Do staple food subsidies improve nutrition?

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Abstract

Many developing countries use in-kind staple food subsidies to improve the food security of poor households. However, economic theory and recent empirical evidence suggest that these food subsidies may have small or even negative effects on nutrition and dietary diversity. In this study, we examine the impact of India's program of staple food subsidies, the Public Distribution System (PDS), on household consumption. Our empirical analysis exploits state-level changes to the generosity of PDS subsidies with the passage of India's National Food Security Act in 2013. Using household monthly food purchase and consumption data from 30 villages across India, we find that increased PDS subsidies led to improved dietary diversity and "crowded-in" consumption of nutritious non-staple foods. PDS beneficiaries consumed 83% of the subsidy's implicit income transfer in the form of food, suggesting that the subsidy did not cause them to substantially reduce their consumption of non-subsidized food. The effect of PDS subsidies on food consumption is highest in households where women have more control over the food budget, suggesting a role of intra-household bargaining. Overall, our results suggest that in-kind staple food subsidies can lead to large improvements in nutritional outcomes of poor households.

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1 Introduction

In-kind food subsidies, or the provision of subsidized food to the needy, are historically an important means to improve food security. About 1.5 billion people worldwide receive in-kind food subsidies (Alderman et al., 2018). In-kind programs subsidize a rationed quantity of food, typically in the form of staple food such as rice, wheat or bread. For example, the Raskin program in Indonesia provides rice to 62 million people, the Public Distribution System (PDS) in India provides rice and wheat to 800 million people and Tamween program in Egypt provides Baladi bread and wheat flour to 150 million people. While emerging-market governments are increasingly interested in moving from in-kind to unconditional cash transfers (Blattman et al., 2017), in-kind transfers still remain the predominant form of assistance in low and middle income countries (Alderman et al., 2018). These programs are large and financially burdensome. For example, the PDS is the largest social assistance program in India that accounts for almost 1% of the GDP (approx. 10 billion $US in 2016 (Government of India, 2017)).

Among the many justifications for in-kind food subsidies that have been suggested[1], perhaps the most cited one is improved nutrition. Proponents argue that providing subsidized staple food will increase consumption of the staple but decrease expenditure on it, thereby allowing recipients to spend more of their budgets on nutritious higher value foods. In this paper, we examine the impact of an in-kind food subsidy on nutrition. Specifically, we evaluate the world's largest in-kind food subsidy India's Public Distribution System (PDS). The efficacy of such a massive program in addressing the persistent problem of malnutrition in India holds important lessons for future food security and social welfare policy both in India and in many other developing countries with similar programs.

In theory, the effect of an in-kind staple food subsidy on overall food consumption is ambiguous. There are two basic scenarios to consider. In the first, a household's allocated quota of subsidized food is larger than the amount of the staple it would have consumed without the subsidy. Furthermore, it is not possible to resell the subsidized food in the local market. Under these conditions, the subsidy distorts consumption choice and leads to an unambiguous increase in consumption of the staple good only. In the second scenario, either the subsidized quota is infra-marginal (smaller than the staple amount consumed without subsidy) or the subsidized food can be resold in the market. Under this scenario, staple food consumption may increase, decrease or remain the same, depending on the income elasticity of the subsidized staple food. For instance, if staple food is highly income inelastic, then subsidizing staple food may have no impact on staple food consumption; that is, the recipient may cash-out[2] or simply reduce market purchases

[1] See Currie and Gahvari (2008) for a review on the justifications for in-kind transfers

[2] "Cash-out" refers to recipients selling their entire rationed food to the market and converting their in-kind subsidy into cash.

one-for-one with the amount of subsidy. On the flip side, non-staple consumption may increase proportionately with the subsidy, with ambiguous effects on overall nutrition. Even worse, staple food may exhibit Giffen behavior, as shown by Jensen and Miller (2011). In such particular cases, staple food subsidies may decrease staple consumption and consequently may have a negative effect on nutrition. Further, reducing the effective price of staple foods may cause households to substitute away from more nutritious foods. Hence for a staple food subsidy to have a positive effect on both staple and non-staple food consumption and overall nutrition, the subsidized staple food should be a normal good.

An additional consideration is the role of intra-household bargaining in determining the effect of in-kind food subsidies. A simple unitary model of consumer demand would predict that an infra-marginal transfer will lead to the same consumption outcome as, for example, an equivalent cash transfer (Southworth, 1945). But, if consumption patterns are the result of the interactions of more than one decision maker, then a unitary model may not be accurate. For instance, in some societies women have more control over the food budget whereas men control non-food expenditures so that resources are not treated as completely fungible across the two budget domains (Armand et al., 2016; Angelucci and Attanasio, 2009; Attanasio et al., 2011; Schady and Rosero, 2008). In such a scenario, an infra-marginal in-kind food transfer may increase the effective budget share controlled by women and have a larger effect on food consumption than the equivalent cash transfer (Breunig and Dasgupta, 2005).[3]

In this study, we examine the impact of PDS on nutrition using ICRISAT's panel data from 30 villages in India between 2010-2015. Our empirical strategy exploits state-level expansions of PDS subsidies that followed the National Food Security Act of 2013. Information on these policy changes comes from personal fieldwork and government records, which we combine to document 11 policy changes to the price and quantity of rice and wheat that beneficiary households are mandated to receive from the PDS. Crucially for our study, the ICRISAT panel contains data on the type of ration card a household possesses[4], which we combine with the policy information to calculate each household's PDS entitlement. This data allows us to estimate the effect of the PDS subsidy on household consumption of staple foods, non-staple foods and other goods in a regression that controls for household and time fixed effects.

Our results indicate that increases in the PDS subsidy substantially improve nutrition. In addition to increasing consumption of staple cereals, PDS subsidies crowd-in

[3]Another justification of in-kind food transfers, in the context of intra-household allocation, is that food is spent equitably within the household, while cash can be cornered by certain individuals (Dreze, 2011). Although a few studies find that food is distributed equally within the household (Pitt et al., 1990; Senauer et al., 1988), the empirical evidence on whether cash may be unequally distributed within the household is scarce.

[4]As the PDS subsidy is targeted and is available only for those who hold a PDS ration card, identification of PDS beneficiaries using their ration card is crucial to identify the effect of PDS.

consumption of diverse food types including pulses, milk and milk products, oils, sugar, fruits and vegetables. Consequently, the PDS subsidy increases the overall calorie, protein and fat intake. A 100 rupees (monthly) increase in subsidy translates to 346kcal increase in energy intake, 8.3 grams increase in protein intake and 4.3 grams increase in fat intake, all measured in daily per adult equivalent. We find that PDS beneficiaries consume 83% of the subsidy's transfer value[5] in the form of food, suggesting that the transfer does not cause them to substantially reduce their expenditures on non-subsidized food.

