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Public Distribution System vs. Market:

Analysis of Wheat and Rice Consumption in India

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Abstract

Despite the large-scale antipoverty programs, especially food and nutrition programs, 15 per cent of Indian population is undernourished. The National Food Security Act (NFSA) aims at reducing food insecurity by granting a right to food to a large share of the population. The implementation of the world largest food aid program, however, is controversially debated: While historically, rationed highly subsidizes staple food have been used to improve the access to food for poor people, cash transfers are considered as an alternative with lower market distortions, leakages and fiscal costs. This study analyzes consumption patterns of wheat and rice delivered through the Public Distribution System in India and investigates targeting errors as well as reasons for leakage, self-selection and under-supply of staples using cross-sectional household data on all-India level. Our findings indicate some serious targeting errors of the current distribution system as migrant workers and female-led households are not well covered. We find that leakage rates are in general very low for poor households and regions with high poverty rates, implying that higher market prices have negative consequences for the poor excluded from the system. Further, wealthier households restrain from consuming subsidized grains. This negative self-selection of wealthier households implies a high potential for cost savings that would be lost under a cash-transfer scheme. Thus, or study provides a subtle and differentiated analysis that is highly useful for improving the current distribution system as well as design and targeting issues relevant for an alternative cash-transfer system.

JEL Code: D12, D45, H53, I38

Keywords

Food Security, Policies, India, Targeted Public Distribution System, targeting

Abbreviations

AAY	Antyodaya Anna Yojana Programme (Poorest of the Poor)
APL	Above Poverty Line
BPL	Below Poverty Line
CIP	Central Issue Price
DFPD	Department of Food and Public Distribution
FCI	Food Corporation of India
MIP	Minimum Issue Price
MPCE	Monthly Per Capita Expenditure
MSP	Minimum Support Price
NFSA	National Food Security Act
NSS	National Sample Survey
PDS	Public Distribution System
TPDS	Targeted Public Distribution System

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Table of Contents

Introduction and research questions

26 per cent of total rice and over 16 per cent of total wheat was consumed out of the Public Distribution System (PDS) supplies in India in 2011/12. High leakage, above 40 per cent (Drèze & Khera, 2015; Gulati & Saini, 2015) and low quality of the PDS grains (Khera, 2011b) due to poor storage and transport facilities (Shreedhar, Gupta, Pullabhotla, Ganesh-Kumar, & Gulati, 2012) are among the biggest problems of the costly system. Currently, the world largest food aid program, the National Food Security Act (NFSA) is being implemented. It scales up the old system. Implementation of cash transfers instead of the PDS is highly debated.

The Government of India makes allocations of food grains to three categories of beneficiaries under Targeted Public Distribution System (TPDS), namely AAY (the poorest of the poor), BPL (Below Poverty-Line) and APL (Above Poverty Line). Since April 2002, the scale of issue to all categories, APL, BPL and AAY, has been revised and made uniform at 35 kg per household per month for all (DFPD, 2013). However, the actual rations differ at the state level. Some states offer per capita ration with an upper bound of 35 kg per household for the BPL households. Often the APL allocation is below the centrally guaranteed ration. The AAY quota of 35 kg per household is rather observed in all states (Balani, 2013). There are also sporadically additional allocations of foodgrains for different cardholder groups. As a result, the eligible consumers, especially the APL cardholders, are often unaware of their ration amount, which then can be used by the Fair Price Shop (FPS) owners to sell less to the card-holders and divert the difference to the black market (Dhanaraj & Gade, 2012; Khera, 2011a).

Grains under these schemes are released to beneficiaries at highly subsidized rates. The Consumer End Price (CEP) is decided by the state authorities and it is linked to the central issue price (CIP) which is set by the central government. CEP can be below the CIP if the state provides additional subsidy or it can be slightly above it, except the AAY group, containing commission. The CIPs have not been revised for the BPL and AAY families since July 25, 2000, and for APL since July 1, 2002.

The reasons behind the low take-up rates and low consumptions of the PDS grains are not fully understood. A few studies explore the problem locally, using household surveys. Jha, Gaiha, Pandey and Kaicker (2011) analyze the access issues related to the TPDS in three Indian states, Rajasthan, Andhra Pradesh, and Maharashtra. They found high transaction costs among the major under-purchase reasons. Dhanaraj and Gade (2012) study the performance of the Tamil Nadu model, which is a universal PDS that covers all households. The authors found high diversion rates due to the recipients' misinformation about their entitlement, which is set according to the household size. Low take-up was also due to non-availability of grains and to cheating during the weighting of grains. Consumers further complained about irregular opening timings and long queues, which can lead a demand driven under-purchase. Khera (2011a) studied the reasons of under-purchase in Rajasthan. Her findings point at supply constraints as the main diver of under-purchase, however she emphasizes that the demand side also plays an important role.

Mehta and Jha (2014) analyze drivers of pilferage in opaque food subsidy programs. In their theoretical model, pilferage of inferior goods can be lower or higher in poorer communities. This is because the poor have higher incentives to prevent leakage, however they usually have less power to do so. The authors found an evidence of the former effect dominating the latter in their case study from Philippines. Further, in theory, an impact of higher price subsidies on pilferage rates is also ambiguous. However, the authors did not find enough statistical evidence of either of the effects. Drèze and Khera (2015) further claim that leakage rates differ significantly between different ration card quotas, being the highest for APL cardholders due to the above mentioned misinformation.

In our study, we address the issue of under-purchase on all India level. We provide an in-depth analysis of the TPDS coverage and consumption, explaining who is coved by the PDS and identifying its major malfunctions. We further analyze the reasons for no take-up or under-purchase of the PDS grains on the all-India level. Specifically, our research questions are:

- How efficiently does the PDS cover poor and traditionally underprivileged (like scheduled castes members) people?

- What is the scale of under-purchase in different card type groups?
- What are the reasons for under-purchase? Is it due to supply constrains or demand reasons (consumer choices)?

Further, in the light of the "cash versus in-kind transfer debate" in India[1], more evidence on the impact of the PDS on food consumption is needed. In general, the theory predicts that if the in-kind transfer is infra-marginal that is a household receiving less than it would consume solely from the market, the subsidy should be treated as a cash transfer. However, the evidence shows that this is not always true. What is even more puzzling is that the results are mixed across literature. Beatty and Tuttle (2014), for example, found that in response to the increase in in-kind benefits (from the Supplemental Nutrition Assistance Program), households increased their share of food expenditures. In case of India, a few studies found that there is no impact of the PDS subsidy on calorie consumption or nutrition, but it seems to skew grain consumption towards subsidized wheat and rice and away from coarse grains. Kaushal and Muchomba (2013), follow Kochar (2005) and use the exogenous increase in subsidy due to the transformation of the PDS into TPDS to study its impact on nutrition. They found that higher food price subsidy shifted the consumption to the subsidized grains and sugar and away from coarse grains. However the calorie, protein and fat consumption remained unchanged. Furthermore, no effect of the food price subsidy on nutrition (measured as calories, fat or protein intake) was found. Khera (2011a) similarly found that the wheat subsidy in Rajasthan affects the grain consumption (towards wheat, away from coarse grains) but does not affect the quantity of cereals consumed. Similar conclusions for the BPL cardholders were obtained by Shaw and Telidevara (2014).

On the other hand, there is still little known about the effect of cash transfers on nutrition and food security. Impact of conditional and unconditional cash transfers on child nutrition was found positive, for example by Agüero, Carter, and Woolard (2007) in South Africa and by Behrman and Hoddinott (2005) in Mexico. Both studies used anthropometric indices to evaluate nutritional status. Manley, Gitter, and Slavchevska (2012) in their comprehensive

[1] There are several proponents and opponents of the introduction of cash transfers in India – both in academia and in political spheres.

literature review found that on average cash transfer programs have positive but insignificant impact on child nutrition. An important insight from this study is that cash transfers are much more effective in improving child nutrition in areas with less developed health infrastructure. Household nutrition and food security effects are also ambiguous. For example, Haushofer and Shapiro (2013), based on an Randomized Control Trial (RCT) in Kenya, conclude that unconditional cash transfers improve consumption, food security and psychological well-being of the recipients. Hoddinott et al. (2013), who evaluate vouchers and cash transfers in four countries (Ecuador, Uganda, Niger, and Yemen), found that effectiveness in improving food security of different programs heavily depend on local conditions, including severity of food insecurity or thickness of markets. Additionally, they found no evidence that cash transfers are used for 'undesirable' goods (alcohol) consumption. The latter result of no significant impact or a significant negative impact of transfers on temptation goods was found to strongly dominate the literature by Evans and Popova (2014).

