Household Responses to Food Subsidies: Evidence from India

Tara Kaul*

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Abstract

The Indian Public Distribution System is one of the world's largest food security programs and provides a monthly quota of cereals at discounted prices to poor households. I study the effect of the program on nutritional outcomes by exploiting variations in value of the subsidy resulting from differences in state program rules and local market prices. Using household consumption data, I find a small but positive impact on calories from all food groups, not just cereals. The impact on caloric intake is substantially smaller in states where corruption is high.
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1. Introduction

Provision of food security is one of the most basic forms of assistance to poor households and many governments around the world provide aid in the form of food subsidies. Despite their popularity and importance, there is a relatively small body of research studying the impact of such subsidies on nutritional outcomes. While the primary rationale for all food subsidies is reducing food insecurity (FAO 1997), their impact on nutrition (via food intake) has generally been found to be quite small, in some cases even zero or negative.[1]

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*International Initiative for Impact Evaluation/GDN, 2nd Floor, West Wing, ISID complex, Plot No .4, Vasant Kunj Institutional Area, New Delhi-110070, India, tkaul@3ieimpact.org, +(91) 11 4323 9494.

[1] Butler, Ohls and Posner (1985) find a very limited nutritional impact of the food stamps program in the United States. The Indian food security program has also historically been found to have a small impact on nutrition (Kochar 2005, Tarozzi 2005, Khera 2011c). Jensen and Miller (2011) find a negative impact of price subsidies on caloric intake in China. There is also a literature comparing the effects of food subsidies and income transfers. Hoynes and Schanzenbach (2009) find that the food stamps program in the United States has the same impact on food expenditure as cash. Steifel and Alderman (2006) and Laderchi (2001) find similar results in Peru where the impact of food subsidies on child nutrition is no different than that of cash transfers.

Food subsidies are implemented via food stamps, price subsidies, direct in-kind transfers or through the operation of ration shops (price subsidies with a quantity cap). The mechanism through which a food subsidy operates depends on the manner in which the program affects income and prices (and the related elasticities of the demand for food), the specific types of food groups it targets (and the income and cross price elasticities of other foods), and how close the beneficiary households are to their ideal level of food consumption. This paper examines India's food security program, the Public Distribution System (PDS). The PDS is one of the country's biggest anti-poverty programs. It has a target population of 65.2 million households and the total cost of food subsidies amounts to almost 1% of GDP (Planning Commission 2012).

The PDS provides a monthly quota of cereals (20-35 kg per household) at substantially discounted prices to households that are below the poverty line (Government of India 2011). The poverty line in India is determined by having an income deemed adequate to purchase a basic minimum level of calories.[2] Since cereals are relatively cheap and rich in energy, they account for a substantial proportion of the total calories consumed by poor households. Thus the PDS aims to directly increase caloric intake by providing supplementary cereals to poor households, who are, by assumption, food insecure. The program may, however, have consequences in terms of consumption of other food groups which are critical to maintaining a healthy and balanced diet. This is particularly important in India where the levels of child malnutrition are alarmingly high and have been linked to severe micronutrient deficiencies (Banerjee and Duflo 2011). Thus it is necessary to study the impact of the program not just on the intake of cereals and total calories, but also on calories from different food groups.[3]

[2]Deaton and Drèze (2009) find that the average caloric intake in India has declined over time. However, they note that this declining trend does not undermine the importance of reducing calorie deficiencies for poor households. In my sample, the caloric intake of the below poverty line (BPL) population is well below the minimum caloric norms (and the calories consumed by more affluent households). See Table 4 ahead.

[3]While the links between improvements in caloric intake and health outcomes certainly exist, the relationship is not necessarily linear and depends critically on other factors such

The value of the subsidy to a household is a function of the quantity cap and the discount (difference between the market and PDS price of cereals) that the household is eligible for. This paper uses two previously unexploited sources of variation in the value of the subsidy to measure its impact on nutritional outcomes. First, the total quantity cap for each household varies by state since the program is jointly funded by the state and central governments. Further, some states index the cap by family size and others offer a fixed quantity to every household. This results in variation, even within state, in the per person quantity cap, due to differences in family size. Second, the price charged for PDS goods is typically set for the year and not linked in any way to fluctuations in market prices. Due to the absence of perfectly integrated agricultural markets and controls on the movement of goods within the country, the difference between the PDS and market price within a year varies substantially across districts (within a state) and seasons.

State level program rules and differences in local market prices are used to compute the value of the subsidy for each beneficiary household, based on its size and district-season-year cell. This value is used to identify the effect of the subsidy, assuming that after controlling for household characteristics, district, state-year and seasonal effects, the remaining variation in the value of the subsidy (owing to unpredictable fluctuations in local market prices and differences in the per person quantity cap due to family size) is exogenous. The consumption data come from six years (2002-2008) of the nationally representative socio-economic surveys conducted by the National Sample Survey Organisation (NSSO). The analysis focusses on eight major states in India where rice is the primary staple. The main outcomes studied are cereal con-

as a balanced diet, activity levels, sanitation, and basic medical facilities (Deaton and Drèze 2009). In the absence of data on health outcomes in my dataset, I am unable to predict the impact of the subsidy on health. However, assessing the impact on caloric intake is important in itself. Reducing the incidence of hunger by improving caloric intake for a food insecure population, such as BPL households in India, is among the major humanitarian goals of many governments and international organisations around the world.

sumption, caloric intake, calories from different food groups, and total food expenditure. In order to compare the estimates with prior work on expenditure and income elasticities, supplementary data on income and consumption from a smaller but much richer dataset, the India Human Development Survey (2004-05), is used.

The estimated elasticities of cereal consumption and calories with respect to the value of the subsidy are small, but higher than previous estimates – the elasticity of caloric intake with respect to the value of the subsidy is 0.144, as compared to 0.06 in Kochar (2005). An increase in the rupee value of the subsidy increases calories by more than twice of what is implied by its impact on cereal consumption alone. This is an important indicator that households benefit from the program in terms of overall caloric intake and not just through the cereals directly provided by the PDS. Even though the program subsidizes only cereals, it has a positive effect on the consumption of all types of food: the impact on calories for all food groups is positive and significant. In contrast to Jensen and Miller (2011), who find a zero or negative effect of pure price subsidies on overall calories and calories from different food groups, the results in this paper suggest that quotas may be more effective than price subsidies in improving nutrition via caloric intake. Results are robust to alternative specifications of the value of the subsidy and the impact of the program on non beneficiary households is examined and found to be small.

State level differences in the administration of the PDS are taken into account using evidence on program fidelity from Khera (2011a). As expected, the subsidy has a substantially smaller impact in those states where the illegal diversion of food grains away from their intended beneficiaries is reported to be high. Despite serious implementation issues, the PDS continues to be one of the government's biggest anti-poverty programs and an expansion of the system is imminent under the National Food Security Bill, which was passed in September 2013. The bill will expand both the reach, and the value of subsidies provided through the PDS. The elasticity estimates from this paper, combined with current data on prices, suggest that the increase in the value of the subsidy under the provisions of the bill will lead to an increase of 66 - 72 kcal in the daily caloric intake of current beneficiaries of the program. These gains will be much higher if states are able to successfully reduce leakages from the PDS.

The paper is organized as follows: Section 2 describes the functioning, history and rules of the Public Distribution System in India. The motivation is described in section 3, which comprises the conceptual framework and a review of the related literature. The data, empirical specification and descriptive statistics are presented in section 4 and section 5 discusses the results. The final section concludes and describes avenues for future work.

2. The Public Distribution System in India

The Public Distribution System was established in India in 1939 by the then British government to cope with rising food prices and food shortages in Bombay and other urban areas. Over the years it expanded its scope dramatically and is currently one of the Indian government's most significant welfare programs. In the 2012-13 central government budget, the food subsidy was projected at Rs 750 billion (approximately US$13.8 billion, Government of India 2012). The PDS provides a minimum support price to farmers and acts as a food safety net for the rural and urban poor. It works alongside the free market and provides rice, wheat, edible oils, sugar and kerosene at subsidized prices through 489,000 fair price shops across the country (Planning Commission 2012).

Prior to 1997, all households were eligible purchase a monthly quota of subsidized products at fair price shops. In 1997, there was a major change in the PDS with the introduction of the Targeted Public Distribution System (TPDS). Under the new system, families classified as being below the poverty line (BPL) could get 10 kg of food grains per month at half the economic cost to the central government of procuring them. This quota was increased in 2000 to 20 kg per month (rice and/or wheat) and in 2002, the quota was revised upwards to 35 kg for most states. The subsidy for above poverty line (APL) families was eliminated.[4] Table 1 presents the details of state specific quotas for the period 2002-2008. Kochar (2005) estimates that the value of the subsidy, defined as the product of the quantity entitlement and the difference between the market and PDS price, increased from Rs 7 per household per month in 1993 to Rs 48 per household per month in 2000 (an increase of over 500%). Thus the TPDS introduced targeting and substantially increased the subsidy for BPL families. Currently, PDS prices are fixed by the central government and state governments are only allowed to add limited transportation costs and taxes. PDS prices are not indexed in any way to market prices. 24.3 million households classified as Antyodaya (poorest of the poor) are entitled to a larger quota and still lower prices. The next big change in the PDS is imminent as per the provisions of the National Food Security Bill, which was passed in September 2013. This bill makes it a legal right for 67% of the population to obtain 5 kg of foodgrains (per person per month) at prices between Re 1 and Rs 3 per kilogram. The eldest woman in the household will be given access to the subsidy on behalf of her family (The Hindu, July 2013). The resulting expansion in the reach and value of subsidies provided through the PDS could make it the largest food security program in the world.

The PDS is an essential part of the social framework in many areas of the country, particularly places with limited access to markets. However, the implementation of the program has been called into question on a number of dimensions. The first is the targeting accuracy of the PDS post 1997. Local governments are responsible for periodically carrying out surveys to assign poverty scores to households. The central government provides a cap on the number of BPL households for each state. State governments translate these caps into cut offs for the poverty score. All households that fall below their

[4] Tamil Nadu continues to have a universal subsidy and, since June 2011, provides 20 kg of rice per month free of cost to BPL households.

respective state- and district-specific cut off are classified as being below the poverty line and are issued BPL cards (Karat 2013 and Dreze and Khera 2010). In 2002, the BPL survey comprised 13 questions related to educational status, asset holdings, indebtedness, demographics etc. Targeting leads to errors of inclusion and exclusion. The reported rate of exclusion (eligible households without a BPL card) varies from 3% in Andhra Pradesh to 47% in Assam (Planning Commission 2005). In an independent study on Rajasthan, Khera (2008) finds an exclusion error of 44%. Swaminathan (2008) also reports high rates of exclusion, particularly in states like Kerala that switched from a universal PDS. Kochar (2005) argues that targeting reduced political support for the program.