We further explore whether intra-household bargaining plays a role in explaining the high rates at which households spend more on food increases in the PDS subsidy. To this end, we use the ICRISAT panel's data on the role of gender in household decisions to generate proxies for bargaining power over the food budget. Our results show that households where women have more control over the food budget spend significantly larger fractions of the implicit PDS transfer on food and smaller fractions on temptation goods such as alcohol and cigarettes. These results are consistent with a model in which some households treat resources as not completely fungible across food and non-food budgets. As a result, households in which women control the food budget spend the PDS transfer predominantly in the form of food and other items preferred by women.

This study adds important new evidence to the literature on nutritional effects of food subsidies. The general consensus in this literature is that in-kind food subsidies have either small or no effects on nutrition outcomes (Fox et al., 2004; Gregory et al., 2013; Kochar, 2005; Kaushal and Muchomba, 2015; Tarozzi, 2005; Jensen and Miller, 2011). In regards to food subsidies in developing countries, most of the evidence comes from the Indian PDS program.[6] For instance, Kochar (2005) and Kaul (2014) show that expansions in the generosity of the PDS subsidy value led to marginal increases in calorie intake. Krishnamurthy et al. (2017) show that the reforms in Chhattisgarh state's PDS program led to improved protein consumption, but limited calorie consumption. Rahman (2016) finds that the universalization of PDS in the hunger-prone districts in Odisha state led to marginal improvements in dietary diversity. Similarly, several studies have shown that the PDS program has no effect on nutrition or dietary diversity (Kaushal and Muchomba, 2015; Svedberg, 2012; Balasubramanian, 2015; Tarozzi, 2005).

There are several reasons why our estimates of nutritional effects of the PDS program are larger than those of previous studies. Most studies use the generosity in the PDS sub-

[5]We quantify the increases in the generosity of the PDS subsidy by considering the value of the transfer, calculated as the product of the subsidized quantity and the price discount (difference between the average market and specific PDS price).

[6]A few studies have shown that the Food Support Program (*Programa de Apoyo Alimentario* or PAL) in Mexico improved nutrition (Cunha, 2014; Skoufias et al., 2013; Leroy et al., 2010). However, the PAL program is designed as a conditional in-kind food subsidy, conditional on attending monthly classes in health, nutrition and hygenie, and the nutritional impacts may not be directly comparable to unconditional in-kind food subsidies such as the PDS.

sidy value as the parameter to estimate the impact of the PDS program on nutrition.[7] But this literature has been plagued by issues related to endogeneity bias and measurement errors, mainly due to data constraints. Studies in this literature use state or district-level variation in the value of PDS cereals consumed, which is not the same as "entitlements", due to the difficulty in observing state-level policy changes in entitlements. Indeed, the amount of PDS consumption is likely to be correlated with unobserved household and community characteristics, as it is chosen by beneficiaries.[8] Furthermore, this literature has been constrained to using cross-sectional data from the National Sample Survey Organization (NSSO) before 2011, when the value of PDS subsidies were relatively low.[9] Indeed, estimating the effect of small policy changes, combined with measurement errors induce attenuation bias in the results and therefore may probably explain the common finding of a moderate or a null effect of PDS.

In contrast to previous studies, we make less restrictive assumptions in our estima-

[7]There is another literature that examines the universalization or reforms in the PDS program (Krishnamurthy et al., 2017; Rahman, 2016; Kishore and Chakrabarti, 2015). For instance, Krishnamurthy et al. (2017) examine the effect of a bundle of policy interventions in Chattisgargh, related to improvements in the effectiveness of the PDS program such as technological interventions to improve the grievance redressal system, reducing leakages by increasing the commission for ration shop owners, verification of bogus ration cards and improving supply chain efficiency by increasing the number of ration shops and the amount of rice procured from in-state farmers for PDS distribution. Similarly (Kishore and Chakrabarti, 2015) examine a bundle of PDS reforms in five states including universalization and several administrative reforms to improve the effectiveness of PDS. In contrast, we examine the effect of a very specific policy change – expansion in PDS entitlements.

[8]There are several other factors that may bias the effect of PDS subsidy towards zero. First, studies in this literature use a continuous measure of market price in calculating PDS subsidy value. A negative correlation between market price and consumption may create a downward bias in the effect of subsidy. Second, a significant source of selection bias in this literature has been the non-availability of consistent ration card data. To identify beneficiaries, previous studies either impute ration cards (Kochar, 2005; Kaushal and Muchomba, 2015; Krishnamurthy et al., 2017) or assume that households reporting any purchase from the PDS are beneficiaries (Kaul, 2014). Any imputation of ration card status may introduce measurement errors in the PDS parameter, and more importantly using ration card status (or BPL status) as a regressor confounds the effect of PDS with other government benefits received by BPL households. Some studies sidestep these problems altogether and examine only the exposure of marginal changes in PDS subsidy (Tarozzi, 2005; Kishore and Chakrabarti, 2015; Rahman, 2016). However, no actual receipt of benefits and no validation of policy implementation are observed. Again, low purchases from the PDS ration shop may bias the effect of the subsidy towards zero. Third, this literature uses imputed market prices (expenditure divided by quantity) of unknown grain quality in the calculation of implicit subsidy value. Quality is an important issue, particularly for rice and any variation in imputed market prices could reflect differences in quality or variety of the rice that household chooses to consume. For instance, if households consume a lower quality of rice than PDS rice, then the implicit subsidy value would be an underestimation of the in-kind transfer. Fourth, cross-sectional data may not aptly represent the temporal nature of PDS supplies. During our study period, a few households in our data consistently received 100% of their entitlement; but the same households received less than 50% of their entitlements in certain months.

[9]NSSO are repeated cross-sections that are representative at the national level. The latest available expenditure data from NSSO is from 2011-12 and the next round of expenditure data would be available no earlier than 2019, which leaves a big data gap especially to study the impact of NFSA on food consumption. Previous studies only predict the effect of the expansion under NFSA (Kaul, 2014; Kjelsrud and Somanathan, 2017). Although, few studies have highlighted issues regarding the implementation of NFSA in terms of coverage, inclusion and exclusion errors and purchase to entitlement ratio. See Table 9 in Puri (2017) for an informative summary of the different studies on NFSA implementation.

tions. In particular, we use the statutory entitlement defined by the state government to account for the endogeneity in PDS purchase decision and use panel data and ration card data reported by the households to arrive at a more precise measure of the PDS parameters. A key contribution in this study is that we use large-scale variation in the PDS program that occurred after the passage of the NFSA in 2013. Hence our results have the appeal of non-marginal changes in PDS subsidy.

