Food Price Subsidy under Public Distribution System in Andhra Pradesh, Maharashtra and Rajasthan*

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ABSTRACT

The present paper uses primary household level data collected in 2007-08 for the rural sector of three Indian states, Andhra Pradesh (AP), Maharashtra and Rajasthan, to evaluate the impact of the Targeted Public Distribution System (TPDS) in these three states. The paper presents a basic profile of the TPDS in these states and then goes on to assess the difference between subsidized TPDS price and market price for rice, wheat sugar and kerosene at the village level by per capita expenditure class and then conducts stochastic dominance comparisons across non-participants and participants in the three states. It examines various other characteristics of the experience with TPDS in these states including waiting times for different types of card holders, the distribution of the shares of expenditure on food items brought from TPDS among TPDS households and the distribution of the real income transferred through TPDS. The paper finally reports on a Tobit analysis of the quantity of food items such as wheat, rice and sugar demanded by households through the TPDS.

KEYWORDS: Targeted Public Distribution System, Food subsidy, Targeting Errors.
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Introduction and background

The Public Distribution System (PDS) in India was introduced as a war-time rationing measure in 1939 in Bombay (now Mumbai) and later expanded to six other cities and a few regions. Following independence and with high rates of undernourishment and food insecurity long standing problems the Indian government rapidly expanded the PDS.

In independent India the PDS has gone through rapid transformation and expansion even as the extent of under-nutrition has remained stubbornly high. This has occurred despite high rates of economic growth in recent times. Thus, between 1980 and 2005 real GDP per head grew at 3.9 per cent per annum whereas this growth between 2000 and 2005 was an even more impressive 5.4 per cent. Real per capita consumption growth (3.9 per cent per annum between 2000 and 2005) has also been strong, if less spectacular. Yet, as Deaton and Dreze (2009) indicate, more than 75 per cent of the population has daily per capita calorie consumption below 2,100 in urban areas and 2,400 in rural areas. These magnitudes are cited as minimum requirements for Indians. At the same time the food subsidy bill has been rising rapidly and was a staggering Rs. 370 billion for Below Poverty Line (BPL) households[1] in 2009-10. There is, hence, a serious problem of food deprivation even though the bill for an antidote (the food subsidy) is large and climbing rapidly.

Broadly speaking there have been four phases in the evolution of the PDS in India. The first covers the period since its inception to 1960. In this period the PDS was expanded to other cities and served as a means to channel imported foodgrain. This was a period when India was reliant on food imports with low and erratic domestic production of foodgrains. In the mid 1960s there was a serious food crisis following which government took an aggressive approach to food security. Deliberate steps such as the establishment of the Agricultural Prices Commission and the Food Corporation of India (FCI) were taken during this period. This led to a rapid expansion and universalization of the PDS between 1987–91, the third phase. In the fourth phase beginning in 1991, and particularly after a 1997advice from the World Bank, an effort was made to target the PDS (TPDS), partly to make it more effective in reaching the poor and partly to reduce the burden of the food subsidy.

[1] This subsidy bill could rise by 25 to 140% if new poverty lines suggested by a committee of the Planning Commission were adopted. See *Livemint* (2010).

TPDS differs from earlier versions of PDS in several key respects. First, TPDS makes a specific attempt at targeting which universal PDS does not. A distinction is made between those households above the poverty line (APL) and those below it (BPL) with the poverty line given by the Planning Commission. Second, APL and BPL households are treated differentially with regard to both quantity and price of foodgrain made available through TPDS. Thus the TPDS now is explicitly a multi-price scheme. In 2000 the government announced a policy whereby the prices at which the FCI sells PDS foodgrain to states would be set at half the 'economic cost' incurred by the FCI for the BPL households and at 'full economic cost' for APL households. A third, even more highly subsidized price, was introduced in 2001 for the 'poorest of the poor' the so-called Antyodaya scheme.

According to assessments by the government itself the transition for PDS to TPDS has neither helped the poor, nor reduced the food deficit (Planning Commission, 2005). Several reasons are advanced as an explanation for this. First, targeting has led to the exclusion of many genuinely needy households and the capture of BPL cards by the non-poor. Targeting has also adversely affected the functioning and economic viability of the TPDS network and led to a collapse of the delivery system. TPDS has failed to stabilize food prices and there are reports of large scale diversion of grain meant for TPDS to the open market.

Against this background the present paper uses primary household level data collected in 2007-08 for the rural sector of three Indian states, Andhra Pradesh (AP), Maharashtra and Rajasthan, to evaluate the impact of the TPDS in these three states. The paper begins by presenting a basic profile of the TPDS in these states; it then goes on to assess the difference between subsidized TPDS price and market price for rice, wheat sugar and kerosene at the village level by per capita expenditure class and then conducts stochastic dominance comparisons across non-participants and participants in the three states. It examines various other characteristics of the experience with TPDS in these states including waiting times for different types of card holders, the distribution of the shares of expenditure on food items brought from TPDS among TPDS households and the distribution of the real income transferred through TPDS. The paper finally reports on a Tobit analysis of the quantity of food items such as wheat, rice and sugar demanded by households through the TPDS.

The plan of this paper is as follows. Section II briefly describes the data and methodology. Section III presents results on the basic profile of TPDS in Andhra Pradesh, Maharashtra and

Rajasthan and provides estimates of the subsidy implicit in the TPDS scheme. Section IV provides results of the Tobit estimation and section V concludes.

I. Data and Methodology

The present paper draws upon primary household data drawn from three Indian states: Rajasthan, Andhra Pradesh and Maharashtra. The data were collected during 2007–08. The sample survey was designed to be a representative one for the following reasons. First, a list of National Rural Employment Guarantee (NREG) districts was compiled for each state. From these districts, three were selected on the basis of probability proportional to size (in this case, rural population as reported in the 2001 Census) in the case of Rajasthan. In a similar manner, six districts were selected for each of AP and Maharashtra. The next step proceeded as follows. In the case of Rajasthan, for example, three villages were randomly selected from each district, followed by a random selection of households. Twenty five households were selected from each of twenty villages spread over three districts. In AP and Maharashtra, these 25 villages were spread over 6 districts each. In each village 20 households were randomly selected giving us a sample of 500 households in each of the three states surveyed. Apart from household level information individuals within households were also interviewed. The data include information on caste, occupation, landholdings, household size, NREG participation, type of ration card, and TPDS participation. The number of individuals interviewed for Rajasthan, AP, and Maharashtra were, respectively, 2664, 2190, and 2270.

Definition and calculation procedures

PDS price for village v for food item j (e.g. wheat, rice, sugar) is defined as

$$P_{vj} = \exp\left(\frac{\sum_{i=1}^{n} \alpha_{vij} \log P_{vij}}{\sum_{i=1}^{n} \alpha_{vij}}\right) \text{ where}$$

α_{vij} =Share of expenditure on food item j for household i of village v

= Ratio of PDS expenditure on food item j for household i of village v to the total expenditure of household i of village v on all the food items

P_{vij} = Price per unit quantity paid by household i of village v on food item j

n = number of households in village v

In a similar manner we also compute market price. We then compute the excess of market price over PDS price for village v for food item j = (Market price –PDS price)*100/ Market price

TPDS participation: A household is said to be participating in TPDS if the household has consumed (bought) some quantities of rice or wheat or sugar from a fair price shop (FPS) in the last 30 days.

Share of expenditure for food item j (e.g. wheat, rice, sugar and food grains (wheat + rice) brought from PDS by for household *i* is defined as

S_{ij} = [Expenditure on food item *j* from PDS for household *i**100]/[Total expenditure (PDS and Market) on food item j for household *i*]

Stochastic dominance comparisons of the log of per capita monthly expenditures of participants and non-participants are made by examining the cumulative distribution functions (CDF) of the log of per capita monthly household expenditure. We also use cross tabulation methods to understand the distribution of waiting times for TPDS grain as well as the distribution of subsidy on foodgrain bought through the TPDS scheme.

