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RESEARCH NOTES

The Central Government Wheat Policy in Uttar Pradesh

INTRODUCTION

Since World War II, the Indian government has obtained wheat from two sources, namely, procurement of wheat from farmers at a uniform price throughout the country (see Paul, 1987) and imports of wheat through P.L. 480. The P.L. 480 programme, instituted by the United States government in the fifties and the sixties, is designed to help fill the gap between production and nutritional needs. This source was particularly important for India during the eighties, when imports during some years accounted for nearly one-third of all wheat consumed. But this proportion has fallen in recent years. This wheat was used to provide poorer consumers with cheap food. By early 1980, India had over 3,00,000 fair price shops, mostly in urban areas. Many questions remain unanswered about the effect of this programme and other programmes on the production and demand for wheat in the open commercial market. The purpose of this paper is to determine the impact of government intervention on the production and distribution of wheat in a wheat consuming region of north India, Uttar Pradesh.

Past research on India's foodgrain policy shows that the food subsidy policy helps poorer consumers through income redistribution and that producers could benefit due to price discrimination (Mishra, 1986; Hayami *et al.*, 1982; George, 1985; Chetty and Srinivasan, 1990). However, a few studies for the state of Tamil Nadu found that the consumer subsidy did not increase the total consumption of rice sufficiently and thus farmers were 'taxed' by the government procurement policy (Harriss, 1983; Prabha, 1983; Chellaraj and Brorsen, 1988). It has also found that income alone did not improve the nutritional status (Behrman and Deolalikar, 1987), but in a few Indian states consumer subsidies did increase total rice consumption (Chellaraj and Farris, 1988).

Government intervention has been studied for other developing countries, but conclusions have varied. A few studies find that agricultural policies discriminate against producers (Gerrard and Roe, 1983; Lutz and Scandizzo, 1980). But, these findings have been disputed (Esfahani, 1987; Byerlee and Sain, 1986). Other studies have argued for input subsidies to increase production (Barker and Hayami, 1976; Mellor, 1985), although recent studies have suggested re-examination of this policy (Hedley and Tabor, 1989). Studies on the impact of income levels and consumer subsidy on total consumption and nutritional status emphasise the importance of urbanisation in increasing consumer subsidies (Byerlee, 1987; Lipton, 1976; Becker and Morrison, 1988), as well as the importance of economic growth and increases in per capita income (Teklu and Johnson, 1988; Heien *et al.*, 1989; Sahn, 1988). However, a few studies suggested that income in general was not an important variable (Yen and Roe, 1989; Musgrove, 1985) and may be important with respect to locally produced cereals, only for low income groups (Savadogo and Brandt, 1988). Ito *et al.* (1990) even suggested that foodgrain consumption fell with increases in income, but they did not include the impact of government intervention.

Another important government policy is improvement in marketing, irrigation, storage facilities and transport infrastructure, which has been shown to improve production as well as nutritional status not only in India (Antle, 1984; Easter, 1977; Adams *et al.*, 1981; Horton, 1985), but in other countries as well (Mellor, 1988, *a*, *b*; Von Braun, 1988). Adoption of technology has also been suggested as a major tool for increasing production along with extensive fertiliser use (Rao, 1989).

Some form of consumer subsidy (as well as producer subsidy) is likely to be favourably considered in most developing countries, including India for many years to come. But, because of budgetary constraints (Kehoe and Serra-Puche, 1986), there is a motivation to target foodgrain consumer subsidy to the poorer sections of the population (Pinstrup-Andersen, 1988; Bigman, 1987; Besley and Kanbur, 1988). Garcia and Pinstrup-Anderson (1987) found that costs can be reduced by targeting. Thus the goal of sustaining the ability of the poor to meet adequate nutritional levels could be achieved at greatly reduced costs.