The second issue is corruption in the PDS, particularly through diversion of food grains at different points along the distribution chain. This has been often highlighted in newspaper editorials, magazines, government reports and journals, though accurate estimates are difficult to obtain. The Planning Commission (2005) estimates that the government of India spends Rs 3.65 to get Re 1 worth of subsidy to a BPL household. Based on a survey conducted in 2001, the report concluded that 58% of food grains procured by PDS did not reach their intended beneficiaries due to a combination of inaccurate targeting and diversion. Khera (2011a) puts this number at 44% in 2007-08 by comparing official figures for food grains distributed through the PDS, with data on purchases from household surveys. She divides states into those that are functioning, reforming, or languishing in terms of the average quantity of food grains reaching households. Of late, significant state level differences in the working of the PDS have emerged and some states are improving delivery. A nine state survey by Khera (2011b) conducted in May and June 2011 finds that over 85% of the monthly entitlement was received by beneficiaries in these states. In November 2012, the Indian government announced that a number of subsidy programs such as scholarships, cooking fuel subsidies, pensions and unemployment benefits would be converted into direct cash transfers in a phased manner starting in January 2013. This move is an attempt to reduce inefficiencies and corruption in the implementation of various welfare schemes. Food grains in the PDS are not yet a part of the proposed switch but some states, such as Bihar, Madhya Pradesh and Delhi, are conducting pilot studies and have expressed an interest in making that change.

3. Motivation

3.1 Conceptual Framework

A price discount with a quantity cap is typically represented by an outward shift of the budget constraint. Figure 1 presents this shift in the household budget set with food on the horizontal axis and the rupee value of non-food consumption on the vertical axis. Let the price of non food purchases be normalized to Re 1. A subsidy comprising a discount of δ and a quota Q shifts the budget set from NF to NCD. As demonstrated in Moffitt (1989) and Deaton (1984), the household will choose segment I if its indifference curve is tangent at any point (say, A) on the segment CD and a similar argument holds for tangency on segment II. If tangency is not achieved on either segment, the household will choose the kink C. The food subsidy program in India varies geographically and by family size in the amount of the quota, the discount and the resulting value of the subsidy. Following Kochar (2005) and Khera (2011c), these program rules are presented below by slightly modifying the standard utility maximization problem.

Let the utility function for household i be $U_i = f((1-\alpha)x_i + y_i, z_i; T_i)$, where x_i represents the subsidized food, y_i represents food purchased from the market, z_i is non-food purchases and T_i denotes tastes which could depend on age, gender, composition and other household characteristics. The subsidized and market food purchases are substitutes and α $(0 \leq \alpha \leq 1)$ represents any (multiplicative) transaction costs associated with buying the former. Let p_x, p_y and p_z be the prices faced by the household where p_x= $(1-\delta)p_y$ with δ being the discount $(0 \leq \delta \leq 1)$. Let Q be the quota and M_i the household income. The household's maximization problem is:

$$\max_{x_i,y_i,z_i} f((1-\alpha)x_i + y_i, z_i; T_i)$$

subject to:

$$\begin{aligned} p_x x_i + p_y y_i + p_z z_i &\leq M_i \\ x_i &\leq Q \\ x_i \geq 0, y_i \geq 0, z_i &\geq 0 \end{aligned}$$

The resulting Lagrangian is:

$$\begin{aligned} \mathcal{L} = \max_{x_i,y_i,z_i,\lambda,\gamma,\mu_1,\mu_2,\mu_3} & f((1-\alpha)x_i + y_i, z_i; T_i) + \lambda(M_i - p_x x_i - p_y y_i - p_z z_i) \\ & +\gamma(Q - x_i) + \mu_1 x_i + \mu_2 y_i + \mu_3 z_i \end{aligned}$$

Solving the first order conditions provides the demand functions for specific parameter values. The solution (x_i^*, y_i^*, z_i^*) will belong to one of the following four cases.

Case 1 : $x_i^* = 0, y_i^* \geq 0, z_i^* \geq 0$
$\alpha > \delta$, $\frac{MU_y}{MU_z} = \frac{p_y}{p_z}$ *(First order conditions)*
Transaction costs (α) far outweigh the discount benefit (δ) and the household does not make any purchases from the PDS (i.e. non participation).

Case 2 : $0 < x_i^* < Q, y_i^* = 0, z_i^* \geq 0$
$\alpha < \delta$, $\frac{MU_x}{MU_z} = \frac{p_x}{p_z}$ *(First order conditions)*
The household meets its entire food requirement through the PDS and does not need to make any purchases from the market. This case is represented by point B in figure 1.

Case 3 : $x_i^* = Q, y_i^* = 0, z_i^* \geq 0$

$\alpha < \delta, \frac{MU_x}{MU_z} > \frac{p_x}{p_z}, \frac{MU_y}{MU_z} < \frac{p_y}{p_z}$ *(First order conditions)*

The household would like to purchase more food at the discounted rate, but not at the market price. This case refers to point C in figure 1, i.e. locating exactly at the kink.

Case 4 : $x_i^* = Q, y_i^* > 0, z_i^* \geq 0$

$\alpha < \delta, \frac{MU_y}{MU_z} = \frac{p_y}{p_z}$ *(First order conditions)*

The quota is binding and the household supplements its food with market purchases. This is represented by point A in figure 1. Note that voluntary under-purchase, where $0 < x_i^* < Q$ and $y_i^* > 0$ could take place if $\alpha = \delta$. However, this will never occur if there is even an infinitely small (ϵ) fixed cost associated with going to the fair price shop and thus, under-purchase is likely driven by supply issues and collapses to case 4.

3.2 Expected Effect of the PDS

Post 1997, both the discount and the quantity cap in the PDS for BPL families were substantially increased. Khera (2011c) finds that participation in the program has dramatically risen since the early 2000's. She confirms that the conditions for case 1, where eligible households make no purchases from the PDS, are unlikely to be realized. Cases 2 and 3, where households make purchases from the PDS but none from the market are also unlikely to be relevant. The PDS is intended as a supplementary program and does not seek to meet the entire food requirement of beneficiary households (Government of India, 2011). Kochar (2005) and Khera (2011c) find that the quota is low enough to necessitate supplementary purchases of food from the market for all households. The data from the NSSO surveys also confirm that cases 1-3 are not supported. As shown ahead in section 4, PDS rice accounts for less than 8% of the total food expenditure and all PDS beneficiary households make food purchases in the market.

The special case of households voluntarily under-purchasing from the PDS and buying additional food in the market is also not likely to hold. Khera (2011c) finds that the quantity of cereal purchased from the PDS does not respond to income, but overall cereal purchase does. She also checks for the impact of other household characteristics on PDS purchases and finds no effect. She concludes that under purchase is largely driven by supply side issues. [5] Thus based on program rules, past studies and summary statistics, the most relevant case is 4, where the subsidy can be viewed as providing extra income to the household. This extra income is given by the horizontal distance FD in figure 1: $S_i = (p_y - p_x)Q$.

For a low enough quota and transaction costs less than the discount, the quota will bind and the household will purchase food and other items in the market. To see this, consider a Cobb-Douglas utility function of the form $f = ((1-\alpha)x_i + y_i)^{1/2} z_i^{1/2}$.The solution to the household's problem is:

$$y_i^* = \frac{M_i - Q(2-\alpha-\delta)p_y}{2p_y}, z_i^* = \frac{M_i + Q(\delta-\alpha)p_y}{2p_z}, x_i^* = Q$$

conditional on:

$$Q < \frac{M_i}{(2-\alpha-\delta)p_y} \qquad \textit{(Quota < threshold value)}$$

$$\alpha < \delta \qquad \textit{(Transaction costs < discount)}$$

The total food consumption ($F_i^* = y_i^* + Q$) is:

$$F_i^* = \frac{M_i + Q(\delta-\alpha)p_y}{2p_y}$$

where $\frac{\partial F_i*}{\partial Q} > 0$, $\frac{\partial F_i*}{\partial \delta} > 0$ and $\frac{\partial F_i*}{\partial \alpha} < 0$.

Thus, the total food consumption is an increasing function of the quota and discount, and a decreasing function of transaction costs. This motivates the use of a regression framework taking into account the program rules, value of

[5] This is supported by data from the India Human Development Survey (2005), where over 57% of poor households report supply side constraints as the primary reason for not accessing the PDS in the last 6 months.

the subsidy, transaction costs and tastes. Inefficiencies and corruption in the administration of the program would manifest in the form of a higher α (poor quality, long waiting time, inconvenience, distance to FPS) or a lower actual Q (supply side constraints).

3.3 Evidence on Food Subsidies and Nutrition

Food subsidies are an important policy tool and their impact on household outcomes such as nutrition, caloric intake, early life development and income stabilization has been examined in both developed and developing countries. The national food stamps program (FSP) in the US (renamed SNAP in 2008) has been studied extensively. Between 1961-75 the program was phased in with different counties adopting it at different times. Hoynes and Schanzenbach (2009) exploit this difference in timing to evaluate the impact of the program and find that it led to an overall increase in food expenditures, as expected. Butler, Ohls and Posner (1985) find very small effects of the FSP on the nutrient intake of the eligible elderly, either through stamps or cash.

Despite lower per capita incomes and greater malnutrition, most studies in the context of developing countries also find very small effects of food subsidies on nutritional outcomes. Jensen and Miller (2011) conduct an experiment in rural China to estimate the impact of price subsidies for rice and wheat and find no evidence that subsidies improve nutrition. Laderchi (2001) finds that food transfers are no more successful at improving child nutrition than other sources of income in Peru. In a survey of 300 households in Rajasthan, Khera (2011c) finds that being eligible for PDS food grains does not lead to higher overall cereal consumption. Kochar (2005) uses the change in 1997 from universal to targeted PDS to estimate the impact on calories consumed by rural households. She finds that the elasticity of caloric intake with respect to the value of the subsidy is very low (0.06 on average.) Tarozzi (2005) studies a sudden increase in the price of PDS rice in Andhra Pradesh and concludes that it did not have a big impact on nutritional status and child anthropometrics.

