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An Evaluation of Indian Government Rice Policy in Tamil Nadu

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Abstract

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The Indian government procures rice from wholesalers or producers at a price below the market price and then distributes it to low-income consumers at a subsidized price. This paper uses a simulataneous equations econometric model to evaluate the effects of this policy on supply/demand of rice in the state of Tamil Nadu, between 1956 and 1985. Results show that production is more responsive to power for irrigation and fertilizer prices than to output prices. Because supply is inelastic, producers bear the burden of the 'tax' imposed by procurement even though rice is procured from the wholesaler. Rice distributed by the government displaces rice demanded in the open market, and thus the government distribution of rice has not increased the total consumption of rice.

Introduction

Low income has been the major reason for low demand for food products in many developing countries. To increase effective demand for food, the Indian government passed the Essential Commodities Act in 1956. Under this Act, the government procures grain from farmers or middlemen, at a price lower than the market price, and sells to consumers at a subsidized price through 'fair-price shops'. Although the program has been in effect for 30 years, questions remain about its impact on production and effective demand. The purpose of this paper is: (a) to determine the factors that affect the demand and

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supply of rice in the state of Tamil Nadu, India, and (b) to determine the welfare effects of this government intervention.

Past research has studied the effect of government policies on the distribution of grains in India. Harris (1983) found that procuring and distributing grains through fairprice shops had little effect on consumption patterns in the Coimbatore district of Tamil Nadu. Prabha (1983) found that the growth of average consumption had not stabilized in the state of Tamil Nadu and tended to fluctuate widely from year to year, in spite of government intervention. Neither study addressed the impacts of this program on quantity demanded in the open market. In a recent study, George (1985) addressed the impact of the fairprice shops on consumption for five Indian states – Gujarat, Kerala, Punjab, Tamil Nadu, and West Bengal. A single equation using ordinary least squares regression was estimated for each state. George concluded that redistribution of income has resulted from public distribution. Consumers depending on open-market purchases contribute to the ration income of consumers who buy foodgrain from fairprice shops. Hayami et al. (1982) studied the issues regarding efficiency and equity in the producr levy of India. They argued that failing to discriminate effectively between high and low income consumers led to a loss in economic efficiency and adverse income distribution effects in the long run. Hayami et al. also showed that due to benefits from price discrimination and consumer subsidies, producers might be better off with the government intervention.

Similar problems to the one addressed here have been studied for other developing countries. Gerrard and Roe (1983) investigated the reasons and impacts of intervention in the maize and rice markets of Tanzania. The results showed the government followed a policy of relative foodgrain self-sufficiency. The cost of food production in Tanzania increased as a result of government intervention. Lutz and Scandizzo (1980) evaluated the impact of government intervention in agricultural commodity markets for several developing countries – Argentina, Egypt, Portugal, Yugoslavia, Thailand, Kenya and Pakistan. The study indicates a heavy tax burden on the agricultural sector of developing countries. Economic reasoning and the evidence from other developing countries suggest that the policy of procuring at a price lower than the farm price is likely to discourage production. However, Mellor (1985) argued aggregate agricultural output in developing countries does not respond to higher farm prices, but is affected by the availability of inputs, infrastructure development and technology. With regard to India, Easter (1977) found that canal irrigation played a significant role in increasing production of rice in the state of Orissa.

For Tamil Nadu, production would only be indirectly affected since procurement is at the wholesale level. Therefore the impacts of procurement must be analyzed with a simultaneous equations approach. This approach allows addressing several important questions. Does the rice distributed through fair-

price shops substitute for open market rice? Does investment in roads reduce marketing costs? Does Mellor's hypothesis that farm prices do not affect production decisions hold for Tamil Nadu? By examining the whole structure of the rice market in the state of Tamil Nadu simultaneously, this paper is an extention of other studies mentioned earlier.

Model

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

In Tamil Nadu, the amount of power available for irrigation and land are both limited. Inputs are assumed to be allocable among production activities (Just et al., 1983). Thus, the production technology is:

$$Y_j = f_j(X_{1j}, X_{2j}, ..., X_{kj}), \qquad j=1, ..., n$$

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

$$X_1 \leq \bar{X}_1, \qquad X_2 \leq \bar{X}_2$$

where Y_j is output j, X_{ij} is the quantity of input i used in the production of output j, $\bar{X}_1$ is the fixed amount of land, and $\bar{X}_2$ is the fixed power for irrigation.