In our study, we focus on wheat and rice consumption and the subsidy's impact on market and total consumption of these grains on all-India level. This is a relevant question not only to analyze nutrition impact of the PDS on the transfer recipients, but in the light of the system's high targeting errors, the total demand shifts are also important for the poor who are not covered by the system. So in addition to the above listed research question, we aim to answer: How does PDS affect the total wheat and rice consumption? More specifically, are PDS grains substitutes for market grains? Are they imperfect substitutes? And if so, what is the rate of substitution?

Given the high cost generated by the PDS and the potential benefits of improving the food security and nutrition by better targeting, less leakage and a change in consumer behavior there are many proponents, both in academia and among policy-makers (Basu, 2010; S. Jha & Ramaswami, 2010) of switching to cash transfers. There were some failed attempts to introduce cash transfers on a local scale, for example in Puducherry. The program was called off mainly because of the operational problems, namely insufficient number of bank branches (Yadav, 2015).

With our results, we contribute to the discussion on how to improve the functioning of the PDS, in case the current system is preserved, and whether to switch to cash transfers.

Conceptual framework and methods

Consumption from the PDS

In our study, we consider a consumer who has a ration card, so can consume wheat and/or rice from two sources – the PDS and the market. The amount consumed from the PDS, q_s, is constrained through the PDS entitlement, q_s^*, depending on both the state and ration card type. However, what is often observed (based on the NSS 68th round), $q_s = 0$ or $q_s < q_s^*$. So there are two types of problems besides the targeting error issue: eligible households do not use their ration cards at all (no PDS take-up) or eligible households consume PDS grains, but less than their ration. These two groups probably differ in terms of their reasons for under-purchase.

In general, we distinguish between two types of reasons for under-purchase: demand or supply specific. The major difference in our analysis between the two is whether the quantity of wheat and rice consumed from the PDS is endogenous or exogenous, from a consumer perspective. Demand driven under-purchase also means that PDS grains are imperfect substitutes of the market grains. This in turn means that consumption form the PDS in not inframarginal, as market and PDS grains are perceived as different products. Similar argument is made by Suryanarayana (1995). He showed that implicit subsidy is significantly and positively correlated with the PDS dependence, which is due to the fact that the PDS grains are not inframarginal.

The demand driven, so voluntary, under-purchase might be due to high transaction costs or consumption habits/preference for other cereals, including inferior quality of the PDS grains. Additionally, there might be liquidity constraints preventing a household from purchasing the full ration[2]. However, the liquidity constraint is not likely to hold for the AAY and BPL households as the PDS grains are distributed at extremely low prices, constituting a small share of their expenditures, which will be further discussed. The first reason, so under-purchase due

[2] PDS beneficiaries are often not allowed to purchase their ration in instalments.

to high transaction costs, would result in positive relation between PDS purchases and the difference between the market price and the subsidized price, which is the level of subsidy. The higher the food subsidy is, the stronger the incentive to consume from the PDS. Similarly, in the case of inferior quality of the PDS grains as compared to the market grains, price subsidy should have a positive impact on the quantity consumed from the PDS. In this case, PDS and market grains can be analyzed as imperfect substitutes. Finally, for the liquidity constrained, lower subsidized price should result in a higher amount purchased. PDS consumption would also depend on the household characteristics (preferences etc.), excluding regional characteristics if the under-purchase is demand driven. The only exception are disempowered and marginalized households who may be less successful in executing their right to subsidized grains and become victims of corrupt fair price shop owners.

If under-purchase is due to the supply causes, like diversion, the difference between the market price and the subsidized price should affect consumption from the PDS negatively – the higher the price difference is, the stronger the incentive for the middlemen (e.g. fair price shop operators) to cheat and sell the subsidized grains on the black market at the market price. In the areas with many poor people, the leakage rates might be lower because the poor have higher incentive to enforce the delivery. If regional characteristics are significant, it could be related to both, demand or supply side reasons.

Finally, an important question is whether there are differences in factors influencing a switch from $q_s = 0$ to $q_s > 0$ as compared to the incremental increase in q_s conditional on $q_s > 0$. Most of the above mentioned reasons for under-purchase can influence both – a complete dropout from the scheme, as well as the scale of under-purchase. High leakage may result in, for example non-deliveries to the local fair price shop ($q_s = 0$), or it can result in underweighting of the subsidized grains ($q_s < q_s^*$). Inferior quality and long waiting time may be a reason for better off households to avoid the PDS and consume solely from the market. But if the transaction costs are low and the PDS grains are of inferior quality, better off households may still decide to purchase some quantity of the subsidized grains, however less than their entitlement.

In order to test the hypothesis regarding the primary reason for under-purchase, we study the impact of the subsidy on the consumption from the PDS.

$$\boldsymbol{d_s = q_s(p_{ratio}, \mathbb{X})},$$

where d_s can be a dummy for a PDS consumption or $d_s = q_s$, p_{ratio} is a market and fair price shop price ratio $\frac{p_m}{p_s}$ and $\mathbb{X}$ is a vector of other important variables.

If the 'demand' hypothesis holds, then q_s is a positive function of p_{ratio}. $\mathbb{X}$ comprises household characteristics (monthly per capita expenditure, hh size, social group, dwelling type and education), a share of households living below the poverty line in the FSU, and state dummies. If the household characteristics are significantly influencing d_s, when controlled for the ration card type, this supports the demand hypothesis. If the other hypothesis is valid, so the 'supply' hypothesis, then q_s is a negative function of p_{ratio}. In practice, there are both supply and demand factors influencing the final quantity of the PDS grains purchased. Separating their impacts with empirical analysis is not possible. As a result, our analysis focuses on the net effect, stating which factors have a deciding role.

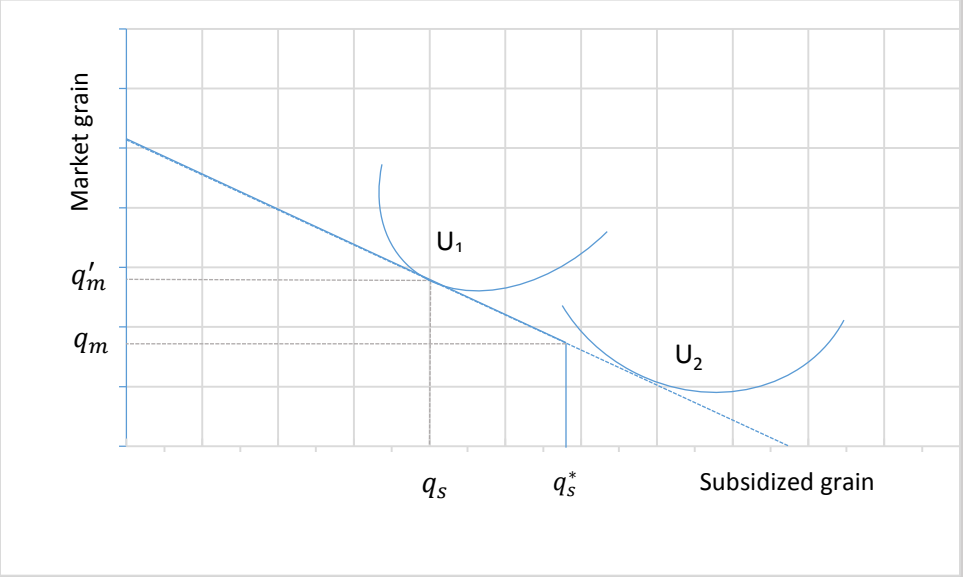
Additionally, by analyzing the impact of the household characteristics on q_s, we will better understand how well the TPDS covers the poor and the vulnerable households and whether, in the light of targeting errors, there is a negative self-selection of the richer households. Further, by including a share of households living below the poverty line in the FSU as explanatory variable, we verify the hypothesis from the theoretical model in (Mehta & Jha, 2014) that pilferage of inferior goods is lower in poorer communities. We expect significant differences in the functioning of the PDS for wheat and for rice that is why we treat them separately, allowing for different coefficients if the model.

Understanding who has access to the PDS grains, how much is consumed by whom and why may have serious implications for the policy makers in terms of pointing at the major problematic areas and pointing at the reform direction.

