The Monthly Abstract of Statistics contains data on real Gross State Product per capita (1960 = 100) (GSP) (which is the proxy for income) and population by state. Various State Handbooks publish data on people living in the urban and rural areas, but complete data are available for only Tamil Nadu, Kerala, Andhra Pradesh, Karnataka, and Bihar. For others a time trend was used. This appears justified, as in the states where data are available, there was clearly an increasing trend towards urbanization. The prices are deflated using the consumer price indices. All prices are expressed in Rp. per q. The quantity of wheat is in kg per thousand

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Rp., rupee: US$ 1.00 = Rp. 27.43 (13 March 1992).
q, metric quintal = 100 kg.
[2] Equation (4) assumes no lags and no storage.

population. Kerala and Tamil Nadu have no commercial market for wheat and hence no results are reported for them. Northern, Western, and Central states are predominantly wheat consuming whereas Southern and Eastern states are rice consuming. A few states were divided in the late 1960s and early 1970s, but because of fewer number of observations, regression results for states such as Punjab and Haryana and Assam and Meghalaya are aggregated.

Equations (2) and (3) are specified linearly and estimated using Seemingly Unrelated Regression (SUR). As the errors are likely to be correlated across states, the estimates of the SUR are more efficient than past studies which used Ordinary Least Squares (OLS). A Q-test is used to determine the presence of autocorrelation and contemporaneous correlation (Langemeier and Patrick, 1990). The calculated Q values of 37.12 for the concessional markets (public distribution) and 44.37 for the commercial markets indicated autocorrelation was present. Hence, the equations were corrected for autocorrelation using the Parks method (Kmenta, 1971). The elasticities in the commercial market equations are calculated at the means. Finally, the leakages of wheat from the public distribution system were calculated for each state. Leakages are defined as the product of the issues coefficient in the commercial market equation and the average of total issues of wheat through the PDS. [3] The total leakage divided by the mean issues is the percentage of leakage through the PDS.

RESULTS

Public distribution

Results presented in Table 1 indicate that for most states urbanization was a significant factor affecting PDS. The only exceptions are West Bengal, Kerala, Rajasthan, and Madhya Pradesh. For Kerala, urbanization did not have a significant impact on wheat distribution, as it is well-served in both rural and urban areas by the PDS. The stocks of wheat had little impact on PDS, because governments could import foodgrains from other states to satisfy PDS needs. Consumption of wheat (rice in the case of Tamil Nadu) through commercial markets during the previous year had a negative and significant impact in all states where wheat is a staple commodity. The only exceptions in the rice consuming areas are West Bengal, Karnataka, and Kerala. Thus, the government's goal of improving

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[3] Thus leakage represents the average reduction in quantity demanded at a given price due to ISSUES.

TABLE 1

Regression estimates for the distribution of wheat per capita by the Government through concessional markets by state in India, 1956–85

State	Constant	Wheat stocks	Rice stocks	Urban population	Lagged open market consumption
North					
Jammu and Kashmir	0.2127	1.0277 *	0.7073	0.1502 *	− 0.3344 *
		(1.9339)	(0.9002)	(3.3594)	(− 3.5394)
Punjab and Haryana	19.4054	0.0359	− 0.0216	0.2045 *	− 0.0258 **
		(1.1940)	(− 0.9317)	(2.0277)	(− 1.5067)
Central					
Bihar	12.1967	− 0.0256	0.7343 *	0.1428 *	− 0.1877 *
		(− 0.1114)	(− 1.6918)	(4.5646)	(− 7.0221)
Madhya Pradesh	9.4454	− 0.3321	0.7994	0.0236	0.1192 *
		(− 0.3689)	(0.6812)	(0.4439)	(− 7.4841)
Rajasthan	13.5090	− 0.0391	0.5184	0.0054	0.1898 *
		(− 0.5218)	(1.0762)	(0.0481)	(− 4.0188)
Uttar Pradesh	9.9316	0.1719 *	2.5309	0.1999 *	− 0.0880 *
		(1.8750)	(1.1933)	(1.7890)	(− 3.1261)
West					
Gujarat	12.4108	0.0431	0.2511	0.3296 *	− 0.3771 *
		(0.4222)	(1.0946)	(1.6422)	(− 2.7724)
Maharashtra	20.5429	− 0.2651	− 0.1172	0.3922 *	− 0.7651 *
		(− 1.3842)	(− 0.3220)	(1.7019)	(− 3.5105)
East					
Assam and Meghalaya	6.7417	0.1954	0.0823 *	0.3360 *	− 1.0969 *
		(0.9832)	(2.4932)	(4.0136)	(− 3.5281)
Orissa	− 1.0646	0.0637	− 0.5192 *	0.6739 *	− 1.4987 *
		(0.1894)	(− 3.5256)	(12.3770)	(− 5.1831)
West Bengal	27.2154	0.0596	1.1025 *	− 0.0601	0.1600
		(0.4001)	(− 3.7980)	(− 0.6373)	(1.2412)
South					
Andhra Pradeseh	2.1991	− 0.0031	− 0.0084	0.0483 *	− 0.6737 *
		(− 0.1382)	(− 0.5625)	(2.3719)	(− 1.9102)
Karnataka	2.6637	0.2143 *	0.7844	0.0974 *	0.1088
		(1.6685)	(1.0641)	(1.5825)	(1.1929)
Kerala	− 0.0327	0.0271	− 0.5016 *	0.3685	0.0430
		(0.0837)	(− 1.7181)	(1.0310)	(0.7696)
Tamil Nadu	7.0712	0.2639 *	0.2669	0.0001 *	0.0059 *
		(4.4424)	(0.5994)	(1.8310)	(2.1398)