However, unlike rice, the procurement price of wheat sometimes acts as a price support. Furthermore, the farmer could benefit from price discrimination, as suggested by Hayami *et al.* (1982) and others, if the subsequent retail price increase also results in an increase in farm price.

The impacts of procurement and distribution as well as other policies are analysed with a simultaneous equation model. This approach allows addressing several questions:

(1) Did procurement and distribution increase or decrease producer revenues?
(2) Would wheat production in Uttar Pradesh be more responsive to input or output subsidies?
(3) To what degree does wheat distributed through fair price shops substitute for open market wheat?
(4) Did the increase in the network of roads lead to a decline in marketing costs?

By proposing to examine the whole structure of the wheat market in Uttar Pradesh, including government intervention, this paper is an extension of most studies mentioned earlier.

MODEL FORMULATION

The theoretical framework and the procedure used are discussed in this section. Farm supply is discussed first, followed by the supply of marketing services and then retail demand.

Power available for irrigation and land are both limited in Uttar Pradesh. Inputs are assumed to be allocable among production activities for wheat (Just *et al.*, 1983). Thus the production function is:

$$(1)\quad Y_j = f_j(X_{1j}, X_{2j}, \ldots, X_{kj})$$

$$X_k = \sum_{j=1}^{n} X_{kj}, k = 1, \ldots, K$$

$$X_1 \leq \overline{X}_1, X_2 \leq \overline{X}_2$$

where Y_j is the vector of outputs, X_{ij} is the vector of inputs, $\overline{X}_1$ is the fixed amount of land and $\overline{X}_2$ is the fixed quantity of power for irrigation. This approach is justified as the state is mostly dependent on hydro-electric power, which due to its dependence on erratic rainfall, cannot be changed in the short-run. The price of power does not influence supply of wheat, since the quantity of power is rationed.

Wheat is procured directly from farmers (Paul, 1987) and although the procurement price always exceeded the cost of production, it never exceeded the farm price. This is true for all years (Krishna and Raychaudhuri, 1979).

Consider a farmer who sells to the government, a certain amount of output (wheat) at a

price less than the farm price as a protection against price instability. The farmer's objective function is:

$$(2)\quad \text{Max}[(\delta(Pp)+(1-\delta)P_1^*)]Y_1+\sum_{j=2}^{n}P_j^*Y_j-\sum_{k=3}^{K}W_kX_k$$

where δ is the proportion procured, Pp and P_1 are procurement and expected farm prices, respectively and Y_1^* is the output of wheat. The first expression is the expected weighted price of wheat. $\sum_{j=2}^{n}P_j^*Y_j$ is the expected total revenue from the n crops (other than wheat), $\sum_{k=3}^{k}W_kX_k$ is the total variable costs in production.

Denote P_t^W as the expected weighted price of wheat at the farm level. The expected open market price (P_1^*) is assumed to be the lagged price and thus $P_t^W=\delta P_t^P+(1-\delta)P_{1t-1}$. The first order conditions yield the following unconditional output supply:

$$(3)\quad Y_j=Y_j(P_t^W,P_2^*,\ldots,P_n^*,\overline{X}_1,\overline{X}_2,W_3,\ldots,W_k),j=1,\ldots,n.$$

The main alternative for wheat is corn, and thus n = 2. Fertiliser is the only input and thus k = 3. The supply function for wheat is:

$$(4)\quad Q_{P_t}^W=f_1(P_{t-1}^W,P_{t-1}^C,FP_t,\text{Power}_t)$$

$Q_{P_t}^W$ should be negatively related to the lagged weighted price (P_{t-1}^W) and fertiliser price (FP_t) and positively related to the lagged price of corn (P_{t-1}^C) and Power ($\overline{X}_2$). The quantity of land is assumed constant and thus $\overline{X}_1$ is not included.