Market consumption

If indeed PDS grains are imperfect substitutes for market grains, the effect of the subsidy on wheat and rice consumption should depend on the cross-price elasticities of their demand and the respective ration quantity, q_s^*. Figure 1 represents the demand for market grains and its rationed imperfect substitute. The blue line represents the household specific budget line depending on the relative prices. If the utility is maximized at $q_s < q_s^*$ (indifference curve U_1), so the ration constraint is not binding, then it is only the price ratio, which matters and q_m', that is the quantity from the market, is consumed. However if the utility would be maximized at $q_s > q_s^*$ (indifference curve U_2), then q_m is a function of q_s^*. As a result, the quantity bought on the market is a function of income, prices, comprising own price and prices of substitutes, PDS prices and PDS ration, a set of household characteristics and state specific factors.

Figure 1 Demand for PDS and market grains



Source: Own design

Data

The estimation is based on the 68th round of the Indian National Sample Survey (NSS) of Household Consumer Expenditure, carried out by India's National Sample Survey Office of the Ministry of Statistics and Programme Implementation. The survey is cross-sectional and representative at the national level. It covers 101651 households in 7469 villages and 5268

urban blocks. The survey was based on a multi-stage stratified design with random household selection. Data was collected between July 2011 and June 2012 and it covers demographic data and household characteristics, as well as consumption quantity and value, total consumption expenditure, and PDS consumption, quantity and expenditure (NSSO, 2013). Basic sample characteristics are reported in table 1.

	Rural	Urban	All India
Sex of household head (male, %)	88.0	88.0	88.0
Mean age of household head	45	44	45
Education of household head			
Not literate	39.1	15.4	31.6
Literate without formal schooling	0.06	0.05	0.05
Literate with formal schooling (below primary -	51.3	49.8	50.8
Higher secondary and diploma / certificate course	5.4	13.8	8.0
Graduate	2.9	14.1	6.4
Postgraduate and above	0.8	6.5	2.6
Mean household size	4.6	4.1	4.4
Number of observations	59,693	41,967	101,660

Table 1 Sample Characteristics of NSS Data

Source: Own design

Most of the households have a male head of age 45 years on average. Over 30 per cent of households are illiterate, with much lower proportion in urban areas (15.4 per cent). The average household size is 4.4 persons, with slightly larger average households in rural areas. Our sample consists of almost 60,000 rural and 42,000 urban households.

We use India's official poverty line estimates from the Rangarajan report (Planning Commission, 2014), which are equal to Rs. 972 for rural areas and Rs. 1407 for urban areas. Mean household expenditures are well above these poverty lines (table 2), but it is estimated that almost 32 per cent of the households live below the poverty line, with proportionally more poor people living in rural areas (35 per cent). Over half of the average expenditure is spent on food and on average 18.2 kg of rice and 15.7 kg of wheat is consumed (total of market, PDS and own stock).

	Rural	Urban	All India
Mean monthly per capita expenditure (Rs.)	1414.5	2912.7	1882.7
Poverty line (Rs.)	972	1407	
Food expenditure share (%)	53.5	44.8	51.2
Below poverty line (%)	35.3	24.4	31.9
Mean market consumption of cereals per household			
Rice	19.8	14.7	18.2

Wheat	16.3	14.5	15.7

Table 2 Expenditure Characteristics

Source: Own design

	Rural	Urban	All India
Households with ration card (%)	86.0	67.3	80.1
Type of ration card (%)			
AAY	6.6	2.3	5.5
BPL	44.1	23.3	38.7
APL	49.3	74.4	55.9
Households with positive PDS consumption (%)	51.8	27.8	44.3
Mean PDS consumption per household (kg)			
Rice	7.67	3.58	6.40
Wheat	3.50	1.66	2.93

Table 3 PDS Consumption characteristics

Source: Own design

Over 80 per cent of the households is estimated to possess some sort of a ration card (table 3). The majority of them (56 per cent) have the APL card, whereas only 5.5 per cent have the AAY card, with slightly more AAY cards in rural areas. However, the number of households which actually consume any PDS wheat or rice is much lower – it is only 44 per cent on average in India, with 51.8 per cent in rural and 27.8 per cent in urban areas. As a result, mean (over all households) PDS quantity consumed is very low – 6.4 kg of rice and 2.93 kg of wheat.

17 per cent of the below poverty line households did not have any ration card and around 45 per cent of the below poverty line households did not consume any subsidized (PDS) grains. This number is very high, however it is comparable to the leakage estimates for the survey period, which are between 42 and 47 per cent (Drèze & Khera, 2015; Gulati & Saini, 2015). Within the ration card holders, there are 60, 44 and 23 per cent of below the poverty line households (meaning that their monthly per capita expenditure is below poverty line) in AAY, BPL and APL respectively, which indicates significant targeting errors. What is interesting, the zero consumption of the PDS grains among the APL cardholders is proportionally similar for above and below poverty line groups.

	Poor			Non-poor		
	Mean	95% confidence interval		Mean	95% confidence interval	
Food in total exp.	56.6	56.3	56.9	48.1	47.9	48.4

Staples in food	42.1	41.8	42.4	32.5	32.3	32.7
Rice market in staples	37.9	37.1	38.6	35.8	35.3	36.4
PDS rice in staples	7.3	7.0	7.6	4.0	3.8	4.1
Wheat market in staples	21.5	20.9	22.1	22.7	22.2	23.2
PDS wheat in staples	3.3	3.2	3.5	2.0	1.9	2.1
Cereal substitutes in staples	0.2	0.2	0.3	0.6	0.6	0.7
Pulses in staples	21.8	21.5	22.2	24.4	24.2	24.6
Wheat and rice products	4.2	4.0	4.3	5.9	5.8	6.1
Coarse cereals	3.8	3.5	4.1	4.5	4.3	4.8

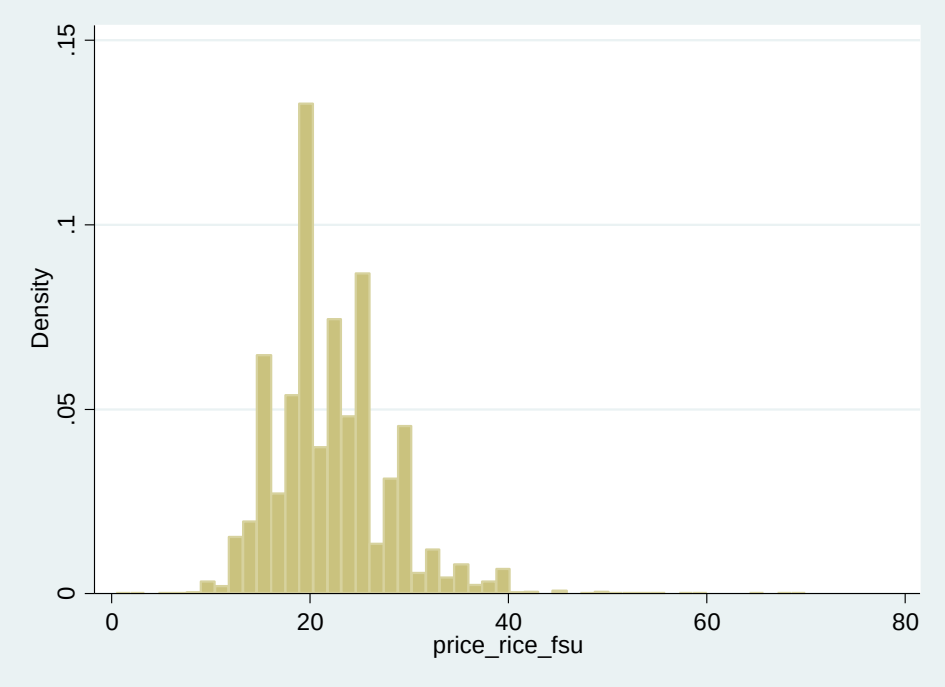
Table 4 Weights of various food groups in expenditure (%)

Source: Own design

Poor households spend relatively more on food than non-poor households (table 4) – on average almost 57 per cent, as compared to 48 per cent. Within food expenditures, the poor spend much more on staples – 42 per cent, whereas non-poor spend only 32.5 per cent of their food expenditures on staples. What is important, even within the staple food expenditures, non-poor spend relatively more on more nutritious coarse cereals (4.5 per cent compared to 3.8 per cent of staple expenditures) and pulses (24.4 per cent compared to 21.8 per cent). Also the poor spend on average quite a big share of their staple food budget on the PDS grains – almost 11 per cent. The non-poor spend around 6 per cent on the PDS wheat and rice. Importantly, for both poor and non-poor, wheat and rice constitute the major source of staple food expenditure – 70 per cent for the poor and 65 per cent for the non-poor. Additionally, there are wheat and rice products (noodles, bread), which constitute 4.2 per cent of the staple food expenditures of the poor; and 5.9 per cent of the non-poor.