Assuming the land and power constraints hold as equalities, the farmer's maximization problem is:

$$\max_{\text{s.t.}(1)} \pi = \sum_{j=1}^{n} P_j Y_j - \sum_{k=3}^{K} W_k X_k \tag{2}$$

where $\Sigma_{j=1}^{n} P_j Y_j$ is the total revenue from the n crops produced, and $\Sigma_{k=3}^{K} W_k X_k$ represents the total variable cost in production.

The first-order conditions yield the following output supply functions:

$$Y_j = Y_j(P_1, P_2, ..., P_n, \bar{X}_1, \bar{X}_2, W_3, ..., W_K), \qquad j=1, ..., n \tag{3}$$

Equation (3) is used to estimate the supply of rice. For Tamil Nadu, the main alternative to rice is sugarcane and thus $n=2$. The only input price considered in the empirical section is for fertilizer and hence $K=3$. The total quantity of arable land ($\bar{X}_1$) is assumed to be fixed over time, and thus $\bar{X}_1$ is not included in the empirical model. The prices P_1 and P_2 are not known at planting and therefore lagged prices are used as expected prices. The supply function is therefore specified as follows:

$$Q_t^{\mathrm{P}} = \mathrm{f}_1(\mathrm{P}_{t-1}^{\mathrm{F}}, \mathrm{P}_{t-1}^{\mathrm{S}}, \mathrm{FP}_t, \mathrm{POWER}_t) \tag{4}$$

The quantity produced (Q_t^P) is expected to be positively related to the lagged harvest price of rice (P_{t-1}^F) and the power for irrigation which was rationed during most of the years of the analysis (Tyner, 1978). Q_t should be negatively related to the lagged harvest price of the principal cropping substitute, sugarcane (P_{t-1}^S), and the price of fertilizer (FP_t).

The supply of marketing services from wholesalers and retailers is derived next. A fixed percentage (λ) is procured from the wholesaler at the procurement price (P^P). Thus, the price received by wholesalers (P^0) is:

$$P^0 = \lambda P^P + (1-\lambda) P^W \tag{5}$$

where P^W is the wholesale price. 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. However, retailers typically transport rice for short distances only and thus roads are not included in their production function.

The wholesaler seeks to maximize profit:

$$\begin{aligned} &\max \pi = P^0 Y^W - P^F X^W - WL \\ &\quad \text{s.t.} Y^W = \{\min [X^W, f(L, \text{ROADS})]; \text{ROADS} = \overline{\text{ROADS}}\} \end{aligned} \tag{6}$$

following Brorsen et al. (1985), where P^F is the farm price and W is the price of other inputs (e.g., wage rate). Roads are a 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 rice marketed by the wholesaler, X^W is the quantity of rice purchased by the wholesaler, and L is other inputs (e.g., labor). Under profit maximization, $Y^W = X^W$, and thus the supply of marketing services is:

$$Y^W = Y^W(P^0 - P^f, W, \overline{\text{ROADS}}). \tag{7}$$

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

$$M^W = P^0 - P^f = f_2(Q^P, \text{ROADS/POP}, W) \tag{8}$$

where $Q^P = Y^W$ is quantity transported, W is the wages of labor, and roads are now included on a per-capita basis.

Similarly, for retailers, not including roads, the margin equation is:

$$M^R = P^R - P^W = f_3(W, Q^D) \tag{9}$$

where Q^D is the quantity moved through the wholesale-retail channel, i.e., the quantity left after government procurement. Both Q^P and wages (W) in equation (8) are expected to be positively related to the margin and Roads/Pop is expected to be negatively related. The wages and quantity demanded (Q^D) are expected to be positively related to the retail margin (M^R), in equation (9).