While the effect of the PDS on nutrition has been found to be quite small, some limitations of the identification strategies used in previous studies could cause their results to be biased in the direction of finding no effect.[6] Kochar (2005) uses variation in the value of the subsidy that is determined by BPL status. The measure of eligibility for the newly targeted program (BPL status) is imputed and not actually observed in the data which results in errors of mis-classification. In practice, BPL status is determined using individual poverty scores and region specific cut offs, both of which vary over time. Even within a particular region, imputing BPL status using multi-dimensional indicators of poverty is problematic. Niehaus et al. (forthcoming) survey households in Karnataka which were identified as potential PDS beneficiaries in the government BPL survey. Using the criteria for 2007 (based on eight measures), they find that 13% of eligible households do not possess a BPL card, while 70% of legally ineligible households do. Thus any exercise in imputing BPL status will have significant mis-measurement resulting in biased estimates. Further, the time frame of Kochar's study is two to three years before and after the targeted program was introduced. Take up rates were low (6%- 14%) during that time and the program was much less generous. Since 1997 and particularly during the early 2000's, the PDS has undergone enormous changes. There has been a push to increase the value of the subsidy to BPL households and participation in the PDS has gone up.[7] Finally, Kochar's analysis also suffers from a bias in the opposite direction. Since BPL status is a prerequisite for

[6]Jensen and Miller (2011) raise similar concerns regarding the methodologies employed by Kochar (2005) and Tarozzi (2005).

[7]Round 61 (2004-05) of the NSSO surveys provides information about the BPL status of a household. The data from this round suggest that participation is not driven by income or idiosyncratic household characteristics that could potentially affect food consumption. 68% of BPL households in 2004-05 report having accessed the PDS in the last 30 days. In data from the India Human Development Survey (2005), over 95% of BPL households report having accessed the PDS in the last 6 months. Thus, as the value of the program to BPL households has increased, there has been a corresponding increase in participation. Non-BPL participation in the PDS has fallen dramatically. In the 2004-05 round of the NSSO surveys, 0.06% of PDS users were non-BPL. This decline has also been noted by Khera (2011a).

other types of government assistance, using the BPL dummy could confound the effect of the PDS with the impact of other government programs such as loans, scholarships and medical benefits. Khera's (2011c) study also uses variation due to BPL status, and does not exploit differences in the value of the subsidy. Tarozzi's (2005) analysis uses data from 1992 and focusses on anthropometrics for children below age 4 during the pre targeted PDS; identification comes from variation in the length of exposure to higher PDS prices but does not use differences in the quantity entitlement. The length of exposure is limited to one to three months and the data do not provide information on PDS participation. This paper adds to the literature by being the first to compute a household specific value of the subsidy using state level program rules and local market prices.

4. Data and Empirical Strategy

4.1 Data and Sample

The National Sample Survey Organisation (Ministry of Statistics and Program Implementation) has conducted socio-economic surveys every one to two years since the 1950s. The surveys are repeated cross sections and collect detailed expenditure information. They are nationally representative, conducted year round to avoid seasonal biases and form the basis for the government's official poverty estimates. The NSSO data have been used to study the PDS and other national programs such as the employment guarantee scheme as well as issues of inequality, poverty and land relations (Kochar 2005, Khera 2011a, Dutta et.al 2012, Deshpande 2000 and Sundaram and Tendulkar 2003). This paper uses six years of data from July 2002 to June 2008.[8]

[8]In 2002, PDS allocations were increased from 20 kg to 35 kg per family, per month in most states. Some states started making changes (increases and decreases) in PDS quotas and eligibility in 2008, implying a change in the composition of beneficiaries over time. I avoid problem associated with imputing BPL status and focus on the period between 2002 and 2008 for which reliable state level program rules are available to ensure comparability within the group of beneficiaries.

The NSSO surveys split expenditure data into several sub categories such as food items, beverages, durable goods, medical expenditure, educational expenditure, conveyance and rent. Other variables include family size, number of children, industry classification of the head of the household, location, land owned, own production, type of dwelling, religion and social group. Data are collected on the age, gender, education level, marital status and relation to the head of each household member. For goods that are available through the PDS, households report spending in terms of cost and quantity separately for PDS and non-PDS sources. This enables the classification of households into PDS beneficiaries and non-beneficiaries based on actual utilization as opposed to imputing BPL status. The final analytic sample for this paper comprises the current participants of the PDS.[9]

Regional preferences for cereals are distinct and strong in India. Atkin (forthcoming) proposes climatic conditions and habit formation as possible reasons for these distinct tastes and previous studies on the PDS (Kochar 2005, Khera 2011c) have focussed either on rice or wheat. Following the literature, I consider the eight states (151 districts) that have rice as their dominant staple and a generous rice subsidy. These states offer a very small or no subsidy for wheat. Though the main focus is on rice, the wheat subsidy in these states is used as a validity check and is found to have a very small impact. Due to data availability and reliability issues, it is standard practice to focus on the major Indian states. Tamil Nadu, a state in southern India, is distinct from the rest of the country in that it has a universal PDS. All households, irrespective of their income, are eligible for the program, making it difficult to compare their outcomes with the rest of the country since the impact at the bottom of the income distribution could be very different from its impact at the top. Thus, in the absence of a credible way to classify households into BPL and APL, and given that the program is so different in this one state, I drop Tamil Nadu

[9] As discussed earlier, non participation in the PDS is not likely to be driven by household specific factors. To the extent that some fraction of households with BPL cards do not make PDS purchases, strictly speaking, my analysis estimates the effect on eligible households that participated in the program in the last 30 days.

from the sample. The states in the final sample are: Andhra Pradesh, Assam, Chattisgarh, Jharkhand, Karnataka, Kerala, Orissa and West Bengal. As a robustness check, I estimate the impact of the program in all the major Indian states. As expected, the rice subsidy has a much smaller impact in the non-rice favoring states. Aside from regional preferences, the rice subsidy specifically is of interest because there is some evidence that rice may be a giffen good for poor households (Jensen and Miller 2008). Finally, the rice subsidy in India is cleaner to study because the amount of illegal diversion of wheat grains is much higher (Khera 2011a).

Prices are computed using households' reported expenditures and quantities for over 150 food items. For every item, prices can be determined by dividing expenditure by quantity. Though technically speaking these are unit values, which can give rise to measurement error and concerns of differentiated products in terms of quality, it is common in the literature to use them as proxies for prices (Subramaium and Deaton 1996, Kochar 2005, Atkin 2013). In the context of this study, these issues pose much less of a threat because prices for PDS and market rice are computed by averaging the district-season-year specific price as reported by BPL households.[10] Each household is assigned this average price and not its self reported unit value. Further, only prices reported by similar households, i.e. beneficiaries of the PDS, are used to compute the local average price. Thus the local average does not include prices paid by much wealthier households, who might be purchasing higher quality rice. Following Atkin (forthcoming), median local prices are used to calculate the value of the subsidy as a check. The results are robust to using median prices, which are not likely to be influenced by outliers. All prices are in 2005 rupees.

The conversion of food purchases into per capita caloric intake is done using standard factors (NSSO 1996) for each of the food items in the survey and to-

[10] Every NSSO survey period (one year) is subdivived into four or six sub-rounds/waves. This is done to ensure that seasonal patterns in consumption can be studied.

tal monthly household calories are converted into per capita daily amounts.[11] While this may not be ideal due to potential differences between purchases and actual intake, it is an approximation used not just in the literature, but also by the government to estimate the income poverty line based on caloric intake. Deaton (1997) discusses the merits and limitations of several types of equivalence scales to convert household consumption into per person quantities. For practical applications, a simple weight is suggested as a reasonable approximation. All per capita values are thus calculated using an equivalence scale that assigns 0.5 weight for children below 15 years. This allows for a correction in the per capita amounts for larger families that are likely to have more children (who consume fewer calories).

4.2 Variation in Value of the Subsidy

The value of the subsidy for each household is calculated as the product of the local price discount and the state specific per capita quota. The discount is the difference between the average market and average PDS price, at the district-season-year level. The quota is calculated based on program rules of the state of residence and household size.[12]

$$PerCapValSub_{ijswt} = (P^{mkt}_{jwt} - P^{pds}_{jwt}) * Q_{is}$$

where i= household, j= district, s= state, w= season, t= year and Q_{is}= state-household size specific quota for household i.

Prices

Recall that the central government sets a PDS price for the year and states are allowed to add transport and distribution costs to the final price that

[11] Subramanium and Deaton (1996) attempt to correct this conversion from the NSSO surveys to account for the number of meals given to guests. However, since there is no way to determine the composition of those meals, caloric consumption from different food groups is not adjusted and neither is the expenditure.

[12] As discussed ahead, I use the national average family size to compute the value of the subsidy for every household as a robustness check.

households pay. The PDS price is not indexed to market prices, which are in turn determined by demand and supply side factors.[13] The diverse nature of India's terrain and climate combined with its large area results in substantial geographic variation in the prices of agricultural commodities. As discussed in Jacoby (2013), controls on the inter state trade of food grains lead to substantial differences in prices across states. Deaton (1997) finds important interregional differences in prices using NSSO data. Kochar (2005) and Atkin (forthcoming) ascribe the within state, inter district variation in market prices of food grains to transportation costs and state specific market controls. Agricultural prices also vary by season and as a result of local conditions and unpredictable weather phenomena.[14] Thus, as a result of the government's policy of maintaining a fixed (within year) PDS price across regions in India, the difference between the market and PDS price varies for every district-season-year cell.[15]

Table 2 presents the spread of the discount across and within states for different seasons. The state level average discount varies between 38% (Assam in the monsoon season) and 67% (Karnataka in winter). These rates are in line with the government's policy of offering food grains at approximately half of the procurement cost. Within any particular season and state, there is substantial variation in the district level discount. Figure 2 confirms this variation

[13] Accoridng to SEWA (2009), 31% of respondents in Delhi report that PDS prices remain low, but market prices keep rising.

[14] Wadhwa (2001) details the restrictions on the marketing and movement of agricultural goods in India. Planning Commission's (2001) extensive study on the price behaviour of rice and wheat confirms seasonality of prices. Sekhar (2003) reports a higher intra year variability in domestic agricultural prices as compared to international prices which suggests incomplete integration of markets within the country.

[15] Antyodaya households are identified as being the poorest of the poor and they pay even lower prices. In round 61 (2004-05) of the NSSO surveys and the IHDS (2005), these households are identified and summary statistics confirm that they pay 30% lower prices on average at the PDS shop (See Appendix Table C, available on request). They comprise less than 10 % of the BPL sample in my data. In the full dataset, it is not possible to identify these households and this source of variation is not explicitly used in the analysis. As a check, I use data from round 61 to include an interaction between the value of the subsidy and an Antyodaya dummy and find no evidence of a differential impact of the subsidy.

graphically for each district-season-year cell in the sample. Panel A plots the discount data from 2002 for each of the 151 districts in the sample. There is heterogeneity within states in the discount across districts. For instance, in 2002, the discount in Assam varies from 15% to about 45% in the monsoon season, with a state level average of 38%. The average discount in Andhra Pradesh is 55% but the spread (47% to 65%) is much smaller as compared to Assam. A similar pattern of within state variation in the seasonal discount is seen for the other six years (panels B to G, Figure 2) .