Tobit Analysis

Finally we use the Tobit model (Greene, 2003) to estimate quantity of food items such as wheat, rice or sugar demanded by households through participation in the public distribution system. Our measure is the quantity of a food item consumed by household in last 30 days.

In the Tobit model, for a latent (unobserved) variable $y_i^* \sim N(\mu, \sigma^2)$ and observed dependent variable y_i, we define an index function as follows:

$$y_i^* = x_i'\beta + \varepsilon_i,$$

$$y_i = \begin{cases} 0 \ \ if \ \ y_i^* \le 0 \\ y_i^* \ \ \ if \ \ y_i^* > 0 \end{cases} \qquad (1)$$

Let us now assume that censoring point is at zero and the disturbance term is normally distributed. Following Greene (2003), the conditional mean is given by

$E[y_i/x_i] = \Phi(\frac{x'_i\beta}{\sigma})(x'_i\beta + \sigma\lambda_i)$, *where* $\lambda_i = \frac{\phi(\frac{x'_i\beta}{\sigma})}{\Phi(\frac{x'_i\beta}{\sigma})}$ and marginal effect (slope) is defined as $\frac{\partial E[y_i/x_i]}{\partial x_i} = \beta\Phi(\frac{\beta' x_i}{\sigma})$. $\phi(.)$ and $\Phi(.)$ are, respectively, the density and cumulative distribution function of the standard normal distribution. $\Phi(\frac{x'_i\beta}{\sigma})$ is termed as the Tobit scale factor.

II. A Profile of TPDS in AP, Maharashtra and Rajasthan

In Table 1 we provide some basic statistics through cross tabulation on TPDS participation in the three states.

Table 1 here

Using this table we comment on basic household characteristics in the three states as well as on their participation in the TPDS.

Household Characteristics

The shares of the Schedule castes (SCs), Scheduled Tribes (STs) and other backward castes (OBCs) in the total population are nearly equal in Rajasthan, with the share of the OBCs being the highest. In Andhra Pradesh, the share of OBCs in the total population (under 49 per cent) is the highest, followed by SCs (about 29 per cent) and STs (under 10 per cent). In Maharashtra, the share of the OBCs in the total population is the highest among the three states (above 51 per cent), with considerably lower though nearly equal shares of the SCs (about 13 per cent) and STs (about 15 per cent).

The share of poor households in the total population is the highest in Rajasthan (about 41 per cent), with the highest share of acutely poor (about 30 per cent); AP and Maharashtra stood second and third in terms of share of poor households in respective populations with nearly the same share (about 25 per cent).

The land ownership distribution of households also varies significantly. Among the three states, AP has the highest share of landless households (nearly 44 per cent) with lowest share in the highest land owning group (more than 5 acres). Maharashtra has the highest percentages of households in land owning category of more than 5 acres (about 16 per

cent).The share of small farmers[2] is the highest for Rajasthan (about 52 per cent), followed by AP(about 41 per cent) and Maharashtra (about 21 per cent).

Education is an important indicator of human development. The education level of household head differs in these states. While the share with illiterate household heads is the highest (above 44 per cent) in AP, Maharashtra has the least (under 28 per cent) and Rajasthan comes in between with 38 per cent of households with illiterate heads. Rajasthan has the highest (above 12 per cent) share of household heads with secondary and higher education level as compared to Maharashtra (under 9 per cent) and AP (under 6 per cent).

The distribution of household size also differs in these states. While nearly 60 per cent of households in AP have less than 5 members, the shares of this group in Maharashtra and Rajasthan are about 53 per cent and 38 per cent, respectively. Rajasthan has the highest share of large households.

TPDS Participation

The proportion of households participating in the TPDS is the highest in Andhra Pradesh (90%), followed by Maharashtra (53%) and then Rajasthan (32%). In Rajasthan, the share of STs is the highest (about 41 per cent) among the PDS participants, followed by OBCs (under 26 per cent), and SCs (about 21 per cent); in Andhra Pradesh, the share of OBCs among all TPDS participant is the highest (nearly 50 per cent), followed by SCs (nearly 29 per cent) and STs (under 10 per cent); OBCs had the highest participation in Maharashtra with the highest share among the three states (nearly 52 per cent), STs come next, followed by SCs.

Among households participating in the TPDS in all three states, share of non-poor households is significantly higher than those for the poor, with ratio of non-poor to poor participating households lying in the range of 1.6 (for Rajasthan) and 2.8 (for Andhra Pradesh).

We next examine the share of landless among TPDS participants, Andhra Pradesh had the highest share (nearly 44 per cent), followed by Maharashtra (above 36 per cent). While the share of participants declines with increase in land owned in both Rajasthan and Andhra Pradesh, it increases substantially in Maharashtra.

[2] Households with land owned in the range 0 to 2 acres.

Among households that participated in the TPDS, the share of those with illiterate heads is nearly equal for Rajasthan and Andhra Pradesh (about 44 per cent) and it is lowest for Maharashtra (29 per cent). Further, while in Andhra Pradesh and Maharashtra the share of household participating in the TPDS falls with higher level of education for the household head, in Rajasthan this declines till secondary education and then increases for the highest education level.

TPDS participation and household size reveals an interesting pattern. While in Andhra Pradesh and Maharashtra small households (with $\leq$4 members) exhibit highest share of TPDS participation; in Rajasthan relatively larger households (5–8 members) do so.

Table 2 presents some preliminary information on the extent of the subsidy provided by the TPDS by reporting on the excess of market price over TPDS price.

Table 2 here.

To assess the difference between subsidized price and market price, we computed excess of market price over PDS price for wheat, rice, sugar and kerosene at the village level. Our key observations are as follows:

In the case of wheat for Rajasthan, the excess of market price over TPDS price varies in the range of 50 per cent to 90 per cent with the highest concentration of villages (about 57 per cent) in the range 60–70 per cent. In Andhra Pradesh, we do not have data available on wheat PDS prices. In Maharashtra, the excess of market price over TPDS price varies in the range of 40 per cent to 90 per cent, with about 88 per cent of villages in the range 40–70 per cent.

We have sufficient data for all three states in the case of rice. The minimum range of excess of market price over TPDS price is 30–40 per cent in all the three states. While in Rajasthan and Maharashtra, very small concentrations of villages are found in the highest range of price differences of 80–90 per cent, in Andhra Pradesh nearly one-third of the villages are concentrated in this range. However, the majority of the villages have excess of market price over TPDS price in the range of 50–70 per cent.

For sugar, data on TPDS price is available only for Rajasthan and Andhra Pradesh. In Rajasthan, nearly 69 per cent of villages have 20–30 per cent of excess of market price over

TPDS price; in Andhra Pradesh, in contrast, the majority of villages (68 per cent) are concentrated in the excess range of 10–20 per cent.

For kerosene, out of the villages for which we have data, 8 villages are in Rajasthan, 19 villages in Andhra Pradesh and 7 villages in Maharashtra. In Rajasthan, the excess range of market price to TPDS price is 30 to 60 per cent; 20–70 per cent in Andhra Pradesh and about 43 per cent villages in Maharashtra have 30-40 per cent of excess of market price over TPDS price.

To examine participation in TPDS by income class we study the cumulative distribution functions (CDF) of participants and non-participants in the TPDS in Figures 1 to 4. We use the concept of stochastic dominance of CDFs around per capita expenditure at the poverty line ± 20 per cent.

Figures 1 to 4 here.

As the CDF of TPDS participants largely overlaps with that of non-participants in Rajasthan, in particular over the poverty range specified, the latter stochastically dominates the former. It follows that the TPDS targeting in forms of the FGT class of poverty indices is not unsatisfactory. In particular in the case of Andhra Pradesh, there is robust confirmation of TPDS targeting in terms of the FGT class of poverty indices as the non-participant CDF shows first order stochastic dominance (not reported here) over the CDF of TPDS participants in the range of poverty line ± 20 per cent. Maharashtra also exhibits first order stochastic dominance (not reported here) of the CDF of non-participants over the CDF of participants, implying satisfactory targeting of TPDS in terms of FGT class of poverty indices.