The quantity of rice distributed through fairprice shops is fixed by the government. Latham (1980) derived demand functions when one of the goods is rationed. Latham assumed the ration constraint is effective which is appro-

priate for Tamil Nadu. Thus, consumers are assumed to consume all rice made available through the fairprice shops. Following Latham, the consumer's problem is to maximize utility:

$$\max U = U[Q^D, Q^J, \text{ISSUES}, Q^A] \quad (10)$$
$$\text{s.t. } \bar{I} = I - P^f \text{ ISSUES} = P^R Q^D + P^J Q^J + P^A Q^A$$

where U is utility, P^f is the price of rice through fairprice shops, I is income, Q^A and P^A are vectors of the quantities and prices of all other goods, P^R is the price of rice in the retail market, P^J is the retail price of the substitute (jowar) in the retail market, ISSUES is the quantity of rice rationed through the fairprice shops per capita, Q^D is the quantity of rice demanded through the commercial market, and Q^J is the quantity of jowar demanded through the commercial market. $\bar{I}$ is 'full income', income less expenditure for the rationed good (Latham, 1980) which in this case is rice.

Assuming rice and jowar are weakly separable from all other goods, the demand function is:

$$Q^D = f_4 (P^R, P^J, \bar{I}, \text{ISSUES}) \quad (11)$$

The retail prices of rice and the quantity supplied through fairprice shops are expected to be negatively related to open-market rice demand. $\bar{I}$ and the price of jowar are expected to have a positive impact.

The system of equations are specified linearly and estimated using three-stage least squares. Past studies have usually used ordinary least squares (OLS). Thus if the errors are correlated across equations, the estimates obtained here are asymptotically more efficient than those in past studies.

Data

Annual data (1956–1985) for quantity produced, procured and issued through fairprice shops and the procurement price are from the *Bulletin on Food Statistics* (Gov. India, 1956–1985). Data for 1956–1978 for exports and imports are also from the *Bulletin on Food Statistics*, while 1979–1985 data were obtained from the Land Tenure Center, University of Wisconsin, Madison, WI. Data on power for irrigation (10^6 kWh). are from the *Statistical Abstracts* (Gov. India, 1956–1985). The fertilizer prices (Rs/kg) and the rice prices (Rs/q)* in the open market are from *Agricultural Prices in India* (Gov. India, 1956–1985). No consumption data are available, and hence quantity consumed is calculated as:

$$Q^D = (S^O + Q^P) - Q^G - Q^T - S^C \quad (12)$$

where S^O is the opening government stocks, Q^P is the quantity produced, Q^G

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q, metric quintal = 100 kg.

is the quantity demanded by the government for the procurement stocks, S^C is closing government stocks, and Q^T is net exports which may be negative or positive depending upon whether there was a deficit or surplus in the state. 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*. The wages of agricultural laborers which include both on-farm and off-farm employees (those connected with handling and transporting agricultural products) are obtained from *The Agricultural Wages in India*. The prices and wages are deflated using the appropriate price indices. All the prices are expressed in Rs/q. The quantity of rice consumed (Q^D) is expressed per capita.

In developing countries, a substantial proportion of food is grown for home consumption, but no data are available for India, and hence this aspect could not be considered. The lack of data on closing stocks in private hands is also a drawback since it introduces error in the measurement of demand. Also, hoarding and black marketing are major problems in India, particularly with regard to foodgrain and vegetable oil marketing, and particularly in semifeudal rural areas (Bahaduri, 1973). Also, the data are of uncertain quality and thus there is the possibility that some coefficients are biased toward zero.

Results

The results are presented in Table 1. In the production equation, the farm price of rice and sugar were insignificant. The fertilizer price was negative and significant as expected and the power coefficient was positive and significant, both at the 5% level. Mellor's hypothesis that output prices have no effect on supply could not be rejected for the state of Tamil Nadu. Output varies significantly with respect to the power for irrigation and fertilizer price. Therefore, production could be increased most effectively by subsidizing fertilizers or by improving access to new technology such as irrigation as suggested by Wade (1982) and Adams et al. (1981).

In the farm-wholesale margin equation, the wages of labor was not significant, but both roads and quantity transported were significant at the 5% level and had expected signs. Therefore, investment in roads helps reduce marketing costs. In the retail margin equation (15), both wages and quantity marketed were significant at the 5% level. Both margin equations vary positively with the respective quantity as expected.