Quotas

Different states set different quotas for rice and wheat ranging from 0 to 35 kg per household per month, as shown in Table 1. Some states do not index the quota to household size and for those that do, there is an upper limit on the maximum amount (except in West Bengal). Thus the per person quota varies by household, depending on its size and state of residence.[16]

Table 3 combines the two sources of variation and presents the spread of the per capita value of the subsidy for the sample under study. As expected, the spread of the per capita value (standard deviation) is the smallest in West Bengal and Andhra Pradesh, both of which index the subsidy to household size. The average subsidy in West Bengal is less than half of the subsidy in Andhra Pradesh. Overall, the value varies across seasons, states and within states.

4.3 Descriptive Statistics

Table 4 presents descriptive statistics for PDS users and the full NSSO sample averaged over all six years. The monthly per capita expenditure for PDS users is lower than that for the full sample, as expected. The average per capita caloric intake for PDS users is 2190 kcal. Given that over 78% of PDS users live in rural areas, this average is well below the minimum daily require-

[16] An examination of the average quantities bought via the PDS confirms that this variation is realized in practice (See Appendix Table A, available on request).

ment (2100 kcal for urban and 2400 kcal for rural areas). PDS users spend a higher fraction of their total monthly expenditure (58%) on food. Scheduled Caste/Scheduled Tribe/Other Backward Castes comprise 76% of PDS users.

The PDS price is 50% lower than the market price. On average, each household buys more rice in the market than what they receive through the program – the PDS contributes 41% of the total rice consumed.[17] Thus, the PDS is an important source, but not one that meets the entire food requirements of the household; almost three-fourths of the total food expenditure is on items other than rice. Per capita cereal expenditure is a little over one fourth of food expenditure, but cereals contribute over 72% of the total calories consumed.

4.4 Empirical Specification and Assumptions

The basic equation to estimate the impact of the subsidy on household outcomes is

$$Y_{ijswt} = \alpha + \beta PerCapValSub_{ijswt} + \mathbf{X}_{ijswt}\gamma + \delta_j + \chi_w + \theta_{st} + \varepsilon_{ijswt} \quad (1)$$

Y_{ijswt} represents the outcome variable (such as per capita caloric intake) for household i in district j, state s, season w and year t. $PerCapValSub_{ijswt}$ is the per capita value of the subsidy to the household based on program rules and local prices. $\mathbf{X}_{ijswt}$ is a vector of household characteristics, δ_j and χ_w control for district-specific and seasonal effects respectively, and θ_{st} are state*year dummies. Standard errors are clustered at the district level, as all households in a district are subject to the same rules determining the per person monthly quota.

Household characteristics in $\mathbf{X}$ include education of the head of the household and the spouse, a quadratic in the age of the household head, the proportion of females in the household, land holdings (proxy for income) and urban

[17]The fact that households purchase over 50% of their rice at market prices suggests that resale of PDS rice through consumers is not a serious concern.

location. Behrman and Deolalikar (1988) provide a comprehensive review of the literature on the demand for nutrients in developing countries and find that education levels, size and demographic composition of the households are important determinants of the demand for calories.[18] While most studies on the PDS have focussed on the rural poor, the program is also critical in urban areas and the nutritional needs of households in the two areas are very different. District and seasonal dummies are included to take regional and climatic effects on the demand for calories into account. The model is saturated by introducing state*year dummies that control for any differences in state level effects and other assistance programs that BPL households in a particular state might be eligible for. With district, season and state*year controls, any variation in the price discount is due to shocks to prices as a result of random weather phenomenon, arbitrary controls on the movement of goods and imperfectly integrated agricultural markets.

The parameter of interest from equation (1) is β, the coefficient on the value of the subsidy. The validity of the model rests on the assumption that after controlling for household characteristics and geographic and seasonal effects, the value of the subsidy (price discount* quota) is exogenous to unobservable factors that may affect the demand for food. If this assumption holds, the value of the subsidy should have a negative (through market price) or zero effect on the caloric consumption of households that do not use the program. To check for this, I perform a falsification test using non-PDS users.

The analysis makes two other substantive assumptions. First, the model as-

[18]Though the dependent and main explanatory variable in equation (1) are both in per capita terms, there may still be economies of scale within a household that are not accounted for by this specification. I check for any effect of household size in the following ways. First, I use an alternative weighting scheme to generate per person variables for the household. Second, I use household level caloric intake and value of the subsidy to estimate the impact and explicitly control for family size. Third, I shut down the variation due to family size by using quotas based on the national average family size. Finally, even though household size as a regressor in equation (1) is potentially endogeneous, as an additional check, I find that adding size to the regression does not qualitatively change the results.

sumes that household size is exogenous to the state level quota, i.e. households do not adjust family size according to more or less generous program rules. While the program is important, it is not likely to affect the fertility or migration decisions of households. On average, the value of the subsidy is 4% of the total monthly expenditure of the household. I check for the validity of this assumption by using the national average family size instead of the actual size of the household to compute the value of the subsidy and find that the results remain qualitatively the same. I also check for the independent effect of family size by using total household caloric intake as the outcome and explicitly controlling for family size. Second, the analysis assumes that the demand for calories or rice by any one household does not affect the market price that it faces i.e. the local price in its district-season-year cell. In the absence of this assumption, the coefficients would suffer from simultaneity bias. Treating the household as a price taker is a standard assumption from the theory of competitive markets. The agricultural market in India has thousands of producers and consumers, which makes this assumption fairly reasonable in the context of this study.

5. Results

5.1 Impact on Cereal Consumption and Caloric Intake

To study the impact of the PDS on nutrition, three outcome variables are considered: per capita cereal consumption, per capita caloric intake and per capita calories from different food groups. Cereals are a cheap and critical source of calories and the PDS is responsible for providing a substantial amount of cereals to vulnerable households.[19] Column 1 of Table 5 presents results for the main specification with per capita cereal intake as the outcome variable. An increase in the monthly subsidy by Rs 10 leads to a 20.3 gm (60 kcal/day) increase in the daily consumption of cereals. Based on average market prices,

[19] Most cereals have 3-3.5 kcal/gm. See Appendix Table B, available on request, for a comparison of the price per calorie for different food groups.

Rs 10 (per month) can buy an extra 30.2 gm of cereals every day. This suggests that infra marginal households prefer to spend part of the extra income on foods other than cereals or on non-food items. The specification in column 1 assumes that an (absolute) increase in the value of the subsidy has the same effect, irrespective of the base value. Evaluated at the means, the estimate from column 1 implies an elasticity of 0.12, which is similar to the estimate from the log-log regression in column 2– 0.123. Given that the elasticity is small and the sample comprises only BPL households, it is not surprising that the estimates are so close.[20] Though small, the elasticity is positive and significant and confirms that the subsidy has a real impact on cereal consumption, as expected. In order to examine the impact of each of the components of the subsidy and determine their relative importance, column 3 splits the value of the subsidy into quota, prices and interaction terms. The coefficient on quota is insignificant, confirming that households are infra-marginal since the amount of the quota doesn't determine overall cereal consumption. The coefficient on market price is negative, as expected. The interaction between the amount of the quota and the market price is positive and significant, suggesting that a higher quota increases cereal consumption more, and is thus more valuable, when the market price of rice is higher.

Though the estimates suggest that the program has a positive effect on cereal consumption, households may be substituting some of the income gains away from cereals. Combining the analysis for calories with the results on cereals helps to determine the impact on overall food intake. Column 1 in Table 6 indicates that a Rs 10 increase in the value of the rice subsidy results in an increase of 126 kcal/day.[21] This is more than double of the impact on

[20] The levels estimate assumes that the impact of an absolute increase in the value of the subsidy is independent of where in the distribution the household is located (linear relationship). In this sample, households are similar to the extent that they all lie below the poverty line and receive a positive food subsidy. The log-log specification assumes a non-linear relationship and a constant elasticity. However, for an elasticity of 0.12, the resulting curve is very flat, i.e. almost linear, over the range of the value of the subsidy, cereal consumption and caloric intake.

[21] In order to compare the estimates, I convert the gains in daily cereal consumption from Table 5 into caloric gains. The 95 % confidence interval from Table 5 implies an increase

calories through increased cereal consumption (60 kcal/day from by column 1 in Table 5), suggesting that the subsidy works by increasing calories through not just cereals, but other foods as well. This is an important indicator that households benefit from the program in terms of overall food intake and not just through the food grains directly provided by the PDS.

Table 6 also presents estimates of the cross food group elasticities. In China, Jensen and Miller (2011) find negative effects of a pure price subsidy for rice on fruits and vegetables and on pulses (lentils). In contrast, all elasticities here are positive and significant. Thus, the results suggest that provision of a food subsidy via quotas has a positive impact on all food groups, similar to what would be expected from an income transfer whereas the pure price subsidy causes households to consume less of the subsidized good and fewer overall calories.

5.2 Comparison with the Expenditure Elasticity of Calories

The PDS subsidy is supplementary in nature and thus is expected to operate through the income effect. The elasticity of calories with respect to the value of the subsidy is 0.144 from column 2 of Table 6. Though small, it lies between the historical estimates of income elasticity of calories for India, which range from 0 to 0.34. Behrman and Deolalikar (1990) find the income elasticity of calories for rural south India to be very low: 0.01. Subramanian and Deaton (1996) use NSSO data and report an expenditure elasticity of calories of 0.34 for rural households. To compare my results with these earlier studies, I estimate the elasticity of calories with respect to total expenditure for rural PDS households in my sample. The expenditure elasticity is close to the higher estimates in the previous literature: 0.4 from column 1 in Table 7. Even though the elasticity of caloric intake with respect to the subsidy is lower than the expenditure elasticity (0.140 for the rural sample), it is still positive and significant. The lower value of the elasticity of caloric intake is

between 51 kcal/day and 69 kcal/day. This does not overlap with the confidence interval from Table 6 which is 104 kcal/day to 148 kcal/day. Thus, the overall gains in caloric intake are greater than the increase in calories from cereals alone.

not surprising for two reasons: First, transaction costs associated with going to the fair price shop, such as irregular supply, inconvenient timings and long queues would make the impact of the subsidy smaller. A pure increase in income does not have any such costs associated with it. Second, this estimate takes into account leakages and inefficiencies in the system since it is based on actual program rules.