Both Andhra Pradesh and Rajasthan show first order stochastic dominance of the CDF of TPDS participants over that of the corresponding CDF for Maharashtra. So in both Andhra Pradesh and Rajasthan, TPDS is better targeted than in Maharashtra. However, given that CDF of Andhra Pradesh crosses over the CDF of Rajasthan at the lower limit of the poverty cut-off point and lies above it over the admissible poverty range, TPDS in Andhra Pradesh is better targeted than in Rajasthan.

Transaction costs associated with transactions in Fair Price Shops

We now examine some elements of the transactions costs associated with buying from Fair Price Shops (those that sell TPDS food grain). Key element of this transactions cost is the distance travelled to Fair Price Shops and the waiting time to buy from these shops.
The former is depicted in Table 3.

Table 3 here

Table 3 indicates that the maximum range of distance of fair price shop from the household is highest for Rajasthan (0–10 km), followed by Andhra Pradesh and Maharashtra with almost equal range of 0 to 3 km. The average distance between a household and fair price shop is the highest for Rajasthan, followed by Andhra Pradesh and, then, Maharashtra. In Maharashtra, an overwhelming majority of the households (above 85 per cent) live within a range of 1 km from the fair price shop. The corresponding figures for Andhra Pradesh and Rajasthan are, respectively, 72 per cent and a little over a third.

As the distance from the Fair Price Shop rises the proportion of households living there as a proportion of total households falls. Maharashtra is an exception to this where lowest proportion of total households (under 2 per cent) lives in the range of 1–2 kilometers.

In Tables 4a and 4b we examine the distribution of waiting times for households participating in TPDS.

Tables 4a and 4b here.

In Rajasthan, more than one-third of the participating households had to wait for more than 45 minutes to make purchases from Fair Price Shops. In contrast, nearly 90 per cent of the TPDS participants in Andhra Pradesh and Maharashtra have to wait 45 minutes or less at the fair price shops. However, going by type of PDS card, in general, APL card holders have the least waiting time in all the three states. The mean waiting time for a TPDS participating household in the shop is highest in Rajasthan (more than 54 minutes), followed by Andhra Pradesh (about 30 minutes) and Maharashtra (about 24 minutes). The maximum waiting time has a similar distribution across the three states. In Rajasthan, BPL card holders had highest mean waiting time at the shop while APL card holders had the lowest. In Andhra Pradesh, APL card holders had the least mean waiting time followed by BPL and Antodaya card holders. In Maharashtra, BPL cardholders had the highest mean waiting time followed by APL and Antodaya cardholders.

In Table 5 we present results on the distribution of the share of expenditure on food items brought from TPDS among participating households.

Table 5 here

In the case of food grains (rice and wheat) in Maharashtra nearly three-fourths of participating households got more than 80% of their grains from Fair Price Shops. The corresponding figure for Rajasthan was less than one-third. Also, in Andhra Pradesh, the vast majority (over 92 per cent) bought relatively small shares of food grains. Mean share percentages of food grains bought are nearly equal in Maharashtra and Rajasthan.
In the case of wheat 89 per cent of the participating households in Maharashtra bought 80 per cent of their wheat purchases through Fair Price Shops. The corresponding figure for Rajasthan was only 37 per cent. In Rajasthan more than half the participating households bought $\leq$40 per cent of their wheat from Fair Price Shops. Mean share percentages of wheat are significantly higher in Maharashtra as compared to Rajasthan. No information on wheat is available for Andhra Pradesh.

In the case of rice, the 94.39 per cent of households in Rajasthan made $\geq$80 per cent of their purchases of rice through TPDS. The corresponding figures for Maharashtra and AP were, respectively, 82 per cent and just 1.39 per cent. This suggests that households in Andhra Pradesh are more dependent on the market rather on TPDS. About 60 per cent of households in Andhra Pradesh bought $\leq$ 20 per cent of their rice through TPDS. Mean share percentage of rice is the lowest in Andhra Pradesh (only 20.53 per cent). Rajasthan has the highest mean share (96.47 per cent), somewhat higher than Maharashtra (88.37 per cent).

In the case of sugar in Rajasthan 77.68 per cent of the households bought $\geq$80 per cent of their sugar from Fair Price Shops. The corresponding figure for AP is lower at 60.52 per cent. Mean share percentage of sugar is significantly higher in Rajasthan (about 91 per cent) as compared to Maharashtra (about 75 per cent).

In Table 6 we report estimates of the real income transferred through the TPDS scheme in the three states.

Tables 6a and 6b here.

In Table 6a we report on mean real income transferred, from sales of various food items through (wheat, rice and sugar) TPDS, per household per village per month. In Table 6b this is further categorized according to the poverty status of the household (defined in Table 7).

The mean real income transferred (RIT) from TPDS per household per village cannot be calculated for wheat in AP and sugar in Maharashtra because of the non-availability of TPDS prices. For all the food items (wheat, rice and sugar) in all the states, the majority of the households received less than Rs. 50 as mean real income transferred through TPDS. The mean real income transferred from TPDS per household per village cannot be calculated for wheat in Andhra Pradesh and sugar in Maharashtra due to non-availability of data on PDS prices. For wheat, mean RIT is the highest for Rajasthan (Rs. 9.44), followed by Maharashtra (Rs. 4.59). Mean RIT for acutely poor participants in wheat consumption is nearly same in both the states; however, significantly higher in Rajasthan for moderately poor, moderately non-poor and affluent participants. In Rajasthan, mean real income transferred was highest for affluent and lowest for acutely poor households. In Andhra Pradesh, moderately non-poor and affluent had slightly higher mean RIT. In the case of rice, Andhra Pradesh had highest mean RIT per household per village (Rs. 7.38), followed by Maharashtra (Rs. 4.21) and Rajasthan (Rs. 3.24). While in Rajasthan and Maharashtra the mean RIT is lower for poor households, in Andhra Pradesh it is other way round. For sugar, very small amount is transferred (less than Rs. 1) in both Rajasthan and Andhra Pradesh, with the lowest in the latter (Rs. 0.18 against Rs. 0.67 for Rajasthan). On average, mean RIT is higher in poor households. For food grains, Maharashtra had highest mean RIT (Rs. 12.45), followed by Rajasthan (Rs. 10.14) and Andhra Pradesh (Rs. 7.38). While in Rajasthan and Andhra Pradesh, mean RIT is highest for acutely poor households, by contrast, in Maharashtra it is highest for the affluent.

Table 7 here

III. Results on Tobit Estimation

In this section we report on the Tobit estimation of consumption through TPDS. Separate equations for each of wheat, rice and sugar are reported for the three states in Tables 8, 9 and 10. We now comment briefly on these results.

Tables 8, 9 and 10 here

Results for Rajasthan are reported in Table 8. In the wheat equation the actual effects of an increase in the wheat and rice village level market to PDS prices are 4.542 and 0.776 respectively at the mean values of wheat and rice village level market to TPDS price ratio. An increase in each of the ratios of market price with respect to TPDS price for both rice and wheat increases the consumption of TPDS wheat. However, these effects are statistically weak. An increase in the per capita monthly expenditure (proxy for household income) increases the demand for wheat from TPDS. The distance to Fair Price Shops and household size do not have any effect on TPDS wheat demand. In the rice equation for Rajasthan, the numerical magnitudes of wheat and rice village level market price to TPDS price ratio are, respectively, 1.504 and 0.488 at the mean values of wheat and rice village level market to TPDS price ratio. Controlling for other factors, an increase in the ratios of market to TPDS prices for both wheat and rice food commodities, increases the demand for TPDS rice.

When ratios of market price to TPDS price of wheat and rice are interacted, there is a weakening of the dependency on TPDS in the case of both the food grains, and especially for rice. This implies that in a period of high prices of food grains, the demand for TPDS weakens presumably implying substitution of other food grains for rice. An increase in per capita monthly expenditure (proxy household income) increases the demand for rice from TPDS. Again, distance of fair price shops, household size and its composition do not have any significant effect on TPDS rice demand. The sugar equation for Rajasthan reveals that the magnitudes of the effects of distance of Fair Price Shop from the village, ratio of Per Capita Monthly Expenditure to state level poverty cut-off and village level Market price of milk products are -0.172, 0.112 and 0.020, respectively. The demand for sugar gets reduced with an increase in the distance of Fair Price Shop from the village. An increase in the ratio of household's per capita monthly expenditure (household income) to the state level poverty cut-off also increases the demand for sugar from TPDS.