The supply of marketing services from wholesalers is derived next. The wholesaler also has a constrained production function since the wholesaler depends on the fixed quantity of roads ($\overline{\text{Roads}}$) provided by the government.
The wholesaler seeks to maximise profit:

$$(5)\quad \text{Max}\,\pi=P_1Y^W=P_1X^W-WL$$

$$\text{s.t.}\,Y^W=[\text{Min}(X^W,f(L,\text{Roads})];\ \text{Roads}=(\overline{\text{Roads}})$$

where P_1 is the farm price and W is the price of other inputs (*e.g.*, wage rate). Roads are public good and have a price of zero to the wholesaler and thus do not appear in the objective function. Y^W is the quantity of wheat marketed by the wholesaler, X^W is the quantity purchased by the wholesaler, and L is the quantity of other inputs (*e.g.*, labour). Following Brorsen *et al.* (1985), $Y^W=X^W$, and thus the supply of marketing services is:

$$(6)\quad Y^W=Y^W(P^W-P_t^W,W,\text{Roads}).$$

The inverse of this supply function is the wholesale margin equation (M^W):

$$(7) \quad M^W = P^W - P_t^W = f_3(Q^W, \text{Roads}, W)$$

where $Q^W = Y^W$ is the quantity transported (after government procurement), W is the wages of labour included on a per capita basis. Both Q^W and wages (W) in equation (7) are expected to be positively related to the margin and Roads/Pop is expected to be negatively related.

For retailers, roads are not included since retailers do little transporting and thus the retail margin is:

$$(8) \quad M^R = P^R - P^W = f_5(W, Q^W)$$

where Q^W is the quantity moved through the wholesale-retail channel and P^R is the retail price of wheat. The wages and quantity demanded (Q^W) are expected to be positively related to the retail margin (M^R) in equation (8).

The quantity of wheat distributed through fair price shops is fixed by the government. Latham (1980) derived demand functions when one of the goods is rationed. Latham assumes the ration constraint is effective which is appropriate for Uttar Pradesh. Thus consumers are assumed to consume all wheat made available through the fair price shops. Following Latham, the consumers' problem is to maximise utility:

$$(9) \quad \text{Max } U = U[Q^W, Q^R, \text{ISSUES}, Q^G]$$
$$\text{s.t.} \overline{Y} = Y - P^f \text{ISSUES} = P^R Q^W + P^{Rice} Q^R + P^A Q^A,$$

where U is utility, P^f is the price of wheat through fair price shops, Y is the income, Q^A and P^A are vectors of the quantities and price of all other goods, P^{Rice} is the retail price of rice, the substitute, ISSUES is the quantity of wheat rationed through the fair price shops per capita, Q^W is the quantity of wheat demanded through the commercial market, Q^R is the quantity of rice consumed through the commercial market. $\overline{Y}$ is the 'full income', income less expenditure for the rationed good (Latham, 1980), which in this case is wheat. The demand function for wheat is

$$(10) \quad Q^W = f_4(P^R, P^{Rice}, \overline{Y}, \text{ISSUES})$$

The retail price of wheat and the quantity supplied through the fair price shops are expected to be negatively related to open market foodgrain demand. $\overline{Y}$ and the price of the substitute (rice) are expected to have a positive impact.

The system of equations are specified linearly and estimated using three-stage least squares. If the errors are correlated across equations, the estimates obtained here are asymptotically more efficient than past studies which used OLS.

DATA

Annual data (1957-1985) for quantity produced, procured and issued through fair price shops and the procurement price are from the Bulletin on Food Statistics published by the Government of India. The prices of wheat and rice (Rs/quintal) are from Agricultural Prices in India (1957-1982) and for 1983, 1984 and 1985 from the Bulletin on Food Statistics and Farm (Harvest) Prices of Principal Crops in India. Data on power for irrigation (mil. kWhr) are from the Statistical Abstracts published by the Government of India. The fertiliser prices (Rs./kg.) are from Agricultural Prices in India. No consumption data are available, and hence quantity consumed (Q^W) is calculated as:

$$(11) \quad Q^W = Q_P^W - Q^G$$

where Q_P^W is the quantity produced and Q^G is the quantity demanded by the government for procurement stocks. Per capita gross state product (GSP) is used as a proxy for income (Monthly Abstract of Statistics). The roads (surfaced) and the population data are from the Statistical Abstracts of India. The wages of agricultural labourers which include both on-farm and off-farm employees (those connected with handling and transporting agricultural products) are obtained from Agricultural Wages in India. The prices and wages are deflated using the appropriate price indices. All the prices are expressed in rupees per quintal. The quantity of wheat consumed (Q^W) is expressed per capita.

Some limitations of the data should be mentioned. The lack of data on closing stocks in private hands results in imprecise measurement of demand. Also, a small portion of wheat is grown for home consumption and this portion may be less price responsive. Furthermore, in semi-feudal areas, hoarding and black marketing are major problems (Bhaduri, 1973). The data are of uncertain quality in many Indian states, and hence some coefficients could be biased toward zero.

EMPIRICAL RESULTS

Regression results are presented in Table I with the means of the key variables presented in Table II. In the production equation, coefficients for the farm price of wheat and the power for irrigation were positive and significant at the 5 per cent level.[1] The fertiliser price was negative and insignificant, whereas the price of corn was negative and significant at the 5 per cent level. The hypothesis that output prices have no effect on supply does not hold for the state of Uttar Pradesh. The elasticity of supply was 0.57.

In the farm wholesale margin equation, the wages of labour and the quantity transported were not significant at the 5 per cent level. All coefficients had the expected sign. But the roads are significant and negative at the 5 per cent level. In the retail margin, only the quantity was significant. Both margin equations vary positively with the respective quantity as expected.

In the retail demand equation, all the variables were significant and all had the expected sign. The elasticity of demand through the commercial market was 0.62, and the cross-elasticity between wheat and rice was 0.44. The presence of the concessional market reduces demand through the commercial market, but not proportionately. The income elasticity of 0.77 for the commercial channel indicates that wheat is income inelastic. Thus an increase in income leads to a less than proportionate increase in the purchase of wheat.

The empirical results show that wheat availability through the fair price shops increased overall demand. A one unit increase through the concessional market resulted in only a

decrease of 0.57 units demanded. For every unit of procurement, 0.97 units are issued, the difference being exported. Thus the impact on retail price due to issues and procurement can be calculated from the demand equation. Solving the demand equation for price and taking the derivative of price with respect to issues yields $\partial PR/\partial ISSUES = -\frac{1}{0.0005327}[-1 + (0.571738)(0.97)] = 1877.22 - 1048.08 = 836.14$. The resultant rise in retail prices is the above derivative times ISSUES which is (836.14)(0.00598) = 5.0001.

TABLE I. REGRESSION COEFFICIENTS FOR THE WHEAT MARKETING CHANNEL IN UTTAR PRADESH

Equation No.	Variables				
(12)	Q^W_t = - 5303.32	+ 124.30P^W_{t-1}	- 3.717P^C_{t-1}	- 24.434FP_t	+ 2.817$Power_t$
		(2.216)**	(-4.529)**	(-0.696)	(1.848)**
	R^2 = 0.84				
(13)	M^W = 14.62	- 71.66Roads	+ 11.775Q^W	+ 0.00160W	
		(-1.817)**	(0.287)	(1.220)	
	R^2 = 0.14				
(14)	M^R = 38.81	+ 0.01738Q^W	+ 27.39W		
		(1.644)**	(0.818)		
	R^2 = 0.28				
(15)	Q^W/Pop = 0.01748	- 0.0005327P^R	+ 0.000729P^{Rice}	+ 0.0001498 $\bar{Y}$	- 0.571738ISSUES
		(-2.481)**	(1.941)**	(7.510)**	(1.800)**
	R^2 = 0.85				

Notes:- The values in parentheses are t-values. One asterisk denotes significance at the 10 per cent level and two asterisks mean significance at the 5 per cent level.