The fact that the PDS acts like an income transfer raises the question of its impact on price paid per calorie i.e., the extent to which a rise in income induces households to sacrifice caloric intake for more expensive and less calorie rich foods. Behrman and Deolalikar (1989) suggest that the income elasticity of calories is smaller than the income elasticity of food expenditures because of changes in the shape of the food indifference curve as income rises. They find that even relatively poor households value variety. Subramanian and Deaton (1996) report the total expenditure elasticity of expenditure on food as 0.75 and the elasticity of price paid per (1000) calories as 0.35. These numbers are very close to the estimates for the sample used in this paper (columns 3 and 5 in Table 7). The elasticity of food expenditure with respect to the value of the subsidy is lower at 0.146, but it is positive and significant. The subsidy elasticity of price per calorie is not significantly different from zero. Thus the value of the subsidy is not large enough to raise concerns of households sacrificing calories for taste.

One issue with the NSSO data (and any estimates based on them) is that they do not contain information on income. Table 8 presents alternate estimates of the elasticity of cereal consumption using income data from the India Human Development Survey 2005.[22] The survey is nationally representative, covers 41,554 households and collects detailed household information on demographics, income, debt, insurance and consumption. The income elasticity of cereals for PDS users is much lower (0.046 in column 1, panel A of Table 8) than the elasticity with respect to the rice subsidy which is 0.295 in column 2. The income elasticity of food expenditure is also much lower than the elasticity of food expenditure with respect to the value of the subsidy from columns 3 and 4 of panel A. While income is a reflection of more permanent

[22]This survey is jointly conducted by National Council of Applied Economic Research in Delhi and the University of Maryland (Desai, Vanneman, & National Council of Applied Economic Research, 2005). I use the IHDS dataset to construct variables that are identical to variables from the NSSO data. I also restrict the sample to the eight rice favoring states used in the main analysis.

characteristics of a household such as age and education of the head, location and occupation, the value of the subsidy fluctuates from month to month depending on market prices. Not all income is consumed, part of it saved or used to purchase durable goods, thus it is not surprising that an increase in the value of the subsidy has a bigger impact on cereal consumption than an increase in income. Further, income tends to be under-reported and the resulting measurement error would bias the estimates downwards.

The IHDS dataset allows me to check if the household characteristics used in the main regression are a valid control for income. Column 2 of panel A in Table 8 estimates the elasticity with respect to the value of the subsidy controlling for income, location, district and season effects. In column 3 of panel B, I run the same regression, but instead of explicitly including income, I add the education of the head of the household and the spouse, a quadratic in the age of the household head, the proportion of females in the household and land holdings. The estimates are similar, which validates the use of these characteristics in place of income.

The food module of the IHDS surveys is similar to the NSSO, but is much less detailed. To check for any effect of differences in survey methodologies, in panel B of Table 8, I estimate identical regressions for the IHDS and data from the NSSO covering the same time period (November 2004 - October 2005). The estimates for expenditure elasticity of cereals from the two datasets are similar: 0.247 and 0.269 in columns 1 and 2 of panel B.[23] The estimates of the elasticity of cereal consumption with respect to value of the subsidy across the two samples (panel B columns, 3 and 4) are also similar, though the IHDS estimate is slightly larger. The NSSO sample is larger than the IHDS, but the two don't differ on observable characteristics.[24] PDS prices are lower, and consequently the subsidy value is marginally higher on average (Rs 25.46) in the IHDS sample as compared to the NSSO data (Rs 24.17). While it is difficult to say with certainty why the estimates differ, the IHDS results do not qualitatively change the implications of the main analysis. At best, they suggest that the estimates from the NSSO data may be a lower bound on the

[23]The expenditure elasticity of cereal consumption (column 2 of panel B, table 8) is lower than the expenditure elasticity of calories (column 1, table 7). Deaton and Drèze (2009) find a similar pattern and attribute it to the fact that a higher fraction of the marginal rupee spent on food goes towards non-cereal food items.

[24]Appendix Table D, available on request, presents descriptive statistics for the two samples.

impact of the program.

5.3 Heterogeneous Impacts

Households that benefit from the PDS are similar to the extent that they all lie below the poverty line. However, the program could have differential impacts on certain sub-groups of the population. Table 9 checks for heterogenous impacts of the subsidy on urban households, traditionally marginalized communities and farming households. While urban households face different patterns of price changes compared to rural ones and may have different mechanisms to cope with food insecurity, traditionally marginalized communities may face discrimination in terms of access to the program. Residing in an urban area has a negative and significant impact on cereal consumption (column 1). This is expected as urban calorie requirements are lower on average. However, the program does not have a significantly different impact in urban areas. From column 2, there is no significantly different impact for the Scheduled Caste/Scheduled Tribe/Other Backward Castes category.

Rice farming households may be more or less affected by market prices depending on whether they are net buyers or sellers in the market. The program has a strong, positive effect on the cereal consumption and caloric intake of farmers, i.e. households that report consuming some of their home grown rice (columns 3 and 6). Given that these households need to rely less on the market and are not likely to make cereal purchases, the subsidy acts like a direct in-kind transfer of extra grains. For the sample of farmers, Table 10 splits the subsidy into its components and confirms that market price alone is not a significant determinant of caloric intake (column 2) and marginally significant for cereal consumption (column 1). This is in contrast to results for the overall sample (column 3 of Table 5) where market price was seen to have a significant and negative impact. The interaction between market price and per capita quota has the expected positive sign and is significant.

5.4 Robustness and Sensitivity Checks

The identification strategy rests on the assumption that there are no underlying factors that simultaneously affect the value of the subsidy and food consumption of households. To test the validity of this assumption, I perform a falsification test by checking for the impact of the local average value of the PDS subsidy on the cereal consumption and caloric intake of households that do not receive subsidies from the PDS. From Table 11, it is clear that the program has no impact on the consumption of Non-PDS beneficiaries. The only (marginally) significant effect is the elasticity of cereal consumption. As expected, this is negative since a higher value of the subsidy (resulting from a higher market price of rice) would negatively affect cereal consumption of households that purchase cereals only in the market.

Table 12 presents results from a series of robustness checks. Concerns about the possible endogeneity of household size are addressed in columns 1 and 2. In column 1, the national average family size is used to calculate the value of the subsidy instead of the actual size and composition of each household. Column 2 presents the elasticity results at the household level, with a control for household size. The estimates from both are very close to the main result (0.144) which supports the assumption that household size is not influenced by the program. To check that the results are not driven by the equivalence scale used in the main analysis, column 3 uses a simple per capita estimate. The results remain qualitatively similar to those from the main analysis, though using a simple per capita without correcting for the composition of the household makes the elasticity appear larger. Averaging across the market price of rice within a district-season-year cell should not raise concerns of significant differences in quality, since households in the sample all lie below the poverty line. However, I check for this possibility by using the median prices to calculate the value of the subsidy and find that the results remain the same (column 4). Finally, I check the sensitivity of my results to seasonal price patterns by utilizing survey waves/sub-rounds. Replacing state*year and season dummies with state*survey wave dummies does not change the estimates, as seen in column 5.

Table 13 checks for the impact of the rice subsidy on three different samples – All India, the rice favoring states and non-rice favoring states.[25] The elasticity is much smaller in states where rice is not the main staple, even though some of them offer a small subsidy on rice, justifying the use of the smaller sample of rice favoring states to get a more valid estimate of the impact of the program.

5.5 Issues in Implementation and Policy Changes

Corruption

The PDS has been criticized for various types of inefficiencies and corruption and there are striking state-wise differences in implementation. Khera (2011a) estimates the extent of diversion in food grains using a combination of NSSO data and administrative records on grain allocation at the state level. She categorizes states into those that are performing (well) and others that are reforming or languishing. Table 14 presents results for the impact on cereal consumption and caloric intake. Of the eight states in the sample, three are categorized as functioning well: Andhra Pradesh, Karnataka and Kerala. Columns 1 and 2 suggest that the impact on cereals and caloric intake is almost 50% lower in states that are more corrupt.[26] This heavy cost of inefficiency is particularly troubling given the high levels of malnutrition that persist in India.

The National Food Security Bill

The PDS is the government's flagship program for improving nutritional outcomes and the National Food Security Bill (NFSB), passed in September 2013,

[25]The rice favoring states are: Andhra Pradesh, Assam, Chattisgarh, Jharkhand, Karnataka, Kerela, Orissa and West Bengal. The non-rice favoring states are: Bihar, Gujarat, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Punjab, Rajasthan and Uttar Pradesh.

[26]These estimates provide suggestive, not causal evidence of the effect of corruption as there could be many other state level factors that make the program less (more) effective in more (less) corrupt states.

plans to expand it further. Unless the enormous leakages in the system are plugged, the government will have to procure a much higher quantity of food grains (than the target) in order to have the intended effect on nutritional outcomes. A rough estimate of the impact of the NFSB can be made using price data, program rules and the elasticity estimates from this paper. The NFSB assures 5 kg of food grains per person per month to 67 % of the population at Rs 3 per kg for rice, Rs 2 per kg for wheat and Re 1 per kg for coarse grains. BPL households are currently eligible for an average of 4 to 5 kg per person per month. At current prices, it is estimated that the per kilogram subsidy will rise from Rs 13.5 to Rs 16.5 (The Financial Express, September 2013). Thus the NFSB does not substantially increase the quantity of food grains assured to BPL households, but it does entail a big increase in the price discount they receive. Combined with average caloric intake and current price data, the elasticity estimate from this paper suggests that the bill will lead to a per person increase of 72 kcal/day in rural areas and 66 kcal/day in urban areas for the current beneficiaries of the program.[27] This estimate is based on program rules and thus takes into account the leakages and inefficiencies in the system. If the expansion of the PDS is accompanied by better enforcement, especially in the more corrupt states, the impact will be even higher.

The bill will also expand the beneficiary pool of the PDS to include 67% of the population. While it is difficult to precisely predict how newly eligible households will respond to the subsidy, there is some evidence to suggest that there will be a positive effect (similar to that for current beneficiaries) on their caloric intake. Given that the new beneficiaries are likely to be better off, the subsidy will not be their primary source of food grains and thus, should have a positive effect on caloric intake through the standard income effect. This hypothesis is supported by the results in Table 11, which show that the elasticity of caloric intake is higher for households in the higher expenditure quartiles.

[27] This estimate uses the approximate caloric intake of PDS rice users in rural (2260.25 kcal/day) and urban areas (2076.5 kcal/day) from the 2009-10 round of the NSSO Surveys (Government of India, 2013).