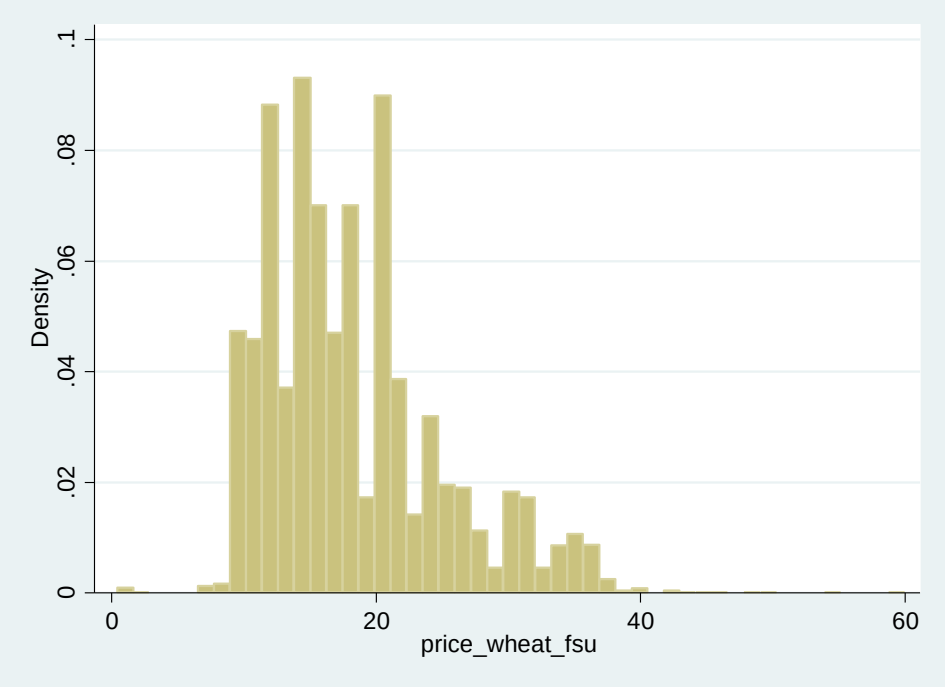
Market prices vary substantially across regions. Figures 2 and 3 present histograms of the district (FSU) level medians of wheat and rice. Most of the prices range between 10 Rs./kg and 40 Rs./kg. This important characteristic of price distribution should be taken into consideration when discussing cash transfers.

Figure 2 Rice market spatial price distribution (FSU medians, Rs./kg)



Source: Own design

Figure 3 Wheat market spatial price distribution (FSU medians, Rs./kg)



Source: Own design

Results and discussion

In the first step, we generate implicit unit values of the market-consumed goods by calculating the ratio of expenditure and quantity. We use an average implicit value for the first stage unit (FSU)[3] to approximate market prices. We take FSU average prices instead of calculating them for individual households separately in order to avoid missing observations in case of non-consumption of certain goods. This method also allows us to decrease quality and measurement biases associated with unit values (Deaton, 1988). Even though, in our analysis we are considering staple foods only and their quality is usually rather uniform, there might be significant differences in varieties (especially in case of rice) affecting the price level. This should be smoothed by taking the average in the FSU.

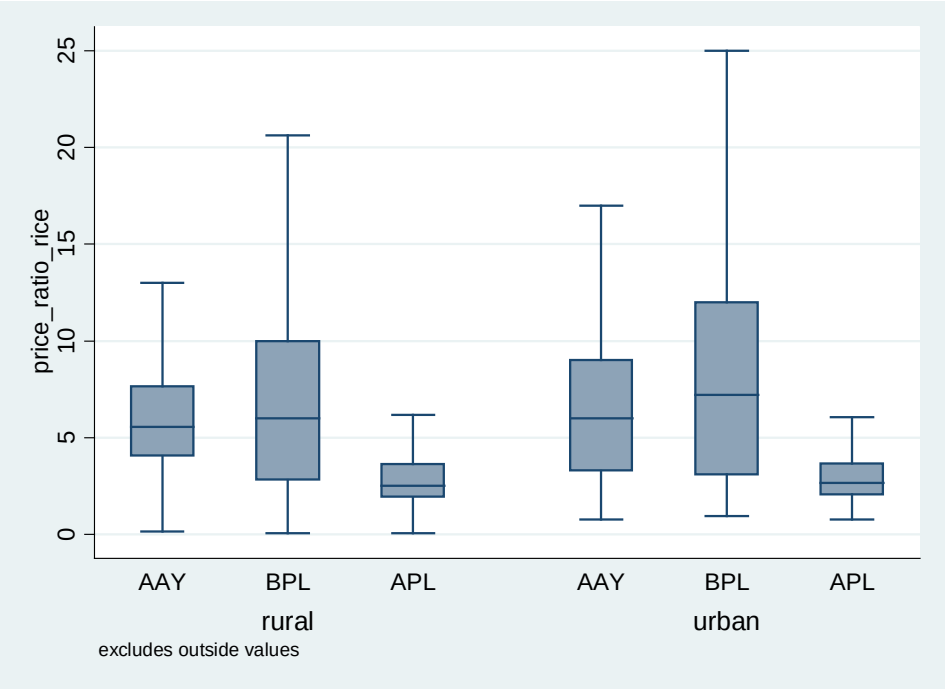
In order to calculate subsidized prices, we use FSU and ration card type specific prices. This allows taking into consideration eligible households (ration card holders) with zero purchase from the PDS.

Consumption from the PDS

There are probably significant differences in the importance of the PDS grains for different ration card type owners due to different subsidy levels - absolute and relative to the market price paid (figures 4 and 5) but also due to different expenditure levels in these groups. Also, there are probably differences in the leakage rates between these groups, as discussed in the introduction.

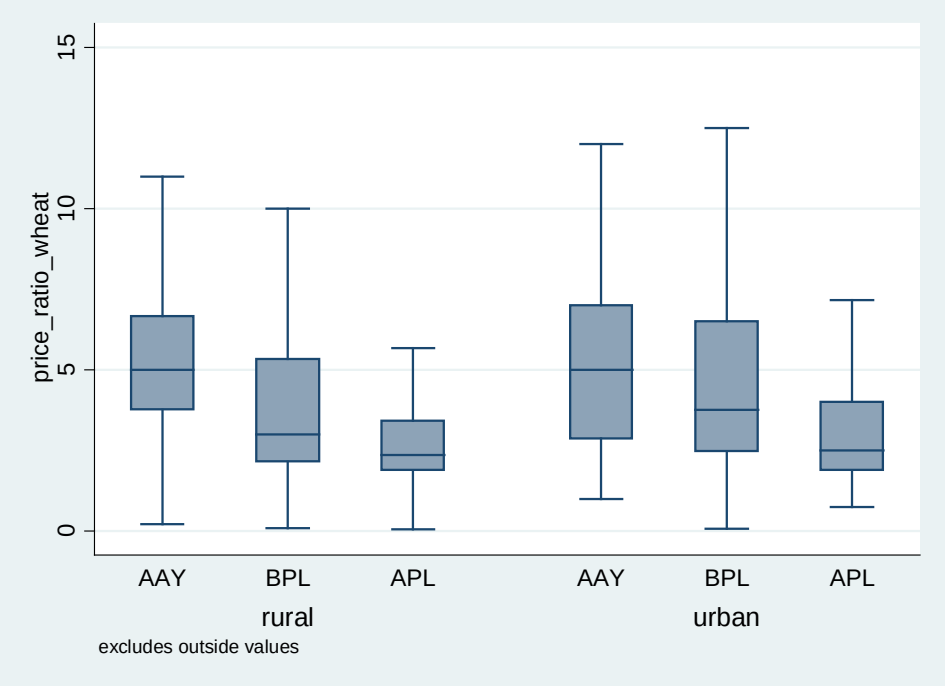
[3] The first stage units (FSU) are the 2001 census villages (Panchayat wards in case of Kerala) in the rural sector and Urban Frame Survey (UFS) blocks in the urban sector. (NSSO, 2013)

Figure 4 Price subsidy ($\frac{p_m}{p_s}$) variability by ration card type and region



Source: Own design

Figure 5 Price subsidy ($\frac{p_m}{p_s}$) variability by ration card type and region



Source: Own design

Table 5 summarizes consumption by different ration card types. There are clear differences between them. First, most of the AAY and BPL (around 90 per cent) actually use their cards, whereas APL cardholders predominantly do not (74 per cent). Interestingly, AAY cardholders usually consume both subsidized grains, whereas BPL cardholders often (42 per cent) consume only one commodity Also, 37 per cent of AAY rice consumers and 31 per cent of AAY wheat consumers do not buy these grains on the market, which means they consume exclusively from the fair price shops. These numbers are much lower for the APL cardholders – 3.2 and 11.3 per cent respectively. This means that the poorest rely on the PDS much more than the non-poor.