Our results offer important implications for the Indian policy debate around the effectiveness of the PDS program. The PDS has been criticized on the grounds that the program is poorly targeted, does not reach the intended beneficiaries and hence may have little impact on nutrition. Furthermore, critics contend that PDS encourages only "empty" staple cereal consumption, and thus may crowd-out more nutritious food items and not improve dietary diversity (Desai and Vanneman, 2015; Gulati et al., 2012). Our results suggest that these criticisms are not generally valid.

Lastly, our study sheds light on the debate concerning the replacement of PDS with cash transfers in India (Svedberg, 2012; Kotwal et al., 2011; Khera, 2014; Saini et al., 2017; Narayanan, 2011; Gentilini, 2017) and the larger discussion on replacing in-kind subsidies with cash transfers (Gentilini, 2016; Blattman et al., 2017).

2 Public Distribution System of India

The PDS has been in existence prior to India's independence. It was initially established as a rationing system by the British Government during World War II to ensure workers in a few urban centers received food supplies (Nawani, 1994). The program later evolved in the early 1970s, as a welfare program with a primary objective to provide food security to vulnerable households, with the advent of green revolution and growth of domestic supply. Since its inception, the PDS primarily supplied rice and wheat at subsidized prices. The program was gradually expanded to provide pulses, sugar, edible oils, as well as kerosene. In this study, we focus on rice and wheat, the two predominant food items distributed under PDS.

The Food Corporation of India (FCI), a central government agency, is the primary stakeholder in the PDS supply chain[10]. The agency procures food grains directly from farmers and stores them in government operated warehouses. The state governments then procure grain stocks from FCI, distribute them to retail outlets known as fair price shops , and also control the functioning of fair price shops. With more than 532,000 fair price shops spread across the country, the PDS supply chain operates at a massive scale, covering 85% of villages in India, rendering PDS as the most far reaching of all social

[10]See (Alderman et al., 2018, Chapter 2) for a more detailed description of the stakeholders in the PDS supply chain.

safety nets in the country.[11]

In most states in India, the PDS subsidy is targeted towards the poor and is available only for those who hold a PDS ration card. Beneficiary households are broadly classified into three ration card types based on an official state-defined poverty line: Above poverty line (APL), Below poverty line (BPL), and Anthodaya Anna Yojana (AAY). The Anthodaya Anna Yojanaa (AAY) is a central government scheme started in 2000 that identifies the poorest of the poor households from amongst the BPL population. Extremely vulnerable households headed by widows, disabled, or destitute households with no assured means of subsistence are identified as AAY. The value of PDS benefits are targeted towards the poor and hence is the lowest for APL households[12] and highest for AAY households, where the central government assures AAY households a minimum PDS entitlement of 35kg of rice and/or wheat. The PDS entitlement for AAY households has been mostly constant and uniform across all states since its introduction in 2002. The benefits for BPL households, which form the majority of the population receiving PDS, differ across states and have increased over time.

The PDS subsidy for BPL households are different in each state as the fiscal expenditures towards the PDS are borne both by the central and state governments and hence are contingent on the state's outlays on PDS. In particular, the difference between FCI's cost of procuring food grains from farmers and the price at which the supplies are sold to the states, also called as the central issue price, is subsidized by the central government. The state governments can further boost the subsidy by providing an additional discount over the central issue price or by increasing the central issued quota. Not all states provide an additional subsidy. The final subsidy is therefore the sum of central and state's outlays on PDS and differs across states as it depends on the state's outlays on PDS.

Furthermore, in the pursuit of food security, the Indian central government substantially increased the outlays on the PDS program under the National Food Security Act in 2013. The Act mandated that the food grains under the PDS be converted to a legal entitlement for beneficiaries (or the right to food) (NFSA, 2013) and the onus was on the State governments to enforce and provide the food entitlements. The NFSA prescribed a national standardized minimum entitlement of 2kg rice and 3kg of wheat per individual at Rs 3/kg and Rs 2/kg respectively. The adoption of NFSA by states, however, was not uniform, as NFSA permitted states to continue their state-specific PDS programs (Gulati and Saini, 2013). Therefore, since 2013, due to renewed political interest, several state governments significantly expanded their PDS programs either under NFSA or through their own state-level PDS programs such as Karnataka, Madhya Pradesh, Maharashtra

[11] In 2011, there were 506,198 PDS ration shops (Government of India, 2011b) in 597,608 inhabited villages (Government of India, 2011a). This suggests that as many as 85% of Indian villages were covered under the PDS. The coverage has since increased. In 2016, there were 532,000 FPS (Government of India, 2016)

[12] APL households in most states do not receive any PDS grain.

and Bihar, whereas other states such as Gujarat and Jharkhand did not expand. These expansions in the PDS program, were either through increase in PDS quota or a decrease in PDS price, hereafter jointly referred to as PDS entitlements.

3 Theory

In the most common form, the PDS Subsidy is offered to beneficiary households through a fixed quantity of staple cereals (Q_0) at a subsidized price cp(where p is the market price of staples and $c < 1$).[13] In this scenario, according to the canonical model of consumer choice Southworth (1945), as shown in Figure 1, the original budget line AB reflects the trade-off between staple and non-staple consumption and is shifted out by the amount of the subsidy (Q_0) leading to the kinked budget constraint ACB. The slope of AC depends on the extent of price discount, that is, if staples are provided for free, as in a take it or leave it program, then AC would be flat. The budget line would shift to ECD for an equal valued cash transfer. Lastly, if staple cereals can be resold in the market, the budget line would be FCD and would depend on the resale price of PDS cereals.

Household I is better off under the in-kind subsidy as the PDS rationed quantity is unconstrained or infra-marginal, that is, staple cereal consumption is more than what is provided by the PDS. However, household II is weakly worse off under in-kind subsidy than under the equivalent cash transfer, as it prefers non-staples relative to staples, and would be constrained to choosing point C (the kink) if resale is unavailable and segment FC if resale is costly, while it would have chosen segment EC under the cash transfer.

3.1 Expected Effect on Dietary Diversity

If the PDS subsidy is extra-marginal and binding, then the subsidy would have no effect on non-staple consumption. For example, suppose the extra-marginal household II does not desire staples at all and consumes at the extreme pt. A in the original budget line, then with the PDS subsidy and no resale, household II would be "force-fed" staple cereals and staple cereal consumption would increase one-to-one with PDS grains.