There is a concern that expansion in the reach of the program could result in the inclusion of some households that have an income high enough to make the relative value of the subsidy too insubstantial to have an effect. These households are also likely to have lower rates of participation, which would further reduce the overall impact of the program on caloric intake. Neither of these concerns is found to relevant in Tamil Nadu, which is the only state in India that has a universal PDS. The participation rate for the entire population of the state (averaged over the six years) is high (61%) and the elasticity of caloric intake with respect to the value of the subsidy is 0.2, which is higher than the national average (0.144). Tamil Nadu has a well functioning PDS and the data from this state suggest that if implemented well, the program can have a substantial impact on caloric intake for a wide range of households.

6. Conclusion

This paper examines the Indian Public Distribution System and presents evidence of its impact on nutrition using variation in state specific program rules and fluctuations in local market prices. In agreement with the literature on food subsidies, the elasticities for cereal consumption and calories with respect to the value of the subsidy are small. However the results indicate that households benefit from the program in terms of food intake (calories) and not this is not just through the food grains (cereals) directly provided by the PDS. Even though the program provides a subsidy only on cereals, it has a positive effect on the consumption of different food groups. Thus, the PDS subsidy generates an income effect for households and is effective in improving nutrition. The results also confirm state wise differences in the functioning and impact of the PDS. Finally, the elasticity estimates suggest that the implementation of the National Food Security Bill will lead to an increase of 66 - 72 kcal in the daily caloric intake of current beneficiaries of the program.

Some states and regions in India have had much more success in implementing the PDS than others. The Indian Human Development Survey is a rich socio-economic dataset that makes it possible to study these regional differences in more detail. In additional to details on household expenditure, income and fertility, indicators for learning skills and anthropometrics for children are also collected. Examining district level outcomes using participation and average value of the subsidy would be an additional dimension to studying the PDS. This would speak to the significant geographic differences that have been noted in the functioning of the system. Another unexplored aspect of the PDS is the protection it provides from fluctuations in market prices. This would be an interesting angle to assess its value as a source of food security. Reduced exposure to market risk could also affect a households investments and labour market choices.

The PDS has been the topic of a lot of debate. The National Food Security Bill, which was passed in September 2013, will give two thirds of the population the legal right to obtain 5 kg of food grains (per person per month) at prices between Re 1 and Rs 3 per kg. The bill also has implications for intra-household bargaining, since it makes the eldest woman in the household responsible for accessing the PDS on behalf of her family. Given the enormous scale of the PDS, its expansion and imminent overhaul, it is important to study the impact that it has in its present form.

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Figure 1: Impact of a food subsidy on the budget set

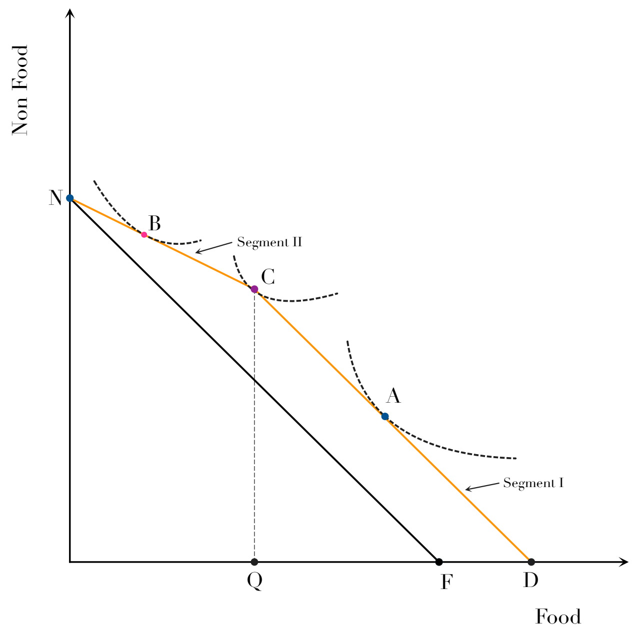


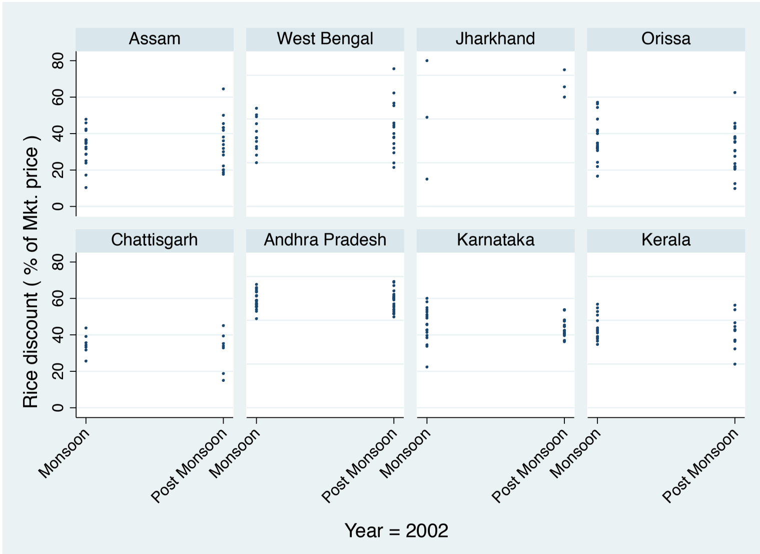
Table 1: State Specific PDS Quotas for BPL households (2002-2008)

State	Rice (kg)	Wheat (kg)
Andhra Pradesh	4 per person (20 hh max)	5 (at APL price*)
Assam	20	0
Bihar	15	15
Chattisgarh	25	0
Gujarat	1 per person (3.5 hh max)	1.5 per person (9 hh max)
Haryana	10	25
Himachal Pradesh	15	20
Jharkhand	35	0
Karnataka	16	4
Kerala	8 per adult 4 per child (20 hh max)	5 (at APL price*)
Madhya Pradesh	6	17
Maharashtra	5	15
Meghalaya	2 per person	0
Orissa	16	0
Punjab	10	25
Rajasthan	5	25
Uttar Pradesh	20	15
West Bengal	2 per person	2 per person

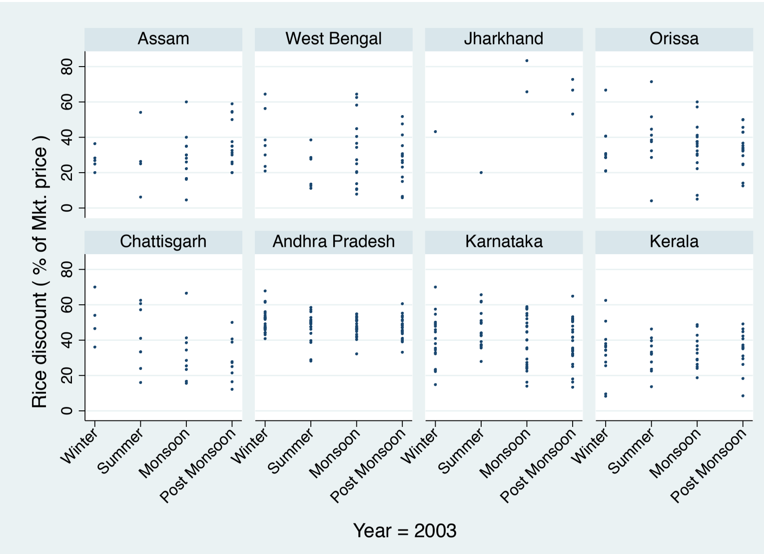
Sources: Planning Commission (2005), Khera (2011b) and *Simplifying the food security bill*at $http://bit.ly/PM_NFSB$ Note: * denotes no price discount for any household.

Figure 2: Variation in PDS rice discount (2002-2008)

Panel A



Panel B



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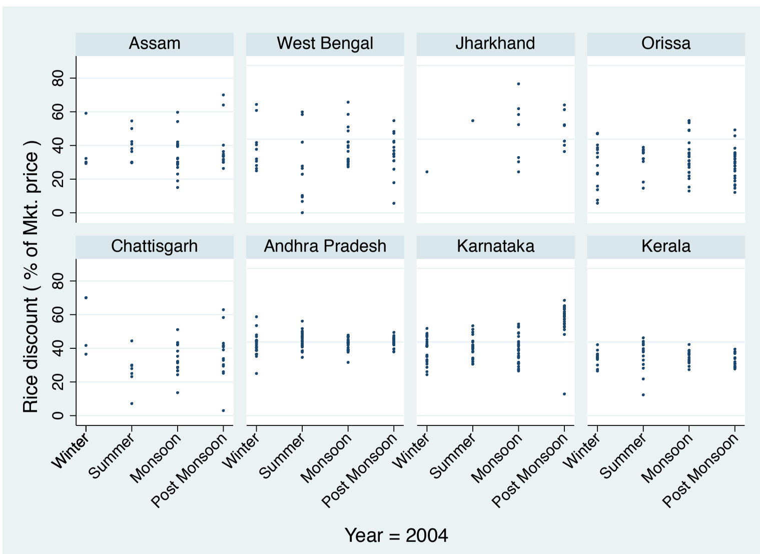
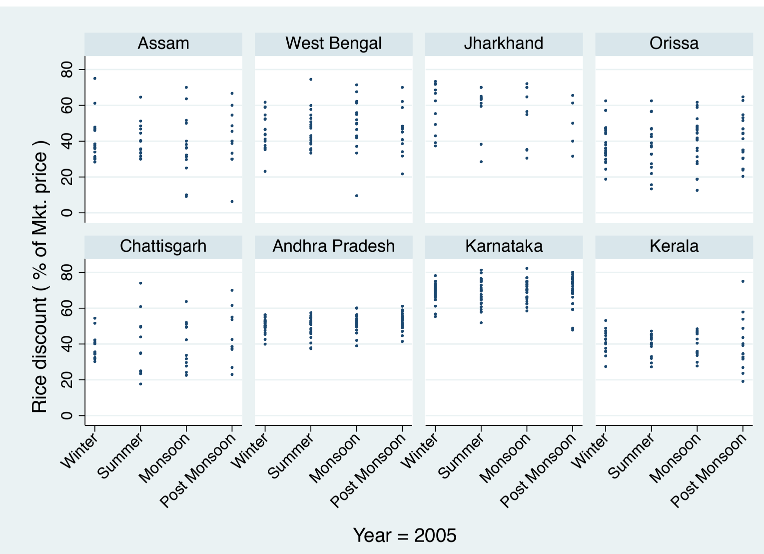