What is important, average consumption of wheat and rice by the AAY households who use their ration cards is 30.4 kg per household, which is close to the full ration (35 kg). On the other hand, BPL consumers utilize on average only 21.9 kg of wheat and rice out of the same ration quantity. Full PDS consumption, so at least 35 kg per household, is observed in 46 per cent of the AAY households and only 13.8 per cent of the BPL households. It is clear that the BPL households are much less successful than the AAY cardholders in obtaining their full ration. APL average consumption is 15.9 kg per household. However, in this group, the most striking finding is a low usage of ration cards and accordingly a high share of zero consumption from the PDS (74 per cent).

In the light of these results, we need to analyze the low take-up by the APL cardholders. The aim is to find out the reasons behind not consuming from the PDS. Is it because of self-selection, so demand driven, or maybe because of high leakage and other supply side causes. This is important because of high targeting errors, as outlined in the data section, there are 23 per cent of poor households with the APL card and many of them do not actively participate in the scheme. Next, we need to explain the low consumption of the PDS wheat and rice – why do so many households buy only a fraction of their ratio? This is especially alarming in the BPL group. Maybe this is also because of the targeting errors, as there are only 44 per cent of poor households in the BPL group, according to the data. So it might be the case that better-off households buy only a small amount of grains from the PDS.

	AAY	BPL	APL

Households' consumption from PDS (%)			
No consumption	10.5	9.6	74.0
Consumption of one crop only	25.8	41.6	13.7
Consumption of both wheat and rice	63.7	48.9	12.3
Households consuming exclusively from the PDS (%)			
Rice	37.0	16.8	3.2
Wheat	30.7	27.5	11.3
Mean PDS consumption per household (kg)			
Rice	18.0	13.8	2.8
Wheat	9.3	6.0	1.4
Mean conditional* PDS consumption per household (kg)			
Rice	21.3	16.5	14.4
Wheat	13.5	10.7	7.2
Total wheat and rice	30.4	21.9	15.9
Mean PDS - market price ratio (%)			
Rice	21.3	24.9	34.2
Wheat	24.4	37.6	37.3
Mean monthly per capita expenditure (Rs.)	1081.5	1292.2	2060.5
Below poverty line (%)	59.6	43.7	23.2

* Average over households with positive consumption from PDS

Table 5 PDS Consumption by Ration Card Type

Source: Own design

First, cardholder groups differ with respect to their financial status (table 5). BPL cardholders' expenditure is 20 per cent higher than the AAY, whereas APL cardholders spend on average 60 per cent more that the BPL group. Different take-up rates and consumption quantities may result from a lower subsidy relative to the total expenditure. This would support the hypothesis that their under-purchase is a result of a negative self-selection. Second, the PDS beneficiaries may live in income and card-type clusters. This might influence pilferage rates (Mehta & Jha, 2014). Indeed, there are 29 per cent of the FSUs without any poor households and over 45 per cent of the FSUs have less than 14 per cent poor households in them (table 6). These are probably the rich areas. On the other side there are 16 per cent of the FSUs where over 60 per cent of the households live below the poverty line, which is a very high concentration of the poor

Poor (%)	Percent	Cum.
0.00	28.95	28.95
0.13	16.04	44.98

0.14	0.18	45.16
0.17	0.02	45.18
0.20	0.01	45.19
0.25	16.96	62.15
0.29	0.17	62.32
0.33	0.01	62.34
0.38	11.46	73.79
0.43	0.06	73.85
0.50	10.06	83.9
0.57	0.06	83.97
0.60	0	83.97
0.63	7.41	91.38
0.71	0.04	91.43
0.75	5.39	96.82
0.86	0.01	96.83
0.88	2.05	98.88
1.00	1.12	100
Total	100	

Table 6 Distribution of the FSUs by the share of poor households

Note: 0 in the column Poor means there are no poor households in a FSU, 1 means everyone in a FSU is poor. Poor measured as expenditures below the poverty line.
Source: Own design

We estimate a probit model to explain the reasons for the low take-up of the APL program. Our dependent variable, the take-up of the APL card, is equal to 1 if there is a positive rice/wheat consumption by an eligible APL cardholder and zero otherwise. As it was mentioned in the theoretical section, we expect differences in functioning of the PDS for wheat and for rice. For example wheat is reported to have higher leakage than rice (Gulati & Saini, 2015). The results are reported in table 7.

We find the price subsidy to have a mostly insignificant impact on the take-up (table 7). Only in case of rural wheat PDS take-up, there is a positive and significant impact. So there is no evidence of leakage having a deciding role on low take-up. But also, except for the rural wheat consumption, the price subsidy does not seem to positively influence the decision of purchasing the PDS grains. There might be an unobserved variable issue in rural areas, which is a transaction cost. Distance to the PDS shop in rural areas may vary substantially and be correlated with the market price. A higher distance to the PDS shop might be positively

correlated with the market price – remote areas without good infrastructure and far from a market have higher market prices and higher chance of long distance to the PDS shop or worse functioning fair price shop, which means higher transaction costs, which we do not observe. As a result, we would obtain underestimated subsidy parameters for rural areas. However, the scale of the issue should be rather small. The example from Bihar (Muralidharan, Niehaus, & Sukhtankar, 2011), where at the time the survey was conducted, the TPDS was among the worst functioning in the country (Gulati & Saini, 2015), shows that the average distance to the ration shop was similar in rural and urban areas. The difference lies in longer waiting times and fewer days when a ration shop is open in rural than in urban areas. Consumer's response to waiting time is similar to response to changes in prices (Alderman, 1987). This means that transaction costs are indeed higher for the rural households than for the urban ones, but there is no evidence of correlation with the distance to the market. This might be the reason for the stronger reaction to the subsidy in case of rural households as compared to urban.

Per capita expenditure and higher secondary and above education have a significant and negative impact on the take up rates of the APL households, which might be due to self-selection - more affluent households drop out of the scheme. The expenditure impact is moderate - the probability of participating in the scheme decreases on average by 0.03-0.04 if the monthly expenditure per capita increases by Rs. 1000 at the means of all the explanatory variables. Higher secondary and above education has much stronger impact decreasing the probability of participation in the PDS by 0.149 for wheat and 0.235 for rice at the means of explanatory variables. Literacy does not affect the probability of participation in the scheme as compared to illiterate cardholders.

Household size has a positive and significant impact for both commodities, which might be that there is a higher chance that someone in the household who is available to go to the PDS shop in more populous households (for example children) or because there are higher consumption needs. This might be also an effect of per capita allocations in some states so there is more to gain from the participation in the PDS. However, the effect is rather weak – additional family member increases a probability of participation by around 0.01 at the means.

VARIABLES	(1) Rice APL	(2) Rice Marginal Effect	(3) Wheat APL	(4) Wheat Marginal Efect
Share of the poor in the FSU (%)	0.004***	0.001***	-0.001	-0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Price ratio rural	0.001	0.001	0.017**	0.007**
	(0.008)	(0.003)	(0.008)	(0.003)
Price ratio urban	-0.007	-0.003	0.009	0.004
	(0.007)	(0.002)	(0.010)	(0.004)
Monthly per capita expenditure,	-0.097***	-0.035***	-0.080***	-0.032***
	(0.018)	(0.006)	(0.017)	(0.007)
Household size	0.038***	0.013***	0.024***	0.010***
	(0.011)	(0.004)	(0.009)	(0.004)
Literate with and without formal	-0.087	-0.031	-0.027	-0.011
	(0.063)	(0.022)	(0.049)	(0.020)
Higher secondary & above	-0.662***	-0.235***	-0.374***	-0.149***
	(0.074)	(0.026)	(0.062)	(0.025)
Hired Dwelling Unit	-0.055	-0.020	-0.035	-0.014
	(0.066)	(0.024)	(0.056)	(0.022)
No Dwelling Unit	2.060***	0.309***	-2.392***	-0.512***
	(0.398)	(0.017)	(0.644)	(0.022)
Other Dwelling Unit	0.102	0.035	-0.174	-0.069
	(0.161)	(0.054)	(0.109)	(0.043)
Scheduled Castes	-0.078	-0.026	-0.112	-0.045
	(0.124)	(0.040)	(0.116)	(0.046)
Other Backward Classes	-0.226**	-0.077**	-0.035	-0.014
	(0.111)	(0.036)	(0.110)	(0.043)
Other social groups	-0.322***	-0.112***	-0.216**	-0.086**
	(0.111)	(0.037)	(0.110)	(0.043)
Urban sector	-0.058	-0.021	0.075	0.030
	(0.071)	(0.026)	(0.065)	(0.026)
Constant	1.096***		0.504***	
	(0.157)		(0.154)	
Observations	69,748	46,002	69,230	37,306
N_sub	20147		19284	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7 PDS APL consumption - probit model results