Village level market price of milk products increases the consumption of sugar purchased from TPDS. However, this effect weakens at higher prices of sugar, implying higher demand for milk substitutes.

Table 9 lays out the Tobit estimation results for Andhra Pradesh. The wheat equation cannot be estimated because of lack of data. In the rice equation the numerical magnitudes of the effects of distance of Fair Price Shop from the village and village level market to TPDS price ratios for rice are -2.068 and 0.751, respectively. Demand of rice from TPDS decreases with

an increase in distance of fair price shop from village. However, this effect weakens at longer distances. In the case of rice, an increase in market price relative to TPDS price increases the consumption of the quantity of TPDS rice. This effect weakens with higher values of this price. An increase in per capita monthly expenditure (proxy for household income) has negative effect on the demand for rice through TPDS. In the sugar equation for Andhra Pradesh, the numerical magnitudes of distance of Fair Price Shop from the village, village level market to TPDS price ratio for sugar and ratio of Per Capita Monthly Expenditure to state level poverty cut-off are 0.219, 0.650 and -0.335, respectively. Surprisingly, the quantity of sugar consumed from TPDS increases with increase in distance of village from fair price shop. The price effect ceases to be positive at longer distance. This implies that the transaction cost of buying from TPDS offsets the price advantage. Also, at higher market to TPDS price ratios, the somewhat counter-intuitive positive effect of distance is considerably weakened. As expected, the market to TPDS price ratio for sugar has positive effect on the demand for sugar from TPDS. An increase in the ratio of per capita monthly expenditure reduces the quantity consumed from TPDS. Market price of milk product (a complement of sugar) in the village has a positive and significant effect on the TPDS quantity of sugar consumed. The market price of Gur (a substitute for sugar), however, does not have a significant effect on sugar consumption from TPDS.

Table 10 portrays the Tobit results for Maharashtra. In the wheat equation the numerical magnitude of the effect of distance of Fair Price Shop from the village is -6.986. Somewhat surprisingly, therefore, the demand for wheat from TPDS decreases with an increase in distance of fair price shop from village. However, this effect weakens at longer distance. The price ratios of wheat and rice (a substitute of wheat) to respective TPDS prices have no effect on TPDS wheat demand. An increase in the village level agricultural wage rate increases the demand for wheat consumption from TPDS. In the rice equation for Maharashtra, the numerical magnitudes of the effects (including the effects of the respective quadratic terms) of household size and distance of Fair Price Shop from the village are 0.565 and -4.478, respectively. The quantity of rice consumed from TPDS increases with an increase in family size but this effect falls off at higher level of household size. The demand of rice from PDS also gets reduced with an increase in the distance of Fair Price Shop from the village. But, this effect is weaker at longer distances. As the rice and wheat market to PDS price ratios appeared to be correlated with other explanatory variables, these were omitted. An increase in the village level agricultural wage rate has a negative effect on the demand for rice from

TPDS. The sugar equation could not be estimated due to lack of TPDS data on sugar consumption.

IV. Conclusions

An important aspect of the assessment of the usefulness of any social welfare program, particularly one that claims to be targeted towards the poor, is the examination of its incidence at the household level. This helps us understand directly whether the program's benefits are reaching those for whom it was intended. In addition, it becomes important to understand the factors determining household access to the program. Such an analysis is particularly relevant for a social welfare program such as the TPDS, given that the cost associated with it is spiraling uncontrollably.

This paper has used primary data from a representative sample of rural households collected from three Indian states, Rajasthan, Andhra Pradesh and Maharashtra to understand various access issues related to the TPDS. It documents the fact that the program is not well targeted in some instances, that both the poor and non-poor get subsidized by the PDS and that the distribution of benefits by caste, waiting time for buying food through fair price shops and land ownership categories are not what was intended. The paper also models the determinants of the demand for TPDS grain as a function of relative price and access factors.

Jha et al. (2010) have shown that the TPDS has an important role in augmenting nutritional outcomes in the three states studied in this paper. It follows that redressing the targeting and other errors identified in this paper be used as important policy tools to leverage an improvement in the TPDS outcomes in rural India.

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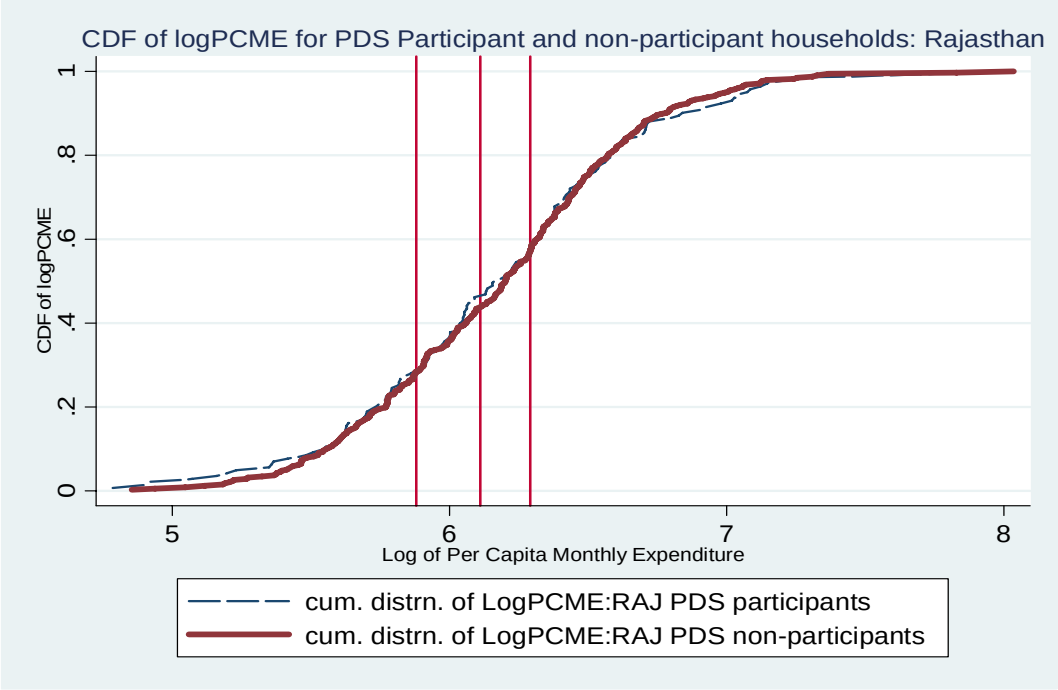
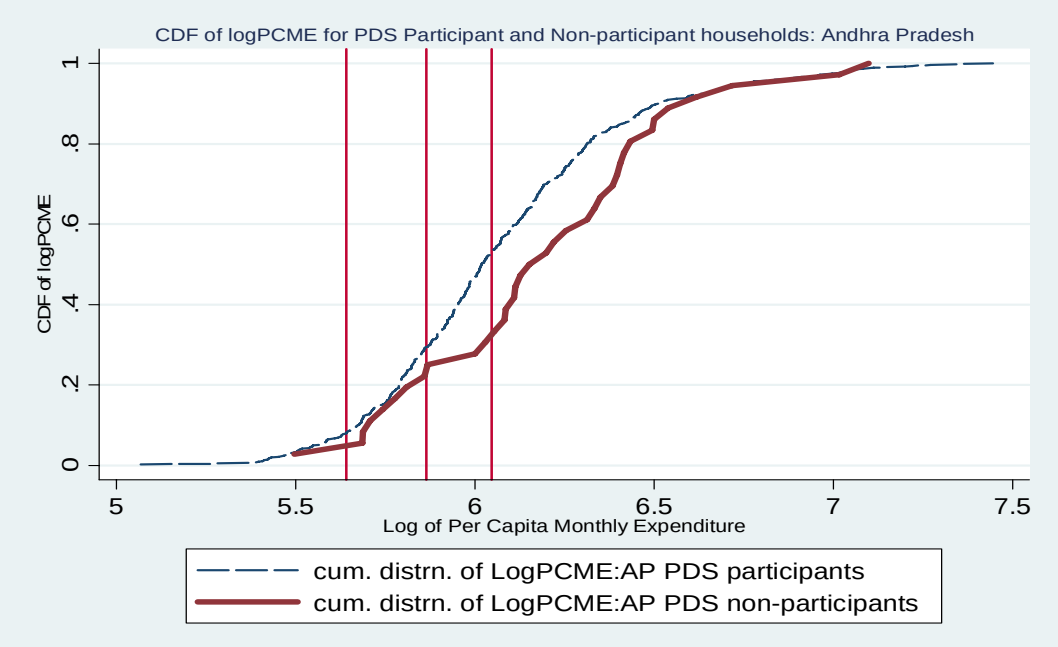
Figure: 1: Cumulative Distribution Functions of Participant and Non-Participant Households in Public Distribution System in Rajasthan