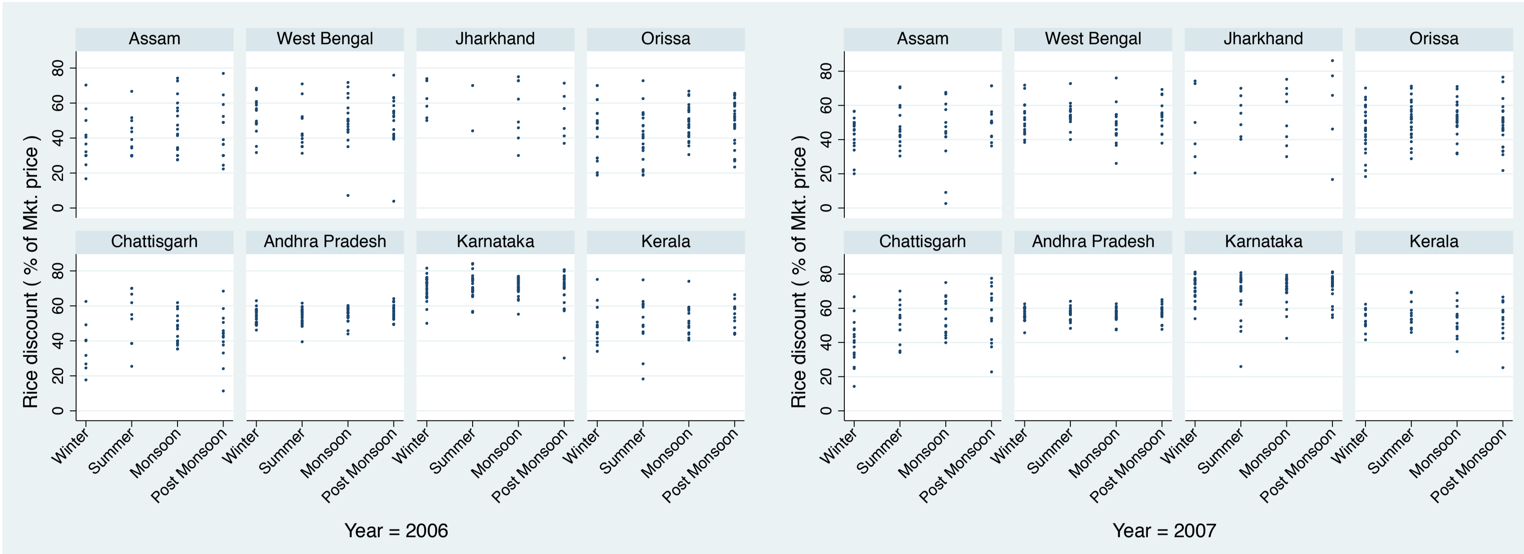
Panel D



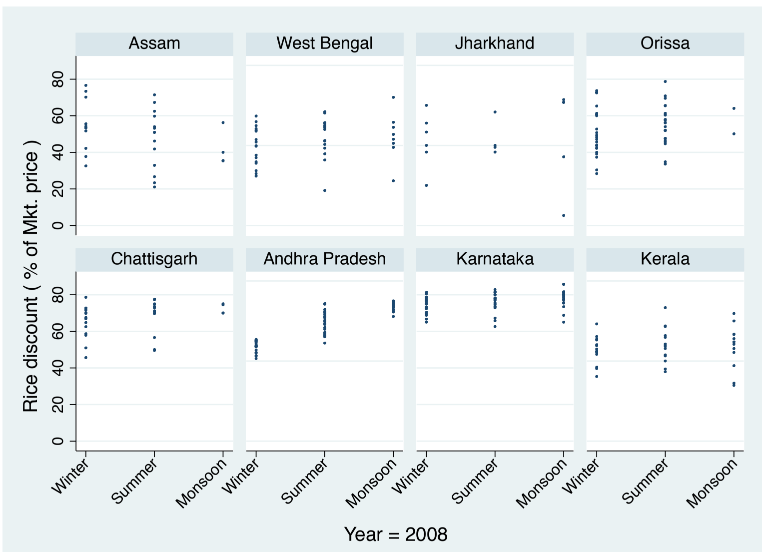
Notes: 1. Round 58 surveyed households between July and December 2002, resulting in no observations from the winter and summer season for this year. 2. Discount calculated as (Mkt. price - PDS price)/Mkt. price*100 3. Averages based on PDS and market prices reported by PDS users in the sample.

Figure 2 : Variation in PDS rice discount (2002-2008)

Panel E | Panel F



Panel G



Notes: 1. Round 63 surveyed households between January and June 2008, resulting in no observations from the post monsoon season for this year. 2. Discount calculated as (Mkt. price - PDS price)/Mkt. price*100 3. Averages based on PDS and market prices reported by PDS users in the sample.

Table 2: Seasonal Variation in PDS Rice discount (%)

State	Mean	Std. Dev	p10	p90	N	Mean	Std. Dev	p10	p90	N
	Winter (January-March)					**Summer (April-May)**				
Assam	41.46	10.59	20	56.45	233	41.78	11.11	6.17	54.17	163
West Bengal	47.79	10	23.51	60.32	445	48.56	11.28	11.12	61.18	320
Jharkhand	54.75	13.57	20.45	72.73	73	56.62	11.6	20	70	68
Orissa	42.88	11.76	18.33	59.42	544	44.58	12.01	13.33	57.92	427
Chattisgarh	45.15	13.83	17.65	67.09	265	49.14	17.95	16	73.33	178
Andhra Pradesh	53.36	5.52	39.91	60.24	2952	56.13	9.96	37.39	72.83	2134
Karnataka	66.92	11.6	23.39	77.32	1239	66.86	11.63	35.56	78.18	791
Kerala	45.16	10.17	27.39	59.89	970	47.03	12.42	18.18	63.74	620
	Monsoon (June-September)					**Post Monsoon (October-December)**				
Assam	38.1	13.92	4.55	60	283	39.44	13.41	17.65	59.13	230
West Bengal	43.29	11.9	7.82	57.19	618	43.35	12.77	6.41	58.5	531
Jharkhand	52.73	17.17	6.25	75	76	54.47	14.22	16.67	71.33	52
Orissa	40.63	10.11	16.59	53.48	693	40.3	10.9	16.67	55.48	623
Chattisgarh	42.48	12.94	22.5	63.69	398	41.21	13.67	11.33	58.43	324
Andhra Pradesh	52.94	8.01	36.13	58.99	3952	52.4	5.53	40.98	60.23	3307
Karnataka	58.22	15.45	24.38	75.07	1697	60.2	15.04	14.67	75	1335
Kerala	42.77	10.55	18.7	58.22	1452	41.65	10.71	18.26	58.66	1217

Source: NSSO Socio-Economic Surveys (2002-08). Notes: 1. Discount= (Mkt. price-PDS price)/Mkt. price*100 2. Averages based on PDS and market prices reported by PDS users in the sample.

Table 3: Seasonal Variation in per capita value of PDS Rice Subsidy (Rs)

State	Mean	Std. Dev	p10	p90	N	Mean	Std. Dev	p10	p90	N
	Winter (January-March)					**Summer (April-May)**				
Assam	23.52	11.11	8.64	38.67	233	26.56	14.4	3.86	43.42	163
West Bengal	11.44	3.27	4.62	16.13	445	11.9	3.37	2.21	15.63	320
Jharkhand	52.11	29.69	14.35	84	73	60.51	38.41	15.12	98	68
Orissa	18.89	12.55	4.14	31.97	544	18.95	11.43	4	29.99	427
Chattisgarh	33.15	27.58	8.28	52.71	265	35.66	29.53	5.19	61.99	178
Andhra Pradesh	25.36	6.23	12.21	33.44	2952	26.95	7.81	11.94	36.35	2134
Karnataka	35.89	21.56	6.93	58.24	1239	37.93	25.26	8.32	63.76	791
Kerala	31.11	14.14	7.27	49.81	970	33.07	15.31	7.8	53.1	620
	Monsoon (June-September)					**Post Monsoon (October-December)**				
Assam	24.38	13.98	2.7	41.81	283	26.12	18.65	7.2	41.63	230
West Bengal	10.76	3.55	2	14.74	618	10.88	3.83	1.52	15.61	531
Jharkhand	45.45	29.08	7.17	77	76	54.03	31.11	7.7	79.8	52
Orissa	17.07	9.69	4.34	28	693	17.94	11.33	4.85	28.8	623
Chattisgarh	32.51	23.28	7.02	59.79	398	31.2	26.64	3.73	54.93	324
Andhra Pradesh	25.87	6.99	12.09	34.72	3952	26.1	6.55	12.43	34.94	3307
Karnataka	32.62	20.37	6.63	55.37	1697	33.71	21.71	4.79	56.25	1335
Kerala	29.89	13.48	7.7	48.89	1452	29.12	12.81	6.34	46.27	1217

Source: NSSO Socio-Economic Surveys (2002-08). Notes: 1. Value of the subsidy=Per capita Quota*(Mkt. price-PDS price) 2. Averages based on PDS and market prices reported by PDS users in the sample.

Table 4: Descriptive statistics for the full sample and PDS users

Sample:	Full Sample		PDS users	
	Mean	Standard deviation	Mean	Standard deviation
Monthly expenditure per capita (Rs)	1011.0	(1085.3)	636.8	(393.4)
Daily calories per capita (kcal)	2334.2	(1300.9)	2190.9	(623.7)
Proportion spent on food	0.547	(0.142)	0.577	(0.116)
Size of the household	4.570	(2.382)	4.736	(1.891)
Number of children below 15	1.411	(1.428)	1.538	(1.339)
Proportion of women	0.515	(0.207)	0.512	(0.152)
Age of household head	46.58	(13.61)	45.38	(12.17)
Urban dummy	0.363	(0.481)	0.219	(0.414)
Electricity	0.724	(0.447)	0.725	(0.446)
Permanent home	0.338	(0.473)	0.314	(0.464)
SC/ST/OBC	0.592	(0.491)	0.765	(0.424)
PDS rice price (Rs/kg)			5.271	(1.855)
Mkt rice price (Rs/kg)			10.80	(2.193)
PDS rice qty (kg)			18.64	(9.392)
Market rice qty (kg)			26.11	(20.24)
Food expenditure per capita (Rs)			400.5	(168.9)
Cereal expenditure per capita (Rs)			116.0	(43.85)
Rice subsidy per capita (Rs)			25.71	(11.90)
Rice proportion of food expenditure			0.260	(0.130)
Proportion of calories from rice			0.615	(0.175)
Proportion of calories from cereals			0.727	(0.0987)
Observations	124228		22564	

Notes: 1. Rural Poverty line is Rs 497.6, Urban Poverty line is Rs 635.7 (Planning Commission, Government of India). 2. Average daily minimum calorie requirements are 2400 kcal for rural and 2100 kcal for urban areas. 3. All prices in 2005 Rupees. (Rs 45.3 = 1 USD in 2005). 4. The category cereals includes rice, wheat, semolina, jowar, bajra, millets, corn, barley and ragi. 5. The sample comprises households in the following states: Andhra Pradesh, Assam, Karnataka, Kerala, Orissa, Jharkhand, Chattisgarh and West Bengal.