In the retail demand equation all the variables except the price of jowar were significant and all had the expected sign. The elasticity of demand through the commercial market was 1.09, and the cross-elasticity between jowar and rice was 0.07. The concessional market reduces the demand through the commercial market. Grain distributed through fairprice shops is substituted for open market grain almost proportionately. These results agree with Harris (1983)

TABLE 1

Regression coefficients for the rice marketing channel in Tamil Nadu, India[a,b]

$$Q_t^P = 3793.38 - 0.2769P_{t-1}^F - 0.121P_{t-1}^S - 0.680\ \text{FP}_t + 1.5426\ \text{POWER}_t \quad (13)$$
$$\qquad -(0.04) \quad (-0.03) \quad (-2.294)^* \quad (6.669)^*$$
$$R^2 = 0.65$$

$$M^W = 77.168 + 0.07539Q_t^P - 95.183\ \text{ROADS/POP} + 2.7817W \quad (14)$$
$$\qquad (2.526)^* \quad (-6.160)^* \quad (1.198)$$
$$R^2 = 0.60$$

$$M^R = -78.0186 + 73.422W + 4.78Q^D \quad (15)$$
$$\qquad (5.428)^* \quad (2.462)^*$$
$$R^2 = 0.46$$

$$Q^D/\text{POP} = 3.416 - 0.4094P_t^R + 0.06307P_t^J + 0.06095I - 1.0026\ \text{ISSUES} \quad (16)$$
$$\qquad (-5.282)^* \quad (0.654) \quad (12.929)^* (-5.161)^*$$
$$R^2 = 0.81$$

[a]The values in parentheses are t-values. Asterisks denote significance at the 5% level.
[b]Q^P is quantity of rice produced, P^F is the farm price of rice at harvest, P^S is the farm price of sugarcane at harvest, FP is fertilizer price, POWER is power available for irrigation, M^W is the farm-wholesale margin, ROADS is the miles of roads (1 mile $\approx$ 1.609 km), POP is population, W is the wage rate, M^R is the wholesale to retail margin, Q^J is quantity demanded in the open market, P^R is the retail price of rice, P^J is the retail price of jowar, $\bar{I}$ is total income minus the amount spent on rice issued through fairprice shops, and ISSUES is the quantity of rice issued through the fair-price shops.

who concluded that government distribution had not increased total consumption. The cross elasticity was extremely low between commercial rice and jowar, although they are substitutes. The income elasticity of 1.72 for the commercial channel indicates that rice is highly income elastic.

Welfare analysis

The welfare analysis presented here is similar to the one presented by Hayami et al. (1982). It is evident from the econometric analysis that the consumers substitute the grain available in the fairprice shops for the open market grain, one to one. Thus, producers do not benefit from price discrimination as Hayami et al. suggested they would. Because of this and because production is inelastic, a simpler approach than the one used by Hayami et al. can be used here.

As Fig. 1 shows, supply is perfectly inelastic and without government intervention, the equilibrium price is P^e. There would be no change in price if quantity procured equaled quantity distributed through fair-price shops. But, Tamil Nadu is a wealthy state and the government ships some of the rice procured to