If the PDS subsidy is infra-marginal, then the transfer is a pure income effect and as a result the consumption outcomes would depend on the income elasticity of the PDS staple cereals. In Figure 1, the infra-marginal household I can choose either of the four points W, X, Y and Z on the smooth part of the budget line CD, depending on the income elasticity of staple cereals. Point Z would be preferred if staple cereals are extremely income elastic ($\eta \gg 1$). In this highly improbable case, PDS subsidy will lead to an increase in PDS consumption only and no change in non-staple consumption. In

[13]PDS price subsidy is a fixed price that is independent of the market price and is not a percentage subsidy.

contrast, if staple cereals are extremely income inelastic ($\eta \approx 0$) then point X would be desired. In this case, PDS Subsidy will lead to an increase in non-staple consumption and the beneficiary would simply reduce market (or out-of-pocket) purchase of staple cereals one-to-one with the amount of subsidy. Another case could be if staple cereals are inferior goods. In this paradoxical case, point W would be chosen and PDS subsidy would lead to a decrease in staple cereal consumption. Lastly, point Y would be desired if staple cereals have a non-negative income elasticity ($0 < \eta < 1$). In this case, PDS Subsidy would increase both staple and non-staple consumption.

Based on this simple model, there can be two probable cases wherein the PDS Subsidy would lead to an increase in staple consumption only, or "crowd-out" consumption of nutritious food items, as argued by certain critics. Either staple cereals are highly income elastic (Pt. Z) or households are extremely constrained or extra-marginal.

Another pertinent case is when PDS grains can be resold in the market. As PDS subsidy is non-binding, beneficiaries have an incentive to sell or trade it away, especially when they strictly prefer higher quality grains over PDS.[14] Under this scenario, if resale is costless, then PDS subsidy is the same as a cash transfer; consequently, consumption outcomes would depend on their respective income elasticities.

3.2 In-kind transfers and intra-household bargaining

The canonical Southworth (1945) model, as illustrated in Figure 1, predicts that an infra-marginal household is indifferent between transfer type. In other words, the marginal propensity to consume from in-kind and cash should be equal for infra-marginal households. But this hypothesis has been consistently rejected empirically in the context of the US food stamp program. Virtually every study finds that the marginal propensity to consume food out of food subsidy income is four to ten times higher than cash income (Fraker, 1990). In what follows, we argue that this empirical regularity is consistent with intra-household bargaining and heterogeneous preferences within the household.

The simple model described above is derived under the assumption that decisions are taken by a unitary household. However, if the consumption patterns are related to the interactions of more than one decision maker, then a unitary model may not be accurate. To deal with these issues, collective models are proposed (Browning and Chiappori, 1998), wherein a household maximizes the weighted average of utility functions of all household

[14]During our field visits in ICRISAT villages, we observed that a few large farmers in Andhra Pradesh, who were also producers of high quality rice, resold all their PDS rice to the market. They complained about the inferior quality of PDS rice and preferred to consume from their own production. In this case, even though the transfer of PDS rice is less than their rice consumption, the subsidy may not be infra-marginal in the traditional sense. In contrast to large rice farmers, landless laborers and teachers in the same village consumed all their allotted PDS rice and had no complaints about the quality. They regularly cleaned and washed the PDS rice before consumption. In this study, we are unable to empirically examine resale or the role of the quality attributes of PDS grains, as these aspects are not recorded in the data.

functions. Under this scenario, suppose women control food and men control non-food, then an infra-marginal in-kind transfer is akin to an implicit income transfer directed towards women. Such a targeted transfer might shift the weights in favor of women and therefore change the nature of the demand system, and consequently the propensity to consume food from the in-kind transfer may be greater than a similar valued cash transfer. This proposition has been conjectured by several researchers for the case of US food stamps, such as Senauer and Young (1986), Orazem (1999) and worked out in detail Breunig and Dasgupta (2005)

4 Data

We use the new wave of ICRISAT's VDSA panel data[15] of 1300 households observed over 60 months from June 2010 to July 2015. The VDSA data cover 30 villages spread across eight states in India. The states covered are Andhra Pradesh[16], Bihar, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra and Orissa; with 4 villages in each state, except Madhya Pradesh that has only 2. The geographical locations of the villages are shown in Appendix figure A4. Similar to the old VLS, households in each village are randomly selected to represent households in four land-holding classes: large, medium, small and landless.

[INSERT FIGURE 1]

The VDSA panel data are geographically divided into 18 villages in the Semi-Arid Tropics (SAT) and 12 villages in the Eastern region of India. Similar to the old VLS, households in each village are randomly selected to represent households in four land-holding classes: large, medium, small and landless. The data follows the agricultural cycle in India from June to July. Endowment and household characteristics such as household size and landholding size are collected annually at the beginning of every panel year in June. Transactions, sales, market price, food and non-food expenditure data are collected every month. Market price data for commodities including rice and wheat are documented in the Monthly Price Schedule. Food expenditures are collected under the Transaction

[15]ICRISAT's Village level studies (VLS) are longitudinal surveys collected between 1975 to 1985 in six villages in the semi-arid tropics of India. Data collection was restarted from 2001 in the same six villages, tagged as the second generation of VLS (VLS2). However, the frequency of household surveys from 2001 to 2004 was limited to annual observations based on the availability of funds, and was increased to monthly data in 2005-06. It was only after 2009, with the funding from the Gates foundation, the VLS was expanded significantly and was renamed as the Village Dynamics in South Asia (VDSA). In 2009, 12 villages in the semi-arid tropics, in addition to the 6 old VLS villages, and 10 more villages from east India were included; summing to a total of 30 villages across India. The data for panel year 2009, however, has many gaps, especially in the consumption module, and is inconsistent with the subsequent panel years. Accordingly, this paper uses data beginning from panel year 2010 until 2014.

[16]Two villages are in Telangana, a state formed in 2014. As our dataset begins before the formation of the new state, and for the purpose of consistency, the 2 villages in Telangana are considered as part of Andhra Pradesh

Module and are recorded item-wise along with information about the source of each food item, whether from home consumption or market purchase or from gifts. PDS rice and wheat are recorded as separate food items in the consumption module and are collected every month.

In order to obtain data on nutrition intake, we convert consumption quantities of each food item (or expenditures for certain food items) into their nutrient content (calorie, protein and fat) in two steps. First, the food items in the ICRISAT consumption module are grouped together to match the food items list in the NSSO. Second, the NSSO's nutrition chart provided in Chapter 2, NSSO (2014), which is largely based on the food composition table in Gopalan et al. (1991), is used to impute the nutrient contents of each food item.

Ration card status of households from 18 villages in SAT and 12 villages in East India come from different sources. In East India, the ration card status is reported in the General Endowment Schedule (GES), and is collected at the beginning of every panel year in June. As for SAT, the ration card status is collected only during two periods - the beginning of panel year in 2009 and during a Household Census Survey (HCS) conducted separately by the VDSA team during 2014. Comparison of the ration card status between the two-time periods, do not reveal any significant changes in ration card status. We therefore use a time-independent ration card status of households in 2009 for SAT villages over the entire sample period. We also conduct robustness test of using 2014 ration card data. All the 30 villages have a fair price shop. The corresponding author of this study visited most of these SAT villages in person and conducted extensive fieldwork. The operation of PDS ration shops in each village, validation of ration card status and perception of PDS among beneficiaries were all documented.