NOTE: State and household type dummies are included but not reported

Source: Own design

There are no significant differences in the PDS participation probability between households living in owned, hired and other dwelling units. However, households without any dwelling[4] significantly and strongly differ, strikingly in the opposite manner for wheat and rice. Households with no dwelling units and the APL cards are more probable to use the PDS by 0.31 in case of rice and less probable by 0.51 in case of wheat as compared to the households with own dwelling units. There is also a significantly higher probability of the participation in the scheme for scheduled tribes and castes[5] with the APL cards as compared to other social groups with the APL cards. But this difference is larger in case of rice consumption. This might mean that the rice consuming states are better, so the rice TPDS, is better in covering the underprivileged households. This should be verified for the other card types and the quantity consumed from the PDS. In general, PDS rice take-up by the APL cardholders seems to be driven by the economic and social status, whereas wheat consumption depend more on the subsidy level.

Finally, there is a significant and positive effect of the poverty concentration in a district (FSU), measured by the share of the below poverty line households in the FSU, on the rice take-up and no effect on the wheat take-up. The marginal effect for rice is moderate – 1 per cent increase of the share of the poor in the FSU increases the probability of PDS take-up by an APL household by 0.1 per cent. As discussed above, this dependency was hypothesized by Mehta and Jha (2014) that the poor communities due to higher incentives are more successful in reducing leakage from opaque subsidy programs.

We estimate a tobit model explaining the quantity consumed from the PDS; separately for wheat and rice:

$$q_s = \begin{cases} 0 & \text{if } q_s^* \leq 0 \\ q_s^* & \text{if } q_s^* > 0 \end{cases} ,$$

[4] Households are considered to be categorized as possessing "no dwelling" when found to be living more or less regularly under bridges, in pipes, below staircases or with temporarily built flimsy improvisations etc. with a liability to be removed at any moment (NSSA classification).

[5] Scheduled castes and tribes, as listed in the Constitution of India, comprise various historically disadvantaged groups of people (Bakshi & Kashyap, 2012). Even though the Constitution guaranties affirmative action, protective arrangements and development of the scheduled casts and tribes (ibidem), they are persistently characterized by lower nutrition, wealth and education as compared to the remaining Indian population (van de Poel & Speybroeck, 2009).

$$q_s^* = \alpha_0 + \alpha_1 p_{ratio} * CT + \alpha_2 MPCE + \alpha_3 S + \alpha_4 \mathbb{H} + \alpha_5 Poor ,$$

where q_s^* is an observed quantity of wheat/rice consumed from the PDS by a household, p_{ratio} is a relative subsidy level per kg (market price of wheat/rice divided their PSD price), CT is a card type (dummy for different card types), $MPCE$ is a monthly per capita expenditure, *S* is a state region dummy, $\mathbb{H}$ vector of household characteristics (hh size, social group, etc.), and *Poor* is a share of the poor in the FSU. We chose a tobit model instead of a linear regression as there is a significant portion of zero consumption of subsidized grains by eligible consumers, as it was shown in table 5.

Estimation results are reported in table 8 for rice and in table 9 for wheat[6]. The first two columns contain results for specification with the price ratio for all card types, and the last two columns show the price ratio interacted with card type dummies.

VARIABLES	(1) Rice	(2) Rice Marginal effects	(3) Rice	(4) Rice Marginal effects
Female	-737.661***	-638.990***	-935.392***	-810.286***
	(234.173)	(202.730)	(229.586)	(198.671)
Share of the poor in the FSU (%)	33.379***	28.914***	27.284***	23.635***
	(5.176)	(4.480)	(4.948)	(4.283)
Monthly per capita expenditure, MRP ('000 Rs.)	-1,566.391***	-1,356.869***	-1,359.872***	-1,177.993***
	(184.164)	(158.548)	(163.646)	(141.015)
Household size	1,133.894***	982.223***	1,158.929***	1,003.926***
	(56.446)	(49.019)	(53.413)	(46.335)
Scheduled Castes	383.710	340.874	202.368	179.301
	(319.369)	(283.286)	(315.936)	(279.662)
Other Backward Classes	-1,246.087***	-1,089.634***	-1,151.999***	-1,007.236***
	(306.101)	(269.730)	(305.530)	(269.253)
Other social groups	-2,257.963***	-1,953.151***	-2,039.348***	-1,766.263***
	(346.230)	(301.783)	(345.314)	(301.564)
Is any member of the household a regular salary earner?	1,201.948***	1,041.174***	881.571***	763.664***
	(222.492)	(192.926)	(216.116)	(187.353)
Urban sector	-2,336.023***	-1,996.900***	-1,999.714***	-1,713.038***

[6] There were no significant differences in the estimated coefficients for rural and urban sector separately, consequently, we present results of the estimation based on the full sample.

	(248.867)	(209.441)	(242.497)	(204.915)
Price ratio AAY			891.121***	771.936***
			(46.883)	(40.449)
Price ratio BPL			328.921***	284.928***
			(33.804)	(29.256)
Price ratio APL			-493.403***	-427.411***
			(109.815)	(95.028)
Price ratio	286.942***	248.560***		
	(30.088)	(26.022)		
Constant	2,754.351**		4,210.401***	
	(1,252.812)		(1,203.845)	
Observations	46,411	46,411	46,411	46,411

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8 PDS rice consumption (grams per household per month) - estimation results and marginal effects

Note: State region and lightning code dummy estimates are included but not reported
Omitted social group is scheduled tribes
Source: Own design

VARIABLES	(1) Wheat	(2) Wheat Marginal effects	(3) Wheat	(4) Wheat Marginal effects
Female	-248.380	-167.682	-323.13	-217.94
	(224.868)	(151.796)	(224.64)	(151.46)
Share of the poor in the FSU (%)	11.159**	7.533**	5.53	3.73
	(5.402)	(3.646)	(5.25)	(3.54)
Monthly per capita expenditure, MRP ('000 Rs.)	-932.455***	-629.500***	-782.98***	-528.09***
	(139.022)	(93.315)	(123.76)	(83.09)
Household size	448.608***	302.855***	470.44***	317.29***
	(50.068)	(33.902)	(48.06)	(32.50)
Scheduled Castes	-175.559	-124.877	-209.93	-147.54
	(432.917)	(308.651)	(429.83)	(302.94)
Other Backward Classes	-1,107.724***	-771.033***	-820.73**	-568.54**
	(415.748)	(294.827)	(410.26)	(288.32)
Other social groups	-2,407.146***	-1,622.697***	-2,010.55***	-1,352.38***
	(435.480)	(303.354)	(433.21)	(299.69)
Is any member of the household a regular salary earner?	881.348***	594.997***	522.32**	352.28**
	(211.057)	(142.230)	(213.15)	(143.69)
Urban sector	-1,183.693***	-788.426***	-760.80***	-508.79***

	(238.258)	(157.261)	(233.09)	(155.08)
Price ratio AAY			952.74***	642.58***
			(65.97)	(43.74)
Price ratio BPL			620.20***	418.30***
			(83.25)	(55.91)
Price ratio APL			-175.48*	-118.35*
			(93.19)	(62.80)
Price ratio	515.334***	347.902***		
	(49.437)	(33.193)		
Constant	9,411.196***		10,133.51***	
	(1,520.641)		(1,501.87)	
Observations	37,540	37,540	37,540	37,540

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 PDS wheat consumption (grams per household per month) - estimation results and marginal effects

Note: State region and lightning code dummy estimates are included but not reported
Omitted social group is scheduled tribes
Source: Own design

Similarly to the aforementioned probit model results of the APL take-up, expenditure has a significant and negative impact on consumption of both PDS wheat and rice, and the impact is higher in case of rice. Additional thousand Rs. of expenditure decreases on average household's consumption of rice by 1.2-1.4 kg and 0.5-0.6 kg of wheat at the means of explanatory variables. Again, this can be interpreted as evidence for negative self-selection of richer households. Also household size has a positive and significant effect on grain consumption (wheat and rice), which again can be due to per capita allocations or just more household members available to reach a fair price shop. In case of rice, the effect of a larger household by one person is up to 1 kg and in case of wheat, around 0.3 kg. All the backward classes, especially scheduled castes and tribes consume significantly more subsidized grains. Households belonging to scheduled tribes consume even 2 kg of rice or 1.6 kg of wheat from the PDS as compared to other (non-backward) social groups. Urban households on average consume less PDS grains than rural ones.