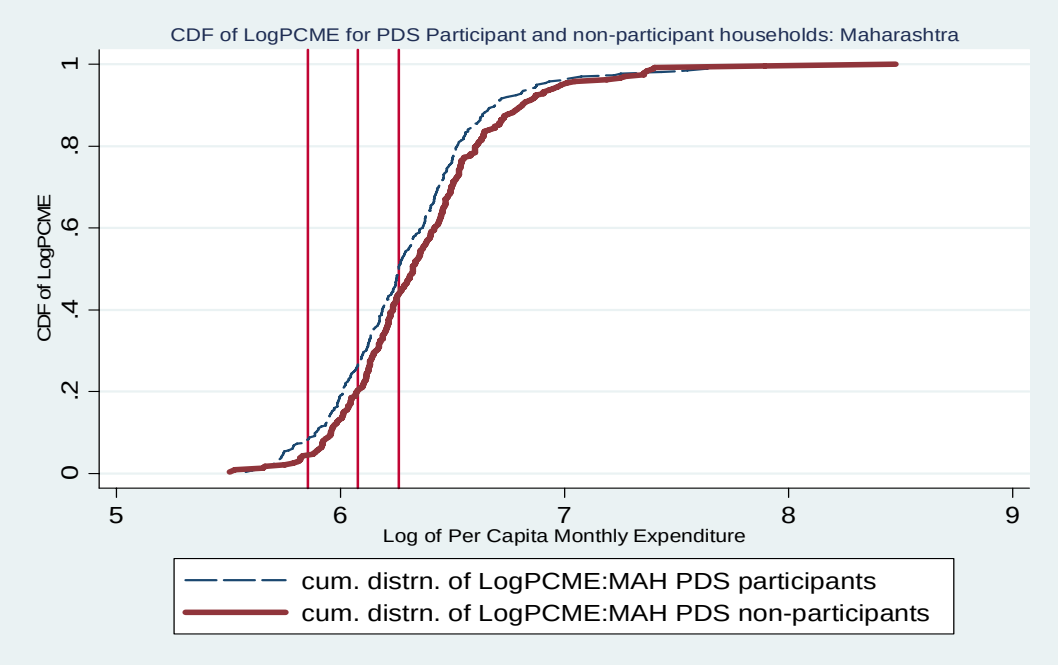
Note: vertical reference lines are drawn at log of poverty line (6.11), 20% below poverty line (at 5.88) and 20% above poverty line (at 6.29), respectively.

Figure: 2: Cumulative Distribution Functions of Participant and Non-Participant Households in Public Distribution System in Andhra Pradesh



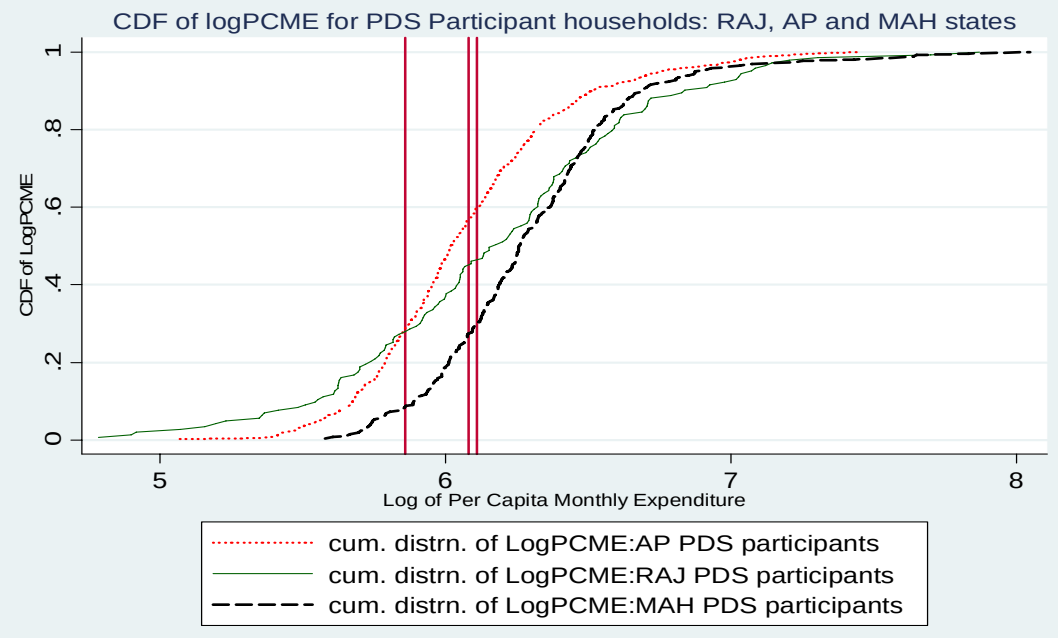
Note: vertical reference lines are drawn at log of poverty line (5.86), 20% below poverty line (at 5.64) and 20% above poverty line (at 6.05), respectively.

Figure: 3: Cumulative Distribution Functions of Participant and Non-Participant Households in Public Distribution System in Maharashtra



Note: vertical reference lines are drawn at log of poverty line (6.08), 20% below poverty line (at 5.85) and 20% above poverty line (at 6.26), respectively.

Figure: 4: Cumulative Distribution Functions of Participant Households in Public Distribution System in Rajasthan, Andhra Pradesh and Maharashtra States



Note: vertical reference lines are drawn at log of poverty lines for Rajasthan (6.11), Andhra Pradesh (5.86) and Maharashtra (6.08), respectively.

Table 1: Per Cent Distribution of Households According to their Participation in PDS