[Insert Table 1]

Table 1 shows the summary statistics. We drop households with less 48 months of data and households whose head lives outside the village. The final sample consists of 1217 households.

Intra-household bargaining measures are derived from the General Endowment Schedule that reports information on the role of gender in decision making. This questionnaire covers important decisions related to utilization of households resources such as assets, inputs, outputs and other miscellaneous resources; and whether the decision is taken by male, female or both. Summary statistics of decision variables for BPL households are reported in Appendix Table 1. The statistics are arranged by gender, the columns represent the percentage of households that fall in each category of decision making and the rows represent the type of household resources. The proportion of households where only female takes decision is minimal for most of the household resources, except for household maintenance. This suggests that, in the ICRISAT data, most of the resource allocations are either jointly decided by both genders or are decided by men only.

A few caveats are in order regarding the ICRISAT data. First, the data is not representative at the national level, state or district level. However, the summary statistics from the ICRISAT are consistent with the nationally representative sample from NSSO. For instance, based on most recent round of NSSO in 2011-12, the national average per capita per day calorie consumption was 2233 Kcal, protein intake was 60.7gms and fat intake was 46 gms NSSO (2014) which are comparable with the summary stats reported in Table 1. Second, the data sample is primarily focused on small holder farmers in rural and impoverished regions and may not cover all types of households. For instance, migrant households or households in remote areas who find it more difficult to access the PDS; or female-headed households for whom PDS may have larger effects.

5 Identification and Empirical Strategy

We examine the impact of PDS on food security in three steps. First, we examine the take-up of PDS[17]; whether expansions in the PDS program translate into a proportional expansion in consumption of PDS grains at the household level. We interpret the increase in PDS grain consumption as an improvement in food availability. Second, we examine whether PDS improves nutrition. We interpret the increase in household consumption in terms of quantities of diverse food items and the enrichment in the calorie, protein and fat intake as an improvement in food access. Third, we examine whether the PDS can insure household consumption against aggregate shocks such as delayed monsoon and idiosyncratic shocks such as health shocks (measured as the number of sick days) and idiosyncratic income. We interpret the extent to which PDS attenuates the negative impact of shocks on consumption as an improvement in food stability. If the PDS supply lines work efficiently, one would expect the PDS program to improve food availability, enrich nutrition and stabilize consumption.

We focus our analysis on BPL households which form the majority of the population receiving PDS. Besides, most of the recent changes in the PDS program are for BPL households after 2012. PDS entitlements for AAY households have been constant over time and uniform across states and APL households in most states do not receive any PDS grain. As there is variation in PDS entitlements, only for BPL households, we focus our analysis and limit our discussion to this target population. As a robustness test, we redo the analysis by considering the full sample.

5.1 Identifying variation in PDS entitlements

During our time frame, certain states expanded their PDS entitlements for the BPL population, either by increasing the rationed quantity of grain or by reducing the subsidized

[17]Take-up refers to the proportion of the PDS entitlement that reaches the intended beneficiaries

price. In total, there are 11 policy changes in the PDS entitlements, that correspond to the eight states in the ICRISAT data. Appendix Table A1 cleanly organizes and documents these changes.

[Insert Figure 2 and 3]

Figure 1 illustrates the increase in the PDS grain quota entitlement and Figure 2 shows the gradual decrease in PDS grain price entitlements. Both figures considered together clearly depict the expansion of PDS entitlements since July 2013. Among the eight states, the NFSA was first implemented in Maharashtra and Bihar in February 2014 and later in Madhya Pradesh from April 2014. In addition to the phased rollout of the NFSA, certain states such as Karnataka and Madhya Pradesh expanded their PDS subsidy by initiating their own state-level PDS programs. For instance, in June 2013, the chief minister of Karnataka introduced the Anna Bhagya Scheme, essentially doubling the PDS entitlements. Similarly, the chief minister of Madhya Pradesh introduced the Mukhyamantri Annapurna Scheme in June 2013, thereby reducing the PDS price entitlements to Re 1/kg for wheat. Both these schemes were initiated during state elections and were believed to have been directed towards gaining the support of the poor[18] (Deccan Herald, 2013; Hindu, 2013).

Among all the eight states, Jharkhand had the most generous entitlement of 35 kg of rice per household at Re. 1/kg. whereas Gujarat had the least entitlement of 17 kg of rice and wheat per household. Also, these states did not implement any changes in the PDS policy rules. In contrast, Karnataka had the most significant increase in PDS entitlements in June 2013 with the introduction of Anna Bhaghya Scheme, followed by Maharashtra and Bihar in Feb 2014 with the introduction of NFSA.

In this paper, we focus our analysis on BPL households which form the majority of the population receiving PDS. Since 2012, most of the recent changes in the PDS program are for BPL households. PDS entitlements for AAY households have been constant over time and uniform across states and APL households in most states do not receive any PDS grain. Thus, due to the observed variation in PDS entitlements, we focus our analysis and limit our discussion to this target population. As a robustness test, we redo the analysis for the full sample.

5.2 Value of PDS subsidy transfer

We quantify the increases in the generosity of the PDS subsidy by considering the value of the transfer, calculated as the product of the quantity and price discount (difference

[18]The first executive decision taken by the Chief Minister of Karnataka was to increase the PDS entitlements. In MP, reduction of PDS price was part of an election manifesto.

between the market and PDS price):

$$Subs_{st} = \overbrace{Q_{st}^{pds\,rice}\left[\overline{P}_{st}^{Market\,rice} - P_{st}^{pds\,rice}\right]}^{RiceSubsidy} + \overbrace{Q_{st}^{pds\,wheat}\left[\overline{P}_{st}^{Market\,wheat} - P_{st}^{pds\,wheat}\right]}^{WheatSubsidy} \quad (1)$$

where $Q_{st}^{pds\,rice}$ is the statutory PDS quota set by state s in month t for rice, $\overline{P}_{st}^{Market\,rice}$ is the average market price of rice over the sample period in state s and $P_{st}^{pds\,rice}$ is the statutory PDS price set by state s in month t. The market price corresponds to a comparable variety of PDS rice and wheat. We use a state-level time invariant average market price to define the PDS subsidy value to ensure that any variation in the subsidy measure is derived solely from changes in the PDS program parameters (or "entitlements"), not changes in market conditions, or household consumption. Consequently, the implicit subsidy value in month t may not represent the value of the income transfer corresponding to the actual market price in month t.

Figure 3 shows the changes in the PDS subsidy value in each state. The figures 1, 2 and 3 together show that there is tremendous variation, both temporally and spatially, in the PDS program parameters.