Interestingly, a regular salary earner in a household significantly increases the PDS consumption. Less than 12 per cent of rural households belong to the category of the regular salary earners. In urban areas, this is estimated to be over 45 per cent of the population. So

probably the combination of the negative coefficient for the urban sector and the positive effect for the regular salary earner, similar in the amplitude, is the sign of not covering the migrant workers, which TPDS has been criticized for.

When it comes to price subsidy, it has on average a positive and significant impact on both wheat and rice consumption (see columns 1 and 2 for marginal effects). This means that the PDS under-purchase is mostly demand driven. As a result, because the PDS grain price is below the market price, we can also conclude that on average, it is treated as imperfect substitute to the market grains. Further, this finding supports the expectation and is in line with the finding in (Suryanarayana, 1995) that PDS grains are not inframarginal.

Interestingly, when the price ratio is interacted with the card type (see columns 3 and 4 for marginal effects), there is a significant difference between its impact on the consumption of the PDS grains. The price subsidy has a negative and significant impact on both wheat and rice PDS consumption of the APL cardholders and a positive and significant impact for both AAY and BPL groups. This can be linked to the already discussed differences in the leakage rates from APL and BPL quotas, and confirms the hypothesis formulated by Drèze and Khera (2015). The higher price incentive has a stronger impact on the shop owners to leak grains in case of the APL quota and a stronger impact on the consumers to buy more in case of the BPL and the AAY cards. Further, there is a significant positive impact of the share of the poor in the FSU (similarly to the probit model for the APL take-up results). This is true for both rice and wheat (except for the specification 3, table 9). Which is again along with the hypothesis formulated by Mehta and Jha (2014) that the poor communities due to higher incentives are more successful in reducing leakage from opaque subsidy programs.

Another interesting result is that a female household head dummy has a negative and significant effect on rice PDS consumption and a negative but insignificant impact on wheat PDS consumption quantity. When interacted with the ration card type (table 10), the negative effect of the female household head is significant only for the APL cardholders, also to a lesser extend for the wheat PDS consumption. APL households with a female head consume on average 1.6 kg of PDS rice and 0.46 kg of PDS wheat less than their male led counterparts. This is an

alarming result, as the women led household are usually socially more vulnerable and food insecure (ADB & FAO, 2013). Women led households are often households without a man, led by divorced or widowed women. These households are extremely marginalized (Masoodi, 2015). This malfunction of the PDS has not been mentioned in the literature so far and should be further analyzed. Higher under-purchase is probably related to the marginalization of female led households. This is why a 'head of the household' definition adopted in the National Food Security Act, which is the eldest woman, who is not less than eighteen years of age, is a very important legal provision.

	(1)	(2)	(3)	(4)
	Rice	Rice	Wheat	Wheat
VARIABLES		Marginal effects		Marginal effects
Female AAY	-792.23	-686.32	-1,075.95	-725.73
	(823.06)	(713.00)	(778.36)	(524.94)
Female BPL	-231.69	-200.72	118.67	80.04
	(312.64)	(270.80)	(304.01)	(205.07)
Female APL	-1,836.04***	-1,590.59***	-679.37*	-458.24*
	(381.44)	(330.56)	(358.74)	(241.96)
Observations	46,411	46,411	37,540	37,540

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Exogenous variable set the same as in regressions in table 8 and 9

Table 10 PDS rice consumption (grams per household per month) and a household head – some estimation results and marginal effects

Source: Own design

Market wheat and rice consumption

Unfortunately, we do not have the exact information on the ration quantity – as it was discussed above, despite the official uniform 35 kg per household, some states provide less grains for the BPL, and even more often for the APL cardholders. Only actual consumption of the market grains can be observed. We can control for ration card type, however it is highly correlated with the subsidized price level. As a result, we estimate two alternative specifications – with PDS prices and with ration card types as explanatory variables.

We estimate a tobit model for market consumption of wheat and rice[7]:

$$q_m = \begin{cases} 0 & \text{if } q_m^* \leq 0 \\ q_m^* & \text{if } q_m^* > 0 \end{cases},$$

and $q_m^* = \alpha_0 + \alpha \ln P + \beta_1 \ln m + \beta_2 \ln^2 m + \gamma \mathbb{X}$,

where q_m is the observed per capita market consumption of wheat or rice, $\ln P$ is a vector of logarithms of prices of staple foods, including either PDS prices or a ration card type, *m* is monthly per capita expenditure (MPCE) and $\mathbb{X}$ is a vector of household characteristics and state dummies. Results are presented in table 11.

From the formula above, we can calculate price and expenditure elasticities of the latent variable q_m^*. Expenditure elasticity of the good *m* consumption:

$$\eta_m = \frac{\partial q_m}{\partial m}\frac{m}{q_m} = \frac{\beta_1 + 2\beta_2 \ln m}{q_m}$$

Price elasticity of the good *m* consumption with respect to the price of good *n*:

$$\epsilon_{mn} = \frac{\partial q_m}{\partial p_n}\frac{p_n}{q_m} = \frac{\alpha_n}{q_m},$$

where α_n is an element of a vector α, corresponding to price coefficient of the good *n*. Respective price and income elasticities for wheat and rice at the mean expenditure and consumption levels are presented in table 12.

For both wheat and rice, own prices have negative and significant coefficient estimates[8], which is according to the theory. Rice consumption has a positive response to upward wheat price changes, however, in case of wheat the coefficients are not significant. Logarithms of income have positive and significant coefficients and their squared values, negative and significant. This is again, according to the expectations based on the Engel's law – consumption increases with income at a diminishing rate.

[7] There were no significant differences in the estimated coefficients based on rural and urban sample. Consequently, we provide the results from the estimation on the full sample.
[8] These are not elasticities as the explanatory variable is expressed in levels, not logarithms.

VARIABLES	(1) Rice	(2) Rice	(3) Wheat	(4) Wheat
ln price other cereals	804.02**	921.35***	574.72	491.44
	(348.74)	(326.68)	(437.39)	(397.25)
ln price rice	-8,158.47***	-8,912.01***	1,437.58	2,361.56**
	(672.84)	(643.09)	(997.33)	(919.57)
ln price wheat	4,591.35***	5,716.84***	-9,684.74***	-10,712.73***
	(893.14)	(886.13)	(935.96)	(879.87)
ln price cereal substitutes	-961.40***	-1,178.93***	-302.58	-577.09
	(313.82)	(314.69)	(453.77)	(502.66)
ln price pulses	-2,159.85***	-2,309.89***	1,499.31	1,162.87
	(696.13)	(684.37)	(1,214.52)	(1,162.31)
ln price PDS rice	-1,632.14***		1,351.21***	
	(265.20)		(331.60)	
ln price PDS wheat	2,208.38***		2,778.69***	
	(257.79)		(359.05)	
ln MPCE	3,927.38***	2,409.50***	8,354.47***	7,145.97***
	(408.54)	(399.25)	(495.85)	(462.51)
ln square MPCE	-722.58***	-390.55**	-1,988.14***	-1,747.01***
	(169.93)	(162.02)	(214.45)	(201.73)
Household size	3,496.15***	3,375.59***	4,787.09***	4,872.28***
	(81.55)	(78.83)	(124.77)	(118.08)
literate with and without formal schooling	-222.52	-384.28	141.54	-406.06
	(309.03)	(290.93)	(355.91)	(338.63)
Higher secondary & above	-472.61	-949.75***	-493.99	-1,609.36***
	(352.28)	(338.59)	(422.37)	(402.45)
AAY card		-7,041.42***		-8,844.99***
		(816.32)		(845.12)
BPL card		-5,405.57***		-5,218.16***
		(364.75)		(410.17)
APL card		-1,481.48***		1,257.23***
		(272.10)		(317.77)
Urban sector	-767.57***	-1,084.43***	-1,964.74***	-2,253.60***
	(282.98)	(278.67)	(374.18)	(364.53)
Constant	31,435.60***	36,780.56***	-10,760.25**	3,551.46
	(4,093.02)	(4,124.23)	(5,478.14)	(5,570.01)
Observations	39,761	43,936	31,618	35,583