Households characteristics	*Rajasthan*		*Andhra Pradesh*		*Maharashtra*	
	% Share in total households	*% households in PDS*	*% Share in total households*	*% households in PDS*	*% Share in total households*	*% households in PDS*
Social group						
SC	25.36	26.91(21.02)	29.23	88.80(28.77)	13.11	49.06(12.23)
ST	29.55	44.53(40.54)	9.59	90.26(9.60)	15.01	53.85(15.37)
OBC	34.19	24.00(25.28)	48.95	91.33(49.55)	50.96	53.42(51.77)
Others	10.91	39.14(13.15)	12.23	89.15(12.09)	20.91	51.88(20.63)
All	*100.00*	*32.46(100.00)*	*100.00*	*90.22(100.00)*	*100.00*	*52.59(100.00)*
Poverty Status						
Acutely Poor	29.61	24.47(22.32)	11.22	95.67(11.90)	8.28	69.02(10.87)
Moderately Poor	11.37	46.05(16.14)	14.09	93.48(14.60)	16.17	53.89(16.57)
Moderately Non-poor	19.01	24.70(14.47)	28.10	92.52(28.81)	33.42	52.56(33.40)
Affluent	40.01	38.19(47.07)	46.59	86.54(44.69)	42.13	48.89(39.16)
Non-poor[1]	59.02	33.84(61.54)	74.66	88.78(73.46)	75.55	50.51(72.56)
Poor[2]	40.98	30.46(38.46)	25.34	94.46(26.54)	24.45	59.02(27.44)
All	*100.00*	*32.46(100.00)*	*100.00*	*90.22(100.00)*	*100.00*	*52.59(100.00)*
Land owned group (in acres)						
Landless	33.61	27.46(28.43)	43.44	91.06(43.84)	35.41	54.09(36.42)
>0-<=1	26.77	37.67(31.07)	24.86	89.59(24.69)	5.96	46.71(5.29)
>1-<=2	24.51	33.05(24.96)	16.40	91.36(16.61)	14.67	44.75(12.48)
>2-<=5	11.16	34.91(12.00)	11.78	90.07(11.76)	28.29	57.79(31.08)
>5	3.95	29.12(3.55)	3.51	79.47(3.09)	15.67	49.39(14.72)
All	*100.00*	*32.46(100.00)*	*100.00*	*90.22(100.00)*	*100.00*	*52.59(100.00)*
Education level						
Illiterate	38.02	37.64(44.09)	44.22	88.32(43.29)	27.64	55.23(29.03)
Literate but up to primary	27.40	28.00(23.64)	32.50	92.30(33.25)	41.03	52.69(41.11)
Middle	13.76	26.40(11.19)	10.86	87.68(10.56)	11.17	47.78(10.15)
Secondary	8.40	28.61(7.41)	7.09	92.50(7.27)	11.67	44.91(9.97)
Secondary and above	12.42	35.72(13.67)	5.33	95.45(5.64)	8.48	60.41(9.74)
All	*100.00*	*32.46(100.00)*	*100.00*	*90.22(100.00)*	*100.00*	*52.59(100.00)*
Household size group						
4 and less	38.47	35.52(42.09)	59.21	89.81(58.94)	53.39	48.46(49.20)
>4-<=8	55.55	31.08(53.18)	39.92	90.61(40.10)	44.44	57.79(48.83)
>8-<=12	5.89	26.06(4.73)	0.87	100.00(0.97)	1.98	47.48(1.79)
>12	0.10	0.00(0.00)	0.00	0.00(0.00)	0.19	50.85(0.18)
All	*100.00*	*32.46(100.00)*	*100.00*	*90.22*	*100.00*	*52.59*

Note: figures in parentheses are the column percentages. In Andhra Pradesh, high percentage of participation is heavily contributed by consumption of rice from PDS. In Maharashtra, PDS sugar consumption is nil. 1 Households above poverty line and includes moderately non-poor and affluent. 2 below poverty line and include acutely poor and moderately poor households.

Table 2: Distribution of Excess of Market Price over PDS price for Wheat, Rice, Sugar and Kerosene Commodities

Ranges of excess of market price over PDS price	% of villages corresponding to commodity			
	Wheat	Rice	Sugar	Kerosene
Rajasthan				
0-10%	0.00	0.00	0.00	0.00
10-20%	0.00	0.00	6.25	0.00
20-30%	0.00	0.00	68.75	0.00
30-40%	0.00	5.26	18.75	37.50
40-50%	0.00	15.79	6.25	37.50
50-60%	21.74	31.58	0.00	25.00
60-70%	56.52	26.32	0.00	0.00
70-80%	13.04	15.79	0.00	0.00
80-90%	8.70	5.26	0.00	0.00
90-100%	0.00	0.00	0.00	0.00
Total number of villages for which information is available	*23*	*19*	*16*	*8*
Andhra Pradesh				
0-10%	*	0.00	8.00	0.00
10-20%		0.00	68.00	0.00
20-30%		0.00	16.00	10.53
30-40%		0.00	8.00	15.79
40-50%		4.00	0.00	5.26
50-60%		28.00	0.00	63.16
60-70%		36.00	0.00	5.26
70-80%		4.00	0.00	0.00
80-90%		28.00	0.00	0.00
90-100%		0.00	0.00	0.00
Total number of villages for which information is available	*1*	*25*	*25*	*19*
Maharashtra				
0-10%	0.00	0.00	**	14.29
10-20%	0.00	0.00		0.00
20-30%	0.00	0.00		14.29
30-40%	0.00	8.00		42.86
40-50%	12.00	20.00		28.57
50-60%	44.00	32.00		0.00
60-70%	32.00	28.00		0.00
70-80%	8.00	12.00		0.00
80-90%	4.00	0.00		0.00
90-100%	0.00	0.00		0.00
Total number of villages for which information is available	*25*	*25*	*0*	*7*

* Data are available only for one village. ** Data are not available for any village

Table 3: Distribution of distance from PDS participating households to Fair Price Shop

(a) PDS participating households to Fair Price Shop (km)	*% of PDS participant households in*		
	Rajasthan	*Andhra Pradesh*	*Maharashtra*
0-1 km	35.35	71.73	85.29
1-2 km	30.65	18.37	1.75
2-3 km	12.23	7.98	7.59
3 km and above	21.77	1.92	5.37
All	*100.00*	*100.00*	*100.00*
(b) Distance from household to Fair Price Shop (km): Key Statistics	*Rajasthan*	*Andhra Pradesh*	*Maharashtra*
Mean	1.58	0.64	0.37
Median	1	0.50	0.00
Standard deviation	1.70	0.62	0.87
Min	0	0	0
Max	10	3	3

Table 4a: Distribution of waiting times for PDS participating households by ration card type

Ranges of waiting times at the fair price shop (in minutes)	% of PDS participant households by households are allotted				
	BPL	APL	Antodaya	Others	All
Rajasthan					
>=0- <=15	15.88(9.27)	77.99(26.38)	6.13(18.46)	0.00	19.99
>15-<=30	27.89(31.60)	69.93(45.93)	2.18(12.77)	0.00	38.82
>30-<=45	50.34(5.43)	30.29(1.89)	19.37(10.79)	0.00	3.70
>45-<=60	29.24(14.10)	57.18(15.99)	13.58(33.80)	0.00	16.52
>60	64.69(39.60)	27.65(9.81)	7.66(24.19)	0.00	20.97
All	*(100.00)*	*(100.00)*	*(100.00)*		*100.00*
Andhra Pradesh					
>=0- <=15	78.59(11.59)	0.00(0.00)	21.41(25.05)	0.00(0.00)	12.88
>15-<=30	88.37(71.47)	1.57(100.00)	9.33(59.87)	0.73(100.00)	70.66
>30-<=45	91.55(6.96)	0.00(0.00)	8.45(5.09)	0.00(0.00)	6.64
>45-<=60	98.67(9.53)	0.00(0.00)	1.33(1.02)	0.00(0.00)	8.43
>60	28.91(0.46)	0.00(0.00)	71.09(8.97)	0.00(0.00)	1.39
All	*(100.00)*	*(100.00)*	*(100.00)*		*100.00*
Maharashtra					
>=0- <=15	46.49(28.07)	48.26(41.03)	5.25(51.51)	0.00	34.08
>15-<=30	57.54(48.04)	38.88(45.70)	3.58(48.49)	0.00	47.12
>30-<=45	68.74(19.77)	31.26(12.66)	0.00(0.00)	0.00	16.23
>45-<=60	89.42(3.68)	10.58(0.61)	0.00(0.00)	0.00	2.32
>60	100.00(0.44)	0.00(0.00)	0.00(0.00)	0.00	0.25
All	*(100.00)*	*(100.00)*	*(100.00)*		*100.00*

Note: Figures in parenthesis are the column percentages.