Using the PDS subsidy value to estimate the effect of PDS is a standard strategy extensively used in previous studies (Kochar, 2005; Kaul, 2014; Drèze and Khera, 2013). Based on the simple demand model, discussed in Section 2, the assumption of an income transfer is valid if the consumption of staple cereals is more than what is provided by the PDS.[19] Such an assumption is perfectly valid with our data. An average household in our data consumes 48kg of staple cereals as compared to a maximum of 35kg of grains per household provided by the PDS. As shown in Appendix Figure A1 the proportion of staple cereal consumption from the PDS goes up to 80% in Karnataka and is never 100% in any state. Similar summary stats at the household-level shows that the 100% consumption from PDS is observed only sporadically for a minute number of households (less than 5% of the sample).

5.3 Does PDS improve dietary diversity?

We examine the impact of PDS on dietary diversity in three steps. First, we examine the direct effect on the quantity of staple cereal consumption. Second, we examine the indirect effects on the consumption quantities of non-subsidized food items such as pulses, milk and milk products, oils, fruits and vegetables, eggs and meat. Third, we also examine the impact on the overall energy and macronutrient intake in terms of calories, proteins

[19] An alternate argument could be that PDS subsidy may not be infra-marginal in the traditional sense, even though the allocated PDS quota may be smaller than their staple consumption, as beneficiaries may prefer higher quality grain over PDS. Even under this scenario, as PDS can be resold, the in-kind subsidy is equivalent to an income transfer.

and fat.

The direct and indirect effects of PDS on food consumption are estimated using fixed effects:

$$Y_{ist} = \alpha_i + \lambda_t + \beta_1 Subs_{st} + \epsilon_{ist} \tag{2}$$

where $Subs_{st}$ is the implicit subsidy value defined in (2), Y_{ist} is the outcome variable (such as staple cereal consumption, consumption of other food items, calorie and nutrient consumption etc.) for household i, in state s and month t. Variables α_i and λ_t are the household and time fixed effects. Standard errors are clustered at the village level. The consecutive month fixed effects λ_t absorb any aggregate time shocks that affect consumption, including any price effects or changes in the government procurement pricing policies.

In this analysis, we take a closer look at the changes in food consumption and spending patterns (in terms of quantities and value). The direct effects of PDS on staple cereal consumption are meticulously examined by separating out total rice and wheat consumption into components that are sourced from home production or purchased from market or from PDS shop or a combination thereof. Each component is examined as an outcome variable in equation (2). Such a detailed examination would provide insights into the channels through which PDS may affect food consumption and spending patterns. The indirect effects of PDS on non-staple cereal consumption (in terms of quantities and value) and the overall effects on energy and macronutrient intake are examined similarly by substituting them as outcome variables.

The model exploits both cross-sectional and temporal variation in the PDS program. The temporal variation comes from the 11 policy changes in the PDS entitlements during the study period. The cross-sectional variation comes from the difference in PDS entitlements across states and the differential expansion in the PDS entitlements for BPL households. The above fixed effects specification is akin to a difference-in-difference methodology, wherein the first difference is between BPL households who were exposed to a more generous and a less generous PDS expansion the second difference is between BPL households before and after the PDS expansion.

5.4 Does Intra-household bargaining increase food consumption for PDS beneficiaries?

According to the theoretical implications of a collective model, discussed in section 3.2, the expected effect of PDS on food consumption would be greater in households where women have greater control over the food budget. To test this proposition requires variation in the level of bargaining power specific to the food budget. In this study, based on the information in the ICRISAT data on the role of gender in decision making, summarized in Table 2, we consider the gender control of household maintenance decisions as the most

appropriate proxy for bargaining power over food-related decisions. Although household maintenance may include resources in addition to food, it is the best possible measure of intra-household bargaining over food available in our dataset. Furthermore, we are unable to test the proposition that PDS may have larger effects on female-headed households, as the proportion of female-headed households in our dataset is less than 10%.

We use the available data on the role of gender in household decision making to conduct a weak-test on whether intra-household bargaining can promote food consumption out of PDS Subsidy, as compared to non-food consumption, by considering the interaction between PDS Subsidy value and intra-household bargaining measures,

$$Y_{it} = \alpha_i + \lambda_t + \delta_i t + \beta_1 IB_{it} + \beta_2 Subs_{st} + \beta_3 IB_{it} Subs_{st} + \epsilon_{it} \tag{3}$$

where α_i and λ_t are household and time fixed effects respectively, δ_i is the household-specific time trend. IB_{it} is a categorical variable that measures intra-household bargaining, where $IB_{it} = 1$ if female decides, $IB_{it} = -1$ if male decides and $IB_{it} = 0$ if both decide. As the marginal effect of PDS Subsidy when female decides household allocations is $\beta_1 + \beta_3$, the co-efficient β_3 can be interpreted as the extent to which intra-household bargaining assists the impact of PDS on nutrition and hence is the coefficient of interest. $\beta_3 > 0$ for food consumption outcomes and $\beta_3 < 0$ for ill-favored non-food consumption outcomes, imply that intra-household bargaining facilitates food consumption from PDS Subsidy.

In addition to using household maintenance, we estimate (3) using the other decision variables on assets, inputs and outputs as a robustness test to show that the effect of PDS on food is specific to women's control over food-related decisions and may not be generalized to "women's empowerment".

6 Results

6.1 PDS subsidy reaches beneficiaries

We first try to answer the basic question of whether the policy changes, discussed in section 5.1, were actually implemented and whether the beneficiaries received their full entitlement. We attempt to answer these questions in two ways. First, we describe the implementation of the program through time-series graphs of PDS entitlements vs PDS consumption. As we have longitudinal data, we can trace the PDS consumption at the household level over time. Second, we empirically test the impact of PDS entitlements on PDS consumption in a more rigorous manner using a fixed-effect regression, similar to equation (2).

Figures 4 and 5 lay side-by-side the PDS entitlements (rice and wheat) in Panel A against the actual PDS entitlements received in Panel B. Disaggregated time-series

graphs for rice and wheat are provided in Appendix Figures A3a, A3b for PDS quantity and Figures A4a,A4b for PDS price, respectively. Each point in Panel B represents the mean entitlement over all the BPL households in that particular state and month.