Q^W_t is quantity of wheat produced, P^W_t is the weighted price for procurement and farm level, P^C_t is the farm price of corn at harvest, FP_t is fertiliser price, Power is power available for irrigation, M^W is the farm wholesale margin, Roads is miles of roads, Pop is population, W is the wage rate, M^R is the wholesale to retail margin, Q^W is quantity demanded in the open market, P^R is the retail price of wheat, P^{Rice} is the retail price of rice, $\bar{Y}$ is total income minus the amount spent on wheat issued through fair price shops, and ISSUES is the quantity of wheat issued through the fair price shops.

TABLE II. MEAN OF THE KEY VARIABLES USED IN THE REGRESSION ANALYSIS

Variables (1)	Mean (2)	Units (3)
Farm price (weighted)	34.94	Rs/quintal
production	7752.2 ('000)	metric tonnes*
Farm price (non-weighted)	39.59	Rs/quintal
Procurement price	24.52	Rs/quintal
Retail price	52.83	Rs/quintal
Population	88918.00 ('000)	
Issues per capita	0.00598	metric tonnes
Fair price	38.86	Rs/quintal
Procurement	550.00 ('000)	metric tonnes
Issues	531.73 ('000)	metric tonnes

* 10 quintals = 1 metric tonne.

On the producer side, the mean farm price is Rs 39.59. Procurement from the farmers resulted in a mean weighted price of Rs 34.94 for the period of analysis. The loss to the farmers due to procurement is Rs 4.65 for the entire period. Thus the loss due to procurement is (farm price - weighted farm price) (production) = (4.65) (7752.27) = 36048.05. The gain due to issues is (rise in price due to issues) (demand) = (5.0001)(7202.0) = 36010.00. The

net loss to producers is 36048.05 - 36010.00 = 38.05. Thus producers do not gain as Hayami *et al.* (1982) suggested they might. But the results do show that there is little net effect on producers.[2]

CONCLUSIONS AND POLICY IMPLICATIONS

The results have several major policy implications. Production is inelastic with respect to price. Power for irrigation but not fertiliser prices significantly increased production. This implies that production is still dependent on hydro-electric power which is in turn determined by the amount of rainfall. The insignificance of the price of fertiliser may result from limited use of fertilisers over the study period.[3]

The total mileage of roads is an important factor with regard to farm wholesale margin, suggesting likely benefits from developing infrastructure. Continued dependence on hydro-electric power which in turn depends on erratic rainfall results in production of wheat being adversely affected during the periods of below normal rainfall. Power is unavailable when it is needed the most. Alternate sources of power for irrigation need to be developed.

Wheat distributed through fair price shops displaces wheat demanded in the open market, but not proportionately. An increase of one tonne of wheat through the fair price shops leads to a decline of only 0.57 tonne of wheat through the open market. Thus the results suggest that the government policy of distributing wheat in Uttar Pradesh increases overall demand. Prices rise in the open market due to effective price discrimination. The benefit to producers from price discrimination nearly compensates them for the losses due to procurement.

G. Chellaraj and B.W. Brorsen*

NOTES

1. Rainfall was also considered as an explanatory variable, but was not significant. This may be partly due to the correlation between power for irrigation and rainfall.

2. An increase in procurement leads to less quantity transported through the wholesale and retail channels. The impact of procurement on margin is negative, but insignificant. Thus there may be a slight decline in margin, which is not considered.

3. These results should be interpreted with some caution since the coefficient could also be insignificant because of poor data.

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* Assistant Junior Project Advisor, Inter-American Development Bank Regional Offices, Georgetown, Guyana and Kingston, Jamaica and Associate Professor, Department of Agricultural Economics, Purdue University, West Lafayette, Indiana, U.S.A., respectively.

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