Table 4b: Key Statistics of Waiting Times (in minutes) for PDS participating by ration card type

Statistics	*Type of Ration card households are allotted*				*All*
	BPL	*APL*	*Antodaya*	*Others*	
Rajasthan					
Mean	76.53	39.85	66.84	-	54.21
Median	60	30	60	-	30
Standard deviation	65.41	44.41	54.33	-	55.60
Min	0	5	10	-	0
Max	300	300	180	-	300
Andhra Pradesh					
Mean	29.72	20.36	36.96	30	29.72
Median	30	20	20	30	30
Standard deviation	14.93	7.63	55.16	0	14.93
Min	2	10	15	30	2
Max	200	30	300	30	200
Maharashtra					
Mean	25.54	21.43	17.91	-	23.63
Median	25	20	15	-	20
Standard deviation	12.25	10.42	8.33	-	11.62
Min	5	5	5	-	5
Max	90	60	30	-	90

Table 5: Distribution of Share (%) of Expenditure on Food Items Brought from PDS among PDS participating households

Share (%)	*Rajasthan*		*Andhra Pradesh*		*Maharashtra*	
	Mean (%)	*% PDS participating households*	*Mean (%)*	*% PDS participating households*	*Mean (%)*	*% PDS participating households*
Share of expenditure on food grains (wheat and rice) brought from PDS*						
>0-<=20	12.50	12.71	11.99	59.89	16.12	2.52
>20-<=40	29.93	30.86	27.33	31.98	31.23	10.29
>40-<=60	45.39	17.39	45.56	5.87	47.80	8.52
>60-<=80	72.07	8.74	62.65	0.88	70.86	4.63
>80-<=100	99.80	30.30	100.00	1.39	99.87	74.04
All	*55.26*	*100.00*	*20.53*	*100.00*	*57.85*	*100.00*
Share of wheat expenditure brought from PDS						
>0-<=20	16.00	18.09	DNA	DNA	16.17	1.47
>20-<=40	30.22	33.64			33.36	5.03
>40-<=60	51.98	8.41			58.44	2.67
>60-<=80	63.75	2.52			70.06	1.88
>80-<=100	100.00	37.35			100.00	88.95
All	*56.38*	*100.00*			*93.74*	*100.00*
Share of rice expenditure brought from PDS						
>0-<=20	14.29	2.56	11.99	59.89	14.57	1.62
>20-<=40	0.00	0.00	27.33	31.98	32.37	11.04
>40-<=60	47.73	2.04	45.56	5.87	47.67	4.89
>60-<=80	72.92	1.02	62.65	0.88	60.47	0.56
>80-<=100	100.00	94.39	100.00	1.39	100.00	81.88
All	*96.47*	*100.00*	*20.53*		*88.37*	*100.00*
Share of sugar expenditure brought from PDS						
>0-<=20	12.07	0.57	17.03	1.92	DNA	DNA
>20-<=40	30.51	1.26	26.43	16.17		
>40-<=60	55.03	6.36	45.10	21.17		
>60-<=80	67.64	14.13	63.64	0.22		
>80-<=100	100.00	77.68	100.00	60.52		
All	*91.19*	*100.00*	*74.81*	*100.00*		

DNA: Data not available.*rice is the only component in the food grains for Andhra Pradesh due to non-availability of PDS data for wheat

Table 6a: Distribution of Real income transferred (RIT) from PDS per household per village

Ranges of RIT from PDS per household (Rs.)	Rajasthan		Andhra Pradesh		Maharashtra	
Commodity	Mean	% of households	Mean	% of households	Mean	% of households
Wheat						
0	0.00	68.59	DNA	DNA	0.00	48.52
>0-<=50	20.92	26.87			8.91	51.48
>50-<=100	65.91	3.63			0.00	0.00
>100-<=150	139.05	0.18			0.00	0.00
>150-<=200	160.35	0.74			0.00	0.00
All	*9.44*	*100.00*			*4.59*	*100.00*
Rice						
0	0.00	73.89	0.00	10.78	0.00	47.50
>0-<=50	8.27	25.06	8.27	89.22	8.02	52.50
>50-<=100	81.84	0.65	0.00	0.00	0.00	0.00
>100-<=150	0.00	0.00	0.00	0.00	0.00	0.00
>150-<=200	156.34	0.41	0.00	0.00	0.00	0.00
All	*3.24*	*100.00*	*7.38*		*4.21*	*100.00*
Sugar						
0	0.00	78.74	0.00	37.79	DNA	DNA
>0-<=50	3.15	21.26	0.29	62.21		
>50-<=100	0.00	0.00	0.00	0.00		
>100-<=150	0.00	0.00	0.00	0.00		
>150-<=200	0.00	0.00	0.00	0.00		
All	*0.67*	*100.00*	*0.18*	*100.00*		
Food grains (wheat and rice)*						
0	0.00	66.93	0.00	10.78	0.00	49.65
>0-<=50	26.21	29.18	8.27	89.22	21.31	46.12
>50-<=100	58.97	3.67	0.00	0.00	61.74	4.24
>100-<=150	121.27	0.16	0.00	0.00	0.00	0.00
>150-<=200	198.02	0.06	0.00	0.00	0.00	0.00
All	*10.14*	*100.00*	*7.38*	*100.00*	*12.45*	*100.00*

DNA: Data not available. *rice is the only component in the food grains for Andhra Pradesh due to non-availability of PDS data for wheat.

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Table 6b: Distribution of Real Income Transferred (RIT) from PDS (in Rs.) per household per village by poverty status

Poverty status of households	Mean Real income transferred (RIT) from PDS per household per village (Rs.)			
	Wheat	Rice	Sugar	Food grains* (wheat and rice)
Rajasthan				
Acutely Poor	4.72	1.42	0.31	5.94
Moderately Poor	12.20	4.29	1.58	14.01
Moderately Non-poor	8.66	3.23	0.72	6.27
Affluent	12.53	4.48	0.66	13.98
All	*9.44*	*3.24*	*0.67*	*10.14*
Andhra Pradesh				
Acutely Poor	DNA	8.93	0.27	8.93
Moderately Poor		8.97	0.19	8.97
Moderately Non-poor		7.92	0.17	7.92
Affluent		6.20	0.15	6.20
All		*7.38*	*0.18*	*7.38*
Maharashtra				
Acutely Poor	4.81	3.63	DNA	12.26
Moderately Poor	4.19	3.11		9.87
Moderately Non-poor	4.78	4.18		12.62
Affluent	4.54	4.76		13.30
All	*4.59*	*4.21*		*12.45*

DNA: Data not available. *rice is the only component in the food grains for Andhra Pradesh due to non-availability of PDS data for wheat. Definition of different poverty status is described in Table 7.

Table 7: Definition of different levels of Poverty

Levels of poverty	Rajasthan	Andhra Pradesh	Maharashtra
Acute poverty	If per capita monthly consumption expenditure<Rs.383	If per capita monthly consumption expenditure<Rs.299	If per capita monthly consumption expenditure< Rs. 371
Moderate poverty	If per capita monthly consumption expenditure>=383 but < Rs.450	If per capita monthly consumption expenditure>=Rs.299 but<Rs.352	If per capita monthly consumption expenditure >=Rs.371 but<Rs.436
Moderate Non-poverty	If per capita monthly consumption expenditure >=Rs.450 but < Rs.585	If per capita monthly consumption expenditure>=Rs.352 but < Rs.458	If per capita monthly consumption expenditure >=Rs. 436 but <Rs.567
Affluent	If per capita monthly consumption expenditure>= Rs.585	If per capita monthly consumption expenditure>=Rs.458	If per capita monthly consumption expenditure >=Rs.567

Table 8: Estimation Results of PDS consumption equations for Rajasthan: Tobit Analysis