[INSERT FIGURES 6 AND 7]

A comparison of the graphs in Panels A and B in figures 4 and 5 suggests that PDS consumption quantity and PDS price received seem to follow PDS entitlements; more so for PDS price. The most significant jump in PDS consumption is in Karnataka in June 2013 with the introduction of Anna Bhaghya Scheme. PDS rice consumption almost doubled and PDS rice price received dropped to Re.1/kg in the same month as the enactment of Anna Bhagya Scheme, as shown in figure 5a and 6a respectively. In Madha Pradesh, under the Mukhyamantri Annapurna Scheme, PDS wheat price drop to Re 1/kg in June 2013 and PDS rice price received drop to Re 1/kg in Feb 2014. Similarly, in Bihar and Maharashtra with the implementation of NFSA, the PDS price for rice and wheat received, drop to the level of NFSA price entitlements, as shown in Appendix figures A4a and A4b. NFSA in Bihar was enacted in March 2014, but in the data the changes in PDS consumption show up only after June 2014. After the adoption of NFSA in Bihar, PDS consumption of rice and wheat significantly increase, as shown in figure 4. Even for states without any changes in the PDS program, PDS consumption and PDS price received closely follows entitlement. PDS rice consumption hovers around the statutory entitlement of 35kg and 30kgs in Jharkhand and Orissa respectively, as shown in Appendix figure A3a. Similarly, PDS rice price drifts around Re 1 in Jharkhand, Orissa and Andhra Pradesh, as shown Appendix figure A4a. In summary, the graphs show that PDS take-up is high and that the intended beneficiaries receive a significant proportion of their entitlements. But, as the graphs in Panel B are only an approximation, we further examine the take-up of PDS subsidy using a more rigorous fixed effects regression.

[INSERT TABLE 2]

PDS consumption is regressed on PDS quantity entitlements, separately for rice, wheat and grain (rice and wheat). PDS price received, is analyzed similarly. Table 2 presents the results of the fixed effects regressions. The coefficient estimates on the entitlements, interpreted as the proportion of PDS quantity and price entitlement received[20], are reported in Panel A and Panel B respectively. For PDS rice, about 59% of the quantity entitlement and 79% of the price entitlement is received by the intended beneficiaries; for PDS wheat, about 46% of the quantity entitlement and 98% of the price entitlement is received; and for rice and wheat together, 55% of the quantity entitlement and 83% of the price entitlement is received by the intended beneficiaries.

The fixed effects regression results reveal some interesting findings. First, PDS price

[20]Previous studies have referred to the ratio of entitlement to consumption as purchase-entitlement ratio Khera (2011). In this case, the coefficient estimates can be interpreted as the marginal purchase-entitlement ratios

received is more compliant than PDS quantity. Low pass-through from PDS entitlement to actual consumption could be due to both demand and supply side factors. **?** argues that supply side constraints are more relevant for PDS. Based on our field visits in the ICRISAT villages, it is more likely that the low-pass through may be due to supply side factors such as leakage in the PDS supply chain, in providing a consistent delivery of grains to the PDS ration shops, or diversion of grains to the market; and less likely due to demand side factors such as tastes. Second, more PDS rice entitlement reaches households than PDS wheat. This is consistent with previous studies that report that there is more leakage and diversion of grains in PDS wheat Khera (2011). The results may also reflect the improved efficiency of PDS rice schemes in Karnataka, Jharkhand, Orissa and Andhra Pradesh.

In summary, the graphs in figures 4 and 5 and the fixed effects results in Table 2, suggest that 55 to 83% of the PDS entitlement reaches the intended beneficiary. Hence, these results validate that the state-level PDS programs and NFSA were actually implemented and reached the intended beneficiaries.

6.2 PDS "crowds-in" nutrition

We examine the effect of the PDS program on food consumption and nutrient intake by estimating equation (2) and report the coefficient estimates on the PDS subsidy value β_1. Table 3 presents the effect on staple and non-staple food consumption, both in terms of quantity and value. Table 4 presents the overall effect on calorie, protein and fat intake. Disaggregated results for rice and wheat are provided in Appendix Table A2. Each coefficient estimate comes from a separate estimation of equation (2) with different food types as outcome variables and the PDS subsidy value as the regressor. Standard errors are clustered at the village level. To interpret the significance of the estimates, we hereafter consider a policy experiment of increasing the PDS subsidy value by 100 rupees per adult-equivalent per month an amount equivalent to the PDS expansion in Karnataka in June 2013.

[INSERT TABLE 3]

As shown in Table 3, we further segregate total consumption of staple cereals based on the source of supply; whether from home production or purchased from market or the PDS shop or a combination thereof. The results for total consumption quantities clearly show that a more generous PDS subsidy increases total staple cereal consumption: 100 rupees in PDS subsidy value translates to 2.3 kg increase in staple cereal consumption (1.3kg rice and 0.47kg wheat), all measured in all measured in monthly per-adult equivalent scale. As one might expect, this increase in total staple cereal consumption is primarily a result of increased consumption of grains from the PDS: A 100 rupees increase in PDS subsidy value translates to 2.6 kg increase in PDS rice and wheat consumption (1.9kg

rice and 0.7kg of wheat). Consistent with the prediction that PDS subsidy decreases out-of-pocket expenditure on staples, we find that the quantity of staples sourced from the market and home production decreases: 100 rupees increase in PDS subsidy translates to 3.5kg decrease in staple cereal consumption without PDS (1.3kg of rice and 2.2kg of wheat), all measured in monthly per-adult equivalent. Results for expenditure values are consistent with quantities. Expenditure on staple cereal consumption decreases, with greater decline in market purchase.

Table 3 also presents the indirect effects of PDS on the consumption of food items other than staple cereals, both in terms of quantity and value. Here, only consumption from all sources (Purchase + Home + Gifts) is considered. For vegetables and fruits only expenditure values are considered as data on quantities are not available for the first three panel years in the ICRISAT data. The results for consumption quantities show that a more generous PDS subsidy increases total consumption of pulses, milk and milk products, sugar and oils: 100 rupees increase in PDS subsidy translates to an increase of 189gms in total pulse consumption, 662gms in milk and milk products and 163gms in sugar and 78gms in oils consumption. The results for expenditure values shows that PDS increases expenditure on pulses, milk and milk products, fruits, vegetables, sugar and spice, other food items (that include beverages, bread, biscuits and savories) and meals consumed outside. Altogether, PDS significantly improves total food consumption, especially through purchases from market.