Table 5: Impact of the subsidy on cereal consumption

Dependent variable:	Cereal consumption (1)	Log cereal consumption (2)	Cereal consumption (3)
Rice subsidy per capita	2.030***		
	(0.158)		
Log rice subsidy per capita		0.123***	
		(0.00963)	
Rice quota per capita			-1.968
			(4.442)
Market price* quota per capita			1.697***
			(0.436)
PDS price* quota per capita			0.157
			(0.463)
PDS price			-1.607
			(2.849)
Market price			-6.131**
			(2.395)
Observations	22564	22564	22564
Adjusted R^2	0.250	0.270	0.258

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: 1. All equations present results clustered at the district level. 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, state*year, district and season dummies. 3. Dependent variable in columns (1) and (3) is daily cereal consumption per capita (grams), dependent variable in column (2) is log of daily cereal consumption per capita.

Table 6: Impact of the subsidy on calories from different foodgroups

Dependent variable:	Caloric intake	Log caloric intake	Log caloric intake from food group			
			Cereals	Lentils	Fruits & Veg	Meat
	(1)	(2)	(3)	(4)	(5)	(6)
Rice subsidy per capita	12.58***					
	(1.116)					
Log rice subsidy per capita		0.144***	0.123***	0.154***	0.234***	0.170***
		(0.0103)	(0.00963)	(0.0177)	(0.0160)	(0.0187)
Observations	22564	22564	22564	22118	22562	19833
Adjusted R^2	0.124	0.166	0.270	0.215	0.441	0.426

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: 1. All equations present results clustered at the district level. 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, state*year, district and season dummies.3. Dependent variable in column (1) is daily caloric intake per capita (kcal), dependent variable in column (2) is log of daily caloric intake per capita, dependent variable in column (3) is log of calories from cereals per capita, dependent variable in column (4) is log of calories from lentils per capita, dependent variable in column (5) is log of calories from fruits and vegetables per capita, and dependent variable in column (6) is log of calories from meat per capita. 3. For the sample of beneficiaries: 5% of total calories come from lentils, 5% from fruits and vegetables and approximately 1% from meat, fish and other animal products.

Table 7: Expenditure elasticity of calories and food expenditure: Rural sample

Dependent variable:	Log caloric intake		Log food expenditure		Log Rupees per calorie	
	(1)	(2)	(3)	(4)	(5)	(6)
Log monthly expenditure per capita	0.406***		0.751***		0.345***	
	(0.0103)		(0.00883)		(0.0102)	
Log rice subsidy per capita		0.140***		0.146***		0.00575
		(0.0135)		(0.0153)		(0.00632)
Observations	13333	13333	13333	13333	13333	13333
Adjusted R^2	0.437	0.157	0.820	0.404	0.675	0.527

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: 1. All equations present results clustered at the district level. 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and state*year, district and season dummies. 3. Dependent variable in columns (1) and (2) is log of daily caloric intake per capita, dependent variable in columns (3) and (4) is log of food expenditure per capita, dependent variable in columns (5) and (6) is log of price paid per 1000 calories. 5. As in Subramanian and Deaton (1996), the sample comprises only rural households and monthly expenditure is calculated net of purchases of durable goods.

Table 8: Income elasticity of cereal and food consumption

Panel A: IHDS data				
Dependent variable:	Log cereal consumption		Log food expenditure	
	(1)	(2)	(3)	(4)
Log monthly income per capita	0.0462***	0.0304***	0.0966***	0.0827***
	(0.00972)	(0.00959)	(0.0108)	(0.0105)
Log rice subsidy per capita		0.295***		0.259***
		(0.0323)		(0.0323)
Observations	3962	3962	3962	3962
Adjusted R^2	0.306	0.354	0.402	0.429
Panel B: IHDS and NSSO data				
Dependent variable:	Log cereal consumption			
Data:	IHDS	NSSO	IHDS	NSSO
Log monthly expenditure per capita	0.247***	0.269***		
	(0.0178)	(0.0264)		
Log rice subsidy per capita			0.320***	0.179***
			(0.0314)	(0.0390)
Observations	3962	4255	3962	4255
Adjusted R^2	0.388	0.357	0.358	0.286

Standard errors in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: 1. All equations present results clustered at the district level. 2. All equations in panel A include urban, district and season dummies. All equations in panel B include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, district and season dummies. 3. Dependent variable in columns (1) and (2) of panel A and columns (1)-(4) of panel B is log of cereal consumption per capita, dependent variable in columns (3) and (4) of panel A is log of food expenditure per capita. 4. The data come from the India Human Development Survey 2004-05 and the NSSO surveys covering November 2004 - October 2005.

Table 9: Impact of the subsidy on cereal consumption and caloric intake: Heterogeneity by social group

Dependent variable:	Cereal consumption per capita			Caloric intake per capita		
	(1)	(2)	(3)	(4)	(5)	(6)
Rice subsidy per capita	1.979***	1.892***	1.960***	12.41***	11.61***	12.28***
	(0.172)	(0.209)	(0.159)	(1.214)	(1.046)	(1.142)
Urban dummy	-31.61***	-24.97***	-24.86***	-82.32***	-63.93***	-59.30***
	(6.412)	(3.026)	(3.030)	(27.98)	(13.52)	(13.91)
Urban*Rice subsidy	0.240			0.772		
	(0.241)			(1.054)		
SC/ST/OBC		1.488			-76.34***	
		(5.767)			(27.20)	
SC/ST/OBC*Rice subsidy		0.186			1.242	
		(0.205)			(1.001)	
Home grown rice			-15.73*			-41.21
			(8.247)			(39.68)
Home grown*Rice subsidy			1.300***			5.893***
			(0.328)			(1.609)
Observations	22564	22564	22564	22564	22564	22564
Adjusted R^2	0.250	0.250	0.251	0.124	0.124	0.126

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: 1. All equations present results clustered at the district level. 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, state*year, district and season dummies. 3. Dependent variable in columns (1)-(3) is daily cereal consumption per capita (grams), dependent variable in columns (4)-(6) is daily caloric intake per capita (kcal).

Table 10: Impact of the subsidy on rice producing households

Dependent variable:	Cereal consumption	Caloric intake
	(1)	(2)
Rice quota per capita	-14.15	-38.18
	(18.56)	(84.41)
Market price* quota per capita	4.483**	19.52**
	(1.792)	(7.896)
PDS price* quota per capita	-0.989	-5.916
	(1.976)	(8.667)
PDS price	3.226	38.62
	(10.98)	(49.72)
Market price	-17.15*	-52.60
	(8.760)	(40.03)
Observations	2111	2111
Adjusted R^2	0.231	0.241

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Notes: 1. The equation present results clustered at the district level. 2. The equation includes household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, state*year, district and season dummies. 3. Dependent variable in column (1) is daily cereal consumption per capita (grams), dependent variable in column (2) is daily caloric intake per capita (kcal). 4. The sample comprises PDS households that report own (produced) rice as one of their sources of supplementary grains.

Table 11: Impact on Non-PDS users

Dependent variable:	Cereal cons.	Log cereal cons.	Caloric intake	Log caloric intake
	(1)	(2)	(3)	(4)
Rice subsidy per capita	-0.0706		0.462	
	(0.115)		(0.772)	
Log rice subsidy per capita		-0.0141*		-0.00863
		(0.00750)		(0.00686)
Observations	26494	26494	26494	26494
Adjusted R^2	0.256	0.261	0.045	0.152

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Notes: 1. All equations present results clustered at the district level. 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, state*year, district and season dummies. 3. Dependent variable in column (1) is daily cereal consumption per capita (grams), dependent variable in column (2) is log of daily cereal consumption per capita, dependent variable in column (3) is daily caloric intake per capita (kcal), dependent variable in column (4) is log of daily caloric intake per capita.
4. The sample comprises households that do not receive any subsidies from the PDS. They are assigned their respective local average value of the PDS subsidy.

Table 12: Alternative specifications for value of the subsidy

Dependent variable:	Log caloric intake				
	(1)	(2)	(3)	(4)	(5)
Log rice subsidy (avg. family size)	0.134***				
	(0.00763)				
Log rice subsidy (household level)		0.131***			
		(0.0147)			
Size of the household		0.134***			
		(0.00243)			
Log rice subsidy (per person)			0.202***		
			(0.00992)		
Log rice subsidy (median prices)				0.119***	
				(0.0103)	
Log rice subsidy per capita (state*survey wave)					0.148***
					(0.0107)
Observations	22564	22564	22564	22543	22564
Adjusted R^2	0.173	0.613	0.200	0.159	0.168

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Notes: 1. All equations present results clustered at the district level. 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females land owned) and urban and district dummies. Equations (1)-(4) include state*year and season dummies. Equation (5) includes state*survey-wave dummies. 3. Dependent variable in columns (1), (4) and (5) is log of daily caloric intake per capita, dependent variable in column (2) is log of daily caloric intake at the household level, dependent variable in column (3) is log of daily caloric intake at the household level divided by the total number of household members.

Table 13: Impact on different sub-samples of states

Dependent variable:	Log cereal consumption			Log caloric intake		
States:	All	Rice	Non Rice	All	Rice	Non Rice
	(1)	(2)	(3)	(4)	(5)	(6)
Log rice subsidy per capita	0.0796***	0.123***	0.0439***	0.101***	0.144***	0.0666***
	(0.00677)	(0.00963)	(0.00664)	(0.00701)	(0.0103)	(0.00675)
Observations	33231	22564	10667	33231	22564	10667
Adjusted R^2	0.263	0.270	0.255	0.197	0.166	0.255

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Notes: 1. All equations present results clustered at the district level. 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, state*year, district and season dummies. 3. Dependent variable in columns (1) - (3) is log of daily cereal consumption per capita, dependent variable in columns (4)-(6) is log of daily caloric intake per capita.

Table 14: Impact of the subsidy: State level functioning

Dependent variable:	Cereal consumption per capita	Caloric intake per capita
	(1)	(2)
Rice subsidy per capita	2.359***	12.04***
	(0.180)	(1.148)
Corrupt*Rice subsidy	-1.207***	-7.060***
	(0.304)	(1.480)
Observations	22564	22564
Adjusted R^2	0.251	0.117

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: 1. All equations present results clustered at the district level 2. All equations include household characteristics (education of household head and spouse, age and age squared of household head, proportion of females, land owned) and urban, state-year, district and season dummies. 3. Dependent variable in column (1) is daily cereal consumption per capita (grams), dependent variable in column (2) is daily caloric intake per capita (kcal).