The values in parentheses are *t*-values. One asterisk denotes significance at the 5% level and two asterisks denote significance at the 10% level.
The stocks of wheat and rice are the opening stocks in government hands per capita, lagged wheat consumption is per capita through commercial channels, and urban population is measured in percent.
Estimates are corrected for autocorrelation and adjusted for contemporaneous correlation using seemingly unrelated regression.

TABLE 2

Regression estimates for the availability (demand) of wheat per capita through commercial markets by state in India, 1956–85

State	Constant	Wheat price	Substitute price	$\bar{Y}$	ISSUES
North					
Jammu and Kashmir	− 4.4627	2.9043	− 16.7896 *	− 0.0133 *	− 0.1716
		(0.3968)	(− 5.0151)	(− 3.0258)	(− 0.5029)
Punjab and Haryana	0.0004	21.8203	− 0.7873	0.6193 *	− 0.9996 *
		(0.5550)	(− 0.0156)	(13.8031)	(− 2.5029)
Central					
Bihar	33.1185	− 23.7467 *	− 4.3756	0.0551 *	− 0.2643 *
		(− 1.7923)	(− 0.2654)	(1.6895)	(− 7.0899)
Madhya Pradesh	− 0.0036	48.0750	63.0004 *	0.0499 *	0.3585
		(0.2337)	(2.3752)	(2.4336)	(0.5662)
Rajasthan	68.1124	10.6311	− 149.894	0.1294 *	− 0.0149
		(0.5818)	(− 0.6581)	(5.0891)	(− 0.0456)
Uttar Pradesh	55.1915	19.8659	− 25.8292	0.0061 *	1.3813
		(0.7547)	(− 0.7215)	(1.7842)	(0.9834)
West					
Gujarat	− 47.4488	6.7150	34.0043 *	0.1436 *	− 0.2432 *
		(1.3152)	(4.9249)	(10.8451)	(− 1.6344)
Maharashtra	− 7.0218	1.9533	− 0.1496	0.0386 *	− 0.0040
		(0.3989)	(− 0.2227)	(4.9302)	(− 0.0628)
East					
Assam and Meghalaya	4.1495	− 0.0272	− 4.5492	− 0.0010	0.0864
		(− 0.0080)	(− 1.4386)	(− 0.1712)	(0.2107)
Orissa	− 3.6781	− 1.7823	0.5756	0.0143 *	0.0894
		(− 0.2023)	(0.6795)	(15.3201)	(0.4561)
West Bengal	− 6.4493	70.3723	− 38.0635	0.0050	0.3397
		(1.4894)	(− 0.3020)	(0.1796)	(0.3297)
South					
Andhra Pradeseh	0.1477	− 0.0930	0.5583 *	0.0010 *	0.0083
		(− 0.9980)	(3.1633)	(2.1716)	(0.6777)
Karnataka	1.4554	− 4.4599 *	− 0.0029	0.0095 *	− 0.2846 *
		(− 2.0272)	(− 0.3393)	(3.3019)	(− 3.3484)

The values in parentheses are *t*-values. One asterisk denotes significance at the 5% level and two asterisks denote significance at the 10% level.

The wheat price is the deflated retail price, the substitute price is deflated price of substitute, the substitute good varies by state, $\bar{Y}$ is income per capita less expenditure per capita on ration wheat, and ISSUES is the quantity of wheat per capita distributed through the public distribution system.

Estimates were corrected for autocorrelation and adjusted for contemporaneous correlation.