Standard errors in parentheses

*** p<0.01, ** p<0.05, *p<0.1

Table 11 Market rice and wheat consumption (grams per capita per month) – tobit model results

Note: State and dwelling unit code dummy estimates were included but not reported

Source: Own design

PDS price	Own price	Income

	elasticity	elasticity	elasticity
Rice	-0.08	-0.42	0.17
Wheat	0.13	-0.44	0.31

Table 12 Market consumptionprice and income elasticities – calculated from the tobit model results

Note: Elasticities were calculated at means of expenditure and consumption quantities
Source: Own design

PDS price of rice has a significant and negative effect and PDS wheat price has a positive and significant effect on market rice consumption (column 1, table 11). For market wheat consumption, both PDS wheat and rice prices have a significant and positive impact (column 3, table 11). So higher subsidy (coming from a lower PDS price) for rice actually increases market rice consumption and decreases market wheat consumption. Lower PDS price for wheat decreases consumption of both market wheat and rice. In terms of price elasticities this means that a lower PDS rice price by one per cent increases market rice consumption by moderate 0.08 per cent, whereas one per cent decrease in wheat PDS price decreases market wheat consumption by 0.13 per cent (table 12). Interestingly, in case of rice, the rural AAY cardholders consume the least grains from the market and the consumption increases with the card type, especially between the BPL and the APL cards. No card means the highest market rice consumption, controlling for all the other factors. However, in case of wheat, APL cardholders consume slightly more than no card households. What is important, the highest coefficients are between around 7,000 and 8,900, which means that the AAY households consume on average 8.9 kg of wheat or 7 kg rice less than no card households. In case of wheat, the average PDS consumption by the AAY cardholders is 9.3 kg, so it seems that the PDS slightly increases the total wheat consumption. In case of rice, the average PDS consumption by the AAY households is 18 kg, so total rice consumption is significantly higher. This result is similar to the conclusions from the specification with the PDS prices – there is a significant and strong crowding in effect of rice and a small effect of wheat consumption by the PDS. We can conclude, that PDS wheat and rice are substitutes (though not perfect substitutes) for market rice and wheat.

Summary and conclusions

Understanding the consumption patterns of the PDS grains, so who and how much consumes and why, contributes to solving a puzzle of low take up and consumption from the PDS in India. It has important implications for policy measures taken to improve its functioning. Further, impact of the subsidy on market grain consumption has several implications – both for covered households, through impacting their diets, and households not covered by the PDS, through impacting total demand and market prices.

What we see in the data, is that the vast majority of the poorest of the poor, at least those with an AYY card, consumes subsidized grains and on average, they buy almost the full ration. However, AAY constitute only 5.5 per cent of all card owners in the country and there are many poor who do not buy any PDS grains. Rural coverage with the PDS is quite high – there were almost 52 per cent of households consuming some amount of the subsidized grains, on average a little above 11 kg per household. Under-purchase among the BPL and APL cardholders is much higher than in the case of the AAY group. Additionally, the APL group is characterized by the very low take-up – only 26 per cent bought any amount of the PDS grains. With our detailed analysis on the all India level we contribute to improved understanding of the strengths and weaknesses of the TPDS.

There is no evidence of leakage having a deciding role on the low take-up observed in the APL group, but also, except for rural wheat consumption, the price subsidy does not seem to positively influence the take-up rate of the PSD grains. Rice PDS seems to be better in covering traditionally underprivileged, backward classes and families without a dwelling unit than the wheat distribution. Higher income and education levels can be associated with lower probability of APL take-up, which is probably due to the negative selection of the more affluent households. A similar effect of income was found on the quantity of PDS grains consumed in all ration card groups. Our results further suggest that the migrant workers and female led households are not well covered by the TPDS- despite having a card, they under-purchase from the PDS. To our knowledge, this is the first empirical analysis of the various targeting errors on all India level.

There is a significant difference in impact of the price subsidy on the PDS consumption between the card types. The price subsidy has a negative and significant impact on both wheat and rice PDS consumption of the APL cardholders and a positive and significant for both AAY and BPL groups. This can be linked to the difference in the leakage rates from APL and BPL quotas. The higher price incentive has a stronger impact on the shop owners to leak grains in case of the APL quota and a stronger impact on the consumers to buy more in case of the BPL and AAY cards. This conclusion is supported by the lack of impact of the subsidy on the take-up rates among the APL households, which are mostly driven by wealth and social status. This means that those APL cardholders who turn to the PDS scheme are income driven and would consume more subsidized grains than they do if not for the leakage and diversion. With our result, we empirically confirm the hypothesis made by Drèze and Khera (2015). This phenomenon can be a consequence of the misinformation about the ration among the APL cardholders – despite the centrally guaranteed 35 kg per household, many states provide less to this group. There are also sporadically some additional allocations for the APL quota, which are not realized by the cardholders. As a result, it is easier for the PDS shopkeepers to divert grains from the APL quota compared to the other groups. Further, PDS recipients in poor areas consume slightly more PDS grains which might be attributed to better monitoring of the Fair Price Shops by these communities and consequently lower leakage. This result supports a theoretical model developed by Mehta and Jha (2014).

There is a significant and strong crowding in effect of total rice consumption by the PDS rice. In case of wheat, it is significant but much weaker. We conclude, that PDS wheat and rice are substitutes (though not perfect substitutes) for market rice and wheat and PDS consumption is not inframarginal. This result contributes to the growing evidence that the PDS crowds in consumption of wheat and rice and we also conclude that in the light of the targeting errors, higher total demand for wheat and rice might have negative consequences for the poor and underprivileged excluded from the system.

To sum up, there are several issues which should be addressed if the food distribution in kind is continued. More diversified rations, including for example pulses, eggs and vegetables, could be

highly beneficial for the improved nutrition of the poor. But also, some problems, like corruption and targeting errors can prevail even under the cash based system, so certain institutional improvements must be done irrespective of the system. In addition to that, the benefit of the negative self-selection of the rich would disappear under the cash transfers, which makes precise targeting one of the crucial elements of the transition to cash transfers. Another one, due to a large variation in prices, is linking the transfer amount to the local market prices as well as local price changes. However, the benefits of the cash based system can be large, both fiscal and on the ground of food security and nutrition. The growing evidence shows that child nutrition and household's food security status can be improved by cash transfers. All this shows that there is high potential and urgent need to seriously discuss and consider cash transfers for the Indian system.

Among the limitations of our method are lack of information about the institutional differences and limited information on the household characteristics and its district (like number of children, distance to the PDS shop and functioning of the PDS shop, distance to the market), which might have a significant influence on the household's decision making process and the outcomes of these decisions. Another caveat is that our analysis is done jointly on the all India level, even though the local (regional or state) differences in cultures and production systems might be an important factor influencing the response to the policies we analyze. However, the aim of this study is to analyze the consequences of the central policy measures on the country as a whole, as opposed to exploring the regional differences in responses to various policies. Nonetheless, further research should be focused on confirming our results on the state scale and testing whether the omitted control variables significantly affect the conclusions.

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FOODSECURE
FOR POLICIES THAT MATTER

The FOODSECURE project in a nutshell

Title	FOODSECURE – Exploring the future of global food and nutrition security
Funding scheme	7th framework program, theme Socioeconomic sciences and the humanities
Type of project	Large-scale collaborative research project
Project Coordinator	Hans van Meijl (LEI Wageningen UR)
Scientific Coordinator	Joachim von Braun (ZEF, Center for Development Research, University of Bonn)
Duration	2012 - 2017 (60 months)

Short description

In the future, excessively high food prices may frequently reoccur, with severe impact on the poor and vulnerable. Given the long lead time of the social and technological solutions for a more stable food system, a long-term policy framework on global food and nutrition security is urgently needed.

The general objective of the FOODSECURE project is to design effective and sustainable strategies for assessing and addressing the challenges of food and nutrition security.

FOODSECURE provides a set of analytical instruments to experiment, analyse, and coordinate the effects of short and long term policies related to achieving food security.

FOODSECURE impact lies in the knowledge base to support EU policy makers and other stakeholders in the design of consistent, coherent, long-term policy strategies for improving food and nutrition security.

EU Contribution	€ 8 million
Research team	19 partners from 13 countries

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