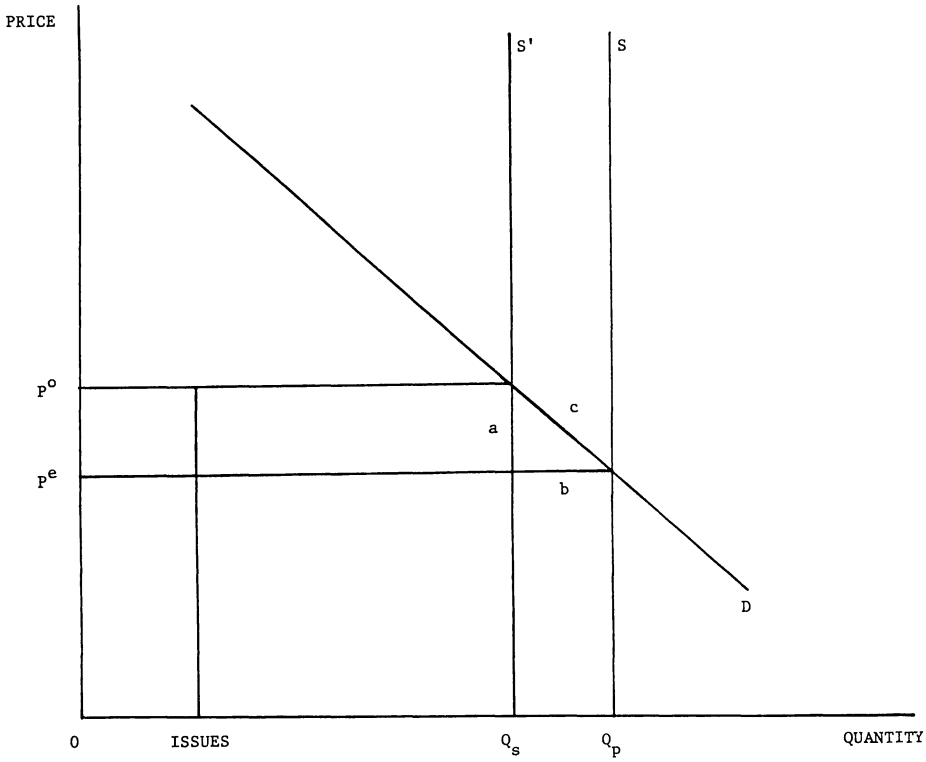

Fig. 1. Effect of distribution through fair-price shops.

other states. Thus, the quantity available through the fairprice shops and the open market is reduced to Q_s. The reduction in supply due to procurement being greater than distributions raises the open market price to P^o. The change in equilibrium price can be calculated as:

$$P^o = P^e = \frac{-b}{B} \tag{17}$$

where B is the coefficient for the price of rice in the demand equation and b is the difference between quantity procured and quantity distributed in Tamil Nadu.

Gain in consumer surplus due to distributions through fairprice shops at susidized prices is $(P^e - P^f)$ (ISSUES). The gain in producer surplus is $(P^o - P^e)(Q_s - \text{ISSUES})$.

It is possible to deduce the loss in consumer surplus as $(P^o - P^e)(Q_s) + \frac{1}{2}(Q_P - Q_s^o)(P^o - P^e)$. The loss in producer surplus due to procurement below market prices cannot be deduced from Fig. 1, but it can easily be derived. Since production is perfectly inelastic the entire 'tax' im-

posed by procurement will be borne by the farmer (Fisher, 1981). This loss in producer surplus is $(P^w - P^p) \times$ Procurement.

The value of B from equation (16) is -0.04094. The value of b was 21.34. The value of $P^o - P^e$ calculated from equation (17) was 0.03. Gain in consumer surplus was $(24.99)(328.82) = 8217.22$ at the mean. The gain in producer surplus was $(0.03)(4043.28) = 121.29$. The loss in consumer surplus was 13.66 and the loss in producer surplus was 4826.23.

The net gain in consumer surplus came to 8203.56 and the net loss in producer surplus came to 4703.00. The government costs can not be calculated from the available data. But assuming the government distribution system operates less efficiently than private distribution government costs would have to be large enough so that there is a net social welfare loss.

On the whole, the scheme leads to considerable gain in consumer surplus and a considerable loss in producer surplus, although gain in consumer surplus was greater than the loss in producer surplus. In its enthusiasm to subsidize the consumers, particularly the urban residents, the government is penalizing the producer. This can act as a tax on the producer and eventually lead to reduction in the production of rice. In recent years, while wheat has come to be supported, compulsory procurement of rice using the producer levy scheme has continued to exist (George, 1985).

Conclusions

The results have at least four major implications for development policy:

Production is inelastic with respect to price. Power for irrigation and fertilizer prices have been a major factor in increasing production. Thus, a price support program may have little impact (at least in the short run). Increasing technology and subsidizing inputs such as fertilizers would have a greater immediate impact on production. This finding should be interpreted with some caution since the insignificance of the coefficients could be due to poor data.

The total mileage of surfaced roads has an impact on the marketing margins. The development of the infrastructure is likely to reduce the margin due to the decline in transportation cost.

Rice distributed through fairprice shops displaces rice demanded in the open market on a one-to-one basis. Thus, these results suggest the government policy of distributing rice has not increased the total consumption of rice in Tamil Nadu.

While the total consumption has not increased, there has been a gain in consumer surplus. At the same time there has been a loss in producer surplus. Since the policy appears to tax the farmer, it may discourage production as well as technology adoption in the long run. This policy may also lead to redistribution of income from the rural to the urban areas.

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