Dependent variables	*Consumption of Wheat from PDS*		*Consumption of Rice from PDS*		*Consumption of Sugar from PDS*	
Explanatory variables	Coefficient (t-value)	Slope	Coefficient (t-value)	Slope	Coefficient (t-value)	Slope
% adult in the household	0.105(0.65)	0.039	-0.021(-0.34)	-0.006	-0.013(-0.42)	-0.002
Household size	-1.083(-0.66)	-0.405	-0.761(-1.48)	-0.206	0.125(0.14)	0.022
Square of household size					-0.020(-0.28)	-0.004
Average distance of FPS from the village	6.118(1.25)	2.286	-0.015(-0.01)	-0.004	0.553(0.97)	0.097
Square of average distance of FPS from the village	-0.524(-0.88)	-0.196				
Village level Market to PDS price ratio: Wheat	191.824 (1.62)w	71.670	66.325**(1.98)	17.903		
Village level Market to PDS price ratio: Rice	165.648 (1.50)w	61.890	57.119*(1.85)	15.418		
Interaction of village level Market to PDS price ratios of wheat and rice	-70.188 (-1.56)w	-26.224	-23.733*(-1.90)	-6.406		
Village level Market to PDS price ratio: Sugar					162.679(1.02)	28.603
Square of village level Market to PDS price ratio: Sugar					-61.691(-1.07)	-10.847
Ratio of PCME to state level poverty cut-off	5.447*(1.84)	2.035	1.821**(1.99)	0.492	1.614***(3.08)	0.284
Interaction of average distance of FPS from the village and Ratio of PCME to state level poverty cut-off					-0.627**(-2.19)	-0.110
Interaction of average distance of FPS from the village and per cent adult in the household			0.015(0.76)	0.004	0.009(1.01)	0.002
Village level Market price: Milk products					0.261*(1.85)	0.046
Square of village level Market price: Milk products					-0.005**(-2.00)	-0.001
Constant	-480.929*(-1.64)		-164.276**(-2.01)		-114.641(-1.04)	
/sigma	33.611		9.625		4.102	
Number of observations	360		360		360	
Left-censored observations (at consumption<=0)	255		287		289	
Uncensored observations	105		73		71	
F-value	1.65*		2.47**		5.02***	
Pseudo R-square	0.0106		0.0223		0.0480	
Log pseudolikelihood	-11047541		-6713191.9		-4893615.8	

Note: Tobit Scale factor for wheat, rice and sugar PDS consumption equations are 0.374, 0.270 and 0.176, respectively. *** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level, w weakly significant at the 10% level.

Table 9: Estimation Results of PDS consumption equations for Andhra Pradesh: Tobit Analysis

Dependent variables	Consumption of Rice from PDS		Consumption of Sugar from PDS	
Explanatory variables	Coefficient (t-value)	Slope	Coefficient (t-value)	Slope
% adult in the household	-0.052(-0.88)	-0.052	-0.001(-0.21)	-0.0004
Household size	0.167(0.15)	0.164	-0.053(-0.86)	-0.029
Average distance of FPS from the village	-5.061*(-1.83)	-4.987	7.506***(3.16)	4.175
Square of average distance of FPS from the village	2.363*(1.80)	2.328		
Village level Market to PDS price ratio: Rice	3.735*(1.81)	3.681		
Square of village level Market to PDS price ratio: Rice	-0.342*(-1.87)	-0.337		
Village level Market to PDS price ratio: Sugar			4.913***(2.60)	2.733
Interaction of market to PDS price ratio of sugar and average distance of FPS at the village level			-5.977***(-3.09)	-3.324
Village level Market price: Milk products	0.011(1.01)	0.011	0.007***(3.68)	0.004
Village level Market price: Gur			0.021(0.63)	0.012
Ratio of PCME to state level poverty cut-off	-2.699***(-2.90)	-2.659	-1.178**(-2.31)	-0.655
Square of Ratio of PCME to state level poverty cut-off			0.202*(1.76)	0.112
Interaction of ratio of PCME to state level poverty cut-off and per cent adult in the household	0.015(1.09)	0.014		
Constant	11.624(1.60)		-4.767*(-1.91)	
/sigma	6.885		1.047	
Number of observations	400		320	
Left-censored observations (at consumption<=0)	30		111	
Uncensored observations	370		209	
F-value	8.98***		3.47***	
Pseudo R-square	0.0341		0.0500	
Log pseudolikelihood	-15517487		-5105348.3	

Note: Tobit Scale factor for rice and sugar PDS consumption equations are 0.9854 and 0.5562, respectively. *** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Table 10: Estimation Results of PDS consumption equations for Maharashtra: Tobit Analysis

Dependent variables	Consumption of Wheat from PDS		Consumption of Rice from PDS	
Explanatory variables	Coefficient (t-value)	Slope	Coefficient (t-value)	Slope
% adult in the household	0.006(0.17)	0.003	0.018(0.66)	0.010
Household size	0.514(1.09)	0.282	2.155*(1.87)	1.176
Square of household size			-0.124(-1.37)	-0.068
Average distance of FPS from the village	-17.369***(-3.62)	-9.550	-11.267***(-3.06)	-6.147
Square of average distance of FPS from the village	6.331***(3.46)	3.481	4.155***(3.00)	2.267
Village level Market to PDS price ratio: Wheat	-3.765(-1.26)	-2.070		
Village level Market to PDS price ratio: Rice	-0.016(-0.01)	-0.009		
Village level agricultural wage rate	0.188***(2.73)	0.103	-0.117***(-2.57)	-0.064
Constant	-2.658(-0.34)		1.406(0.25)	
/sigma	13.520		10.914	
Number of observations	500		500	
Left-censored observations (at consumption<=0)	240		238	
Uncensored observations	260		262	
F-value	4.48***		3.93***	
Pseudo R-square	0.0110		0.0108	
Log pseudolikelihood	-27077948		-26188626	

Note: Tobit Scale factor for wheat and rice PDS consumption equations are 0.5499 and 0.5456, respectively.
*** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Annex: Definitions of the variables used in the Tobit analysis

Variables	Definition
Dependent Variable	
Consumption of Wheat from PDS	Quantity of wheat consumed from PDS in last 30 days(takes value 0 if not consumed)
Consumption of Rice from PDS	Quantity of rice consumed from PDS in last 30 days(takes value 0 if not consumed)
Consumption of Sugar from PDS	Quantity of sugar consumed from PDS in last 30 days(takes value 0 if not consumed)
Explanatory Variables	
% adult in the household	% of adults in the total household size (=number of total adult male and female *100/household size)
Household size	Size of the household
Square of household size	Square of size of the household
Average distance of FPS from the village	Average distance of Fair Price Shop from the village (in km)
Square of average distance of FPS from the village	Square of average distance of Fair Price Shop from the village
Village level Market to PDS price ratio: Wheat	=(Market price/PDS price) for wheat at the village level
Village level Market to PDS price ratio: Rice	=(Market price/PDS price) for rice at the village level
Square of village level Market to PDS price ratio: Rice	Square of village level Market to PDS price ratio for rice
Interaction of village level Market to PDS price ratios of wheat and rice	=Village level Market to PDS price ratios of wheat *Village level Market to PDS price ratios of rice
Village level Market to PDS price ratio: Sugar	=(Market price/PDS price) for sugar at the village level
Square of village level Market to PDS price ratio: Sugar	Square of village level Market to PDS price ratio of sugar
Ratio of PCME to state poverty cut-off	=household's per capita monthly expenditure divided by state poverty cut-off (poverty lines for Rajasthan, Andhra Pradesh and Maharashtra are 450.5857, 352.4016 and 435.7654, respectively)
Square of ratio of PCME to state poverty cut-off	Square of ratio of PCME to state poverty cut-off
Interaction of average distance of FPS from the village and ratio of PCME to state level poverty cut-off	=Average distance of fair price shops to village *Ratio of PCME to state level poverty cut-off
Interaction of average distance of FPS from the village and per cent adult in the household	=Average distance of fair price shops to village *% of adults in the total household size
Village level Market price: Milk products	Market price for milk products at the village level
Square of village level Market price: Milk products	Square of village level market price of milk products
Village level Market price: Gur	Market price for Gur at the village level
Interaction of ratio of PCME to state level poverty cut-off and per cent adult in the household	=Ratio of PCME to state level poverty cut-off *% adult in the household
Village level agricultural wage rate	Village level agricultural wage rate (Rs./day/per person)
Interaction of average distance of FPS from the village with village level Market to PDS price ratio for Rice	=Average distance of FPS from the village *Village level Market to PDS price ratio for Rice
Interaction of market to PDS price ratio of sugar and average distance of FPS at the village level	=Village level market to PDS price ratio of sugar *Average distance of FPS at the village level