TABLE 3

Elasticity estimates for the availability of wheat per capita through commercial markets by state in India calculated at means [a]

State	Own price	Cross price	Income [b]
North			
Jammu and Kashmir	–	– 0.341	0.181
Punjab and Haryana	–	–	1.003
Central			
Bihar	– 0.523	–	0.335
Madhya Pradesh	–	0.299	0.307
Uttar Pradesh	–	–	0.361
Rajasthan	–	–	0.647
West			
Gujarat	–	0.557	1.724
Maharashtra	–	–	1.538
East			
Assam and Meghalaya	–	–	–
Orissa	–	–	0.933
West Bengal	–	–	–
South			
Andhra Pradesh	–	1.125	1.594
Karnataka	– 0.381	–	1.077

[a] For those states where serial correlation was a problem, the elasticities calculated after correcting the problem are reported.

[b] Per capita gross state product was used as a proxy for per capita income.

and maintaining the nutritional status of the people appears to be satisfied. A fall in rice stocks in the eastern states led to increased distribution of wheat. Otherwise, there were no distinct regional patterns.

Commercial markets

Results in Table 2 indicate that all states where wheat is a staple commodity (north, west, and central states) showed a substantial increase in consumption per capita with an increase in income. This was also true in all states where rice is a staple commodity, except in Assam and Meghalaya and West Bengal. The price of wheat was significant for only Bihar and Karnataka, and the price of the alternate commodity was positive and significant for only three states and negative and significant for one.

The elasticities (Table 3) in the relatively prosperous areas had higher income elasticities than in less developed areas. Except for Andhra Pradesh, the cross-elasticities are low. In Andhra Pradesh there was significant substitution between sorghum and wheat. Results of the income coeffi-

TABLE 4

Estimated leakage from the public distribution system for wheat [a]

State	Mean Issues (10^6 kg)	Issues coefficient [a]	Leakage = Coeff. × Mean	Leakage (%)
North	2127.13 [c]		2071.67	97.00
Jammu and Kashmir	55.46	–	–	–
Punjab and Haryana	2071.67	0.9996	2071.67	100.0 [b]
Central	1387.10 [c]		138.51	10.00
Bihar	524.07	0.2643	138.51	26.43
Madhya Pradesh	173.17	–	–	–
Rajasthan	148.36	–	–	–
Uttar Pradesh	541.50	–	–	–
West	1041.93 [c]		57.28	5.00
Gujarat	235.53	0.2432	57.28	24.32
Maharashtra	806.40	–	–	–
East	1317.12 [c]	–	–	–
Assam and Meghalaya	180.53	–	–	–
Orissa	116.93	–	–	–
West Bengal	1019.66	–	–	–
South	338.58 [c]		57.56	17.00
Andhra Pradesh	136.35	–	–	–
Karnataka	202.23	0.2846	57.56	28.46
Kerala	–	–	–	–
Tamil Nadu	–	–	–	–
Total	6211.86	–	2325.02	37.43

a Only those significant at the 5% or 10% level are considered here.
b Leakages calculated after rounding the coefficient to 1.
c Sum of the Mean Issues by region.

cients suggest that as an area develops, demand for wheat through the commercial market is likely to increase.

Finally, in three states where the ISSUES variable was significant, Bihar, Gujarat and Karnataka, there were some significant increases in the total consumption of wheat and leakages were low (Table 4). In Punjab, increases in ISSUES approximately offset sales in the commercial market. The insignificance of the ISSUES variable in the other states suggests that issues did not diminish sales in the commercial market. Consumers apparently considered the commercial and concessional markets separate in all states in the eastern region.

CONCLUSIONS AND POLICY IMPLICATIONS

Increased consumption through commercial channels in India appears to be associated with higher incomes, particularly in more prosperous states

like Punjab and Haryana. The own price of wheat and prices of substitutes were associated significantly with consumption only in a few states. In a few states, publicly distributed wheat was significantly related to increases in total consumption.

Public distribution of wheat was relatively higher in the more urbanized states. In Kerala, both the urban and the rural areas are well served by the PDS. Consumption through the commercial market during the previous year played a major role in determining the distribution of wheat through the PDS in all states where wheat is a staple commodity. A fall in consumption during the previous year, in most states, led to an increase in wheat distribution through the PDS. Other variables such as government stocks had a major impact on quantities distributed through the PDS in only some states.

The public distribution system appears to be meeting its goal of improving the nutritional intake of the poorer urban consumers. The distribution of wheat through the PDS in most states had little effect on demand in the open market.

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