Table 4 presents the main results of this paper on the overall nutritional impact of PDS, in terms of calorie, protein and fat intake. We separately examine the energy and macronutrient intake sourced from all food types, from staple cereals (further segregated into those sourced from PDS versus the market) and from non-staple food types. Not surprisingly, the most significant amount of calories are derived from the PDS ration shop: A 100 rupees monthly increase in PDS subsidy translates to 303kcal daily per adult equivalent increase in energy intake. These results are consistent with the increases in consumption quantities reported in Table 3.[21] Consumption of calories and macronutrients from staple food other than PDS decrease, and this decrease is compensated in greater magnitude by an increase in calorie and nutrient intake from other food types. A negligible 0.4kcal drop in calories from non-PDS staple cereals is substituted by 1kcal increase in calorie intake sourced from other food items including 0.2kcal each in pulses,

[21]The disaggregated results for rice and wheat, reported in Appendix Table 3 imply that a monthly increase of 100 rupees in PDS subsidy value translates to a 1.9kg increase in PDS rice and 0.7 kg increase in PDS wheat monthly consumption per adult-equivalent. In the NSSO nutrition chart NSSO (2014), based on the nutrition values provided in Gopalan et al. (1991), the daily calorie equivalent of 1 kg of rice and wheat is 3460 Kcal and 3410 Kcal respectively. Therefore, assuming 30 days in a month, 1.9kg monthly increase in PDS rice is equivalent to 219Kcal per day (=3460*1.9/30) and 0.7kg monthly increase in PDS wheat is equivalent to 80Kcal per day (=3410*0.7/30). Hence the total increase in daily calorie intake from a monthly increase of 100 rupees in PDS subsidy value approximately equal to 299Kcal.

milk and milk products, oils, sugar and 0.1kcal from fruits. As a result, consumption of more nutritious foods purchased from the savings from the PDS subsidy significantly increases intake of overall calorie, proteins and fats: A monthly increase of 100 rupees in PDS subsidy translates to 353kcal increase in energy intake, 8.5 grams increase in protein intake and 5 grams increase in fat intake, all measured in daily per adult equivalent.

Overall the results in Tables 3 and 4 suggest that PDS substantially improves nutrition and dietary diversity. In addition to an increase in staple cereals, consumption of diverse food types including pulses, milk and milk products, oils, vegetables, fruits and sugar increases. Consequently, the overall calorie, protein and fat intake increases. Hence, the results clearly show that PDS "crowds-in" consumption of nutritious foods.

These results also throw light on the channels through which PDS may affect household consumption and spending patterns. An important consumption pattern, implied by an increasing trend on the proportion of staple cereal consumption from PDS, is that households basically cash-out the in-kind PDS subsidy by reducing their market purchases. As a result, PDS provides significant savings to intended beneficiaries. In addition to the amount saved from buying from the PDS ration shop instead of the market, reductions in purchases from the market further add to their savings. These savings from PDS may unbind liquidity constraints and subsequently increase purchases of other food items and non-food items. Hence, in this manner, PDS provides more flexibility in consumption patterns for beneficiary households, who benefit not only from the provision of subsidized cereals but also in terms of overall food and nutrient intake.

6.3 Elasticities and marginal propensity to consume with respect to PDS subsidy value

We assess the magnitude and significance of our results on the nutritional impact of PDS, by comparing our estimates with past research on food subsidies and with respect to fungible income sources observed in our dataset. We follow the standard procedure in the food subsidy literature and compute elasticities and MPC with respect to both PDS subsidy value and total expenditure or cash income. While the estimations on cash income in this study are not experimentally identified, there are several reasons that validate this approach. First, the literature on US food stamps extensively use household income as a proxy for cash income (Hoynes and Schanzenbach 2009; Beatty and Tuttle 2011; Fraker 1990). Second, expenditure elasticity of calorie intake and MPC food out of total expenditure are widely studied and estimated parameters (Deaton and Muelbauer 1980; Strauss1995; Subramanian1996). Nonetheless, we are cautious in interpreting the estimations as causal for total expenditures and income. The idea of this exposition is to determine whether the nutritional improvements from PDS found in this study is larger than previous estimates or alternative sources of fungible income.

Specifically, we estimate MPC food and non-food expenditures and elasticities of calorie, proteins and fats; all with respect to PDS Subsidy and total expenditure value. Lastly, we compute elasticities with respect to benefits received from other government schemes such as middaymeals, pensions, scholarships, NREGA and also with respect to different sources of income.

Table 6 shows the MPC food and non-food expenditures with respect to PDS Subsidy value in Panel A and total expenditure in Panel B. Disaggregated results by food type are reported in Appendix Table A3. The results suggest that a significant proportion of PDS Subsidy income is spent on food expenditures, whereas only a small proportion of total expenditure is spent on food. An increase of 100 rupees in PDS subsidy translates to 82.5 rupees increase in food expenditure, out of which 50 rupees is spent on market purchases, all measured in monthly per-adult equivalent scale. In other words, 82.5% of the PDS Subsidy income is spent on food. Conversely, only 12.7% of total expenditure is spent on food and 84.2% is spent on non-food.[22] Therefore, the results imply that the MPC food from PDS Subsidy is about 6.5 times MPC food from total expenditures. These results are consistent with the empirical findings on the US food stamp program, that the MPC of food from food stamp income is four to ten times that of cash income.

We also estimated MPC calories, proteins and fats with respect to total expenditure value. Results are reported in Appendix table A4. The MPC nutrients out of PDS Subsidy (shown in Table 5) is considerably greater than the MPC nutrients out of expenditure: about 15 times greater for calorie intake, about 13 times greater for total protein and about 8 times greater for fat intake.

To compute elasticities, we estimate equation (2) in the log-log form and thereby limit the sample to BPL households with a non-zero PDS subsidy value in all the estimations.[23] Table 7 lays side-by-side the estimates of subsidy elasticities in Panel A and expenditure elasticities in Panel B; we separately examine the intake of calories, proteins and fat sourced from all food types, segregated into staple cereals and from non-staple food types. The results for disaggregated food types are reported in Appendix table A5.

All the elasticity estimates in both Panels A and B are positive and significant. The subsidy elasticities of calories, proteins and fat intake from total food consumption are comparable to expenditure elasticities. Not surprisingly, the magnitude of the subsidy elasticities is greater for staple foods and smaller for non-staples; although, it is important to note that the magnitudes on non-staple consumption are positive and large. The

[22]Our estimate of MPC food out of total expenditure (0.12) is within the estimates found in previous studies ranging from 0.03 to 0.17 (Fraker 1990, Deaton and Muelbauer 1980; S. Souleses 1999; Blanciforti and Green 1983). We are however, not able to compare our estimates with more rigorous randomized controlled experiments, as most of these studies report the treatment effects of the program, rather than the dollar value on food expenditures (Attanasio, Battisin, Mesnard 2011; Cunha 2014)

[23]To ensure comparability, we do not consider the entire sample size in estimating expenditure elasticities. Although, the expenditure elasticities are similar over the entire sample of households and for PDS beneficiary HHs.

estimated elasticity of the overall calorie intake with respect to the value of the PDS subsidy in this study is 0.285 and is significantly larger than previous estimates: 0.144 in Kaul (2014), 0.06 in Kochar (2005), -0.003 and statistically insignificant in Kaushal and Muchomba (2015).[24] One of the possible reasons for a higher estimate in this study could be the inclusion of non-marginal expansions in the PDS program, post-NFSA. Hence, the results suggest that the percentage change in the overall calorie and protein intake in response to a one percent change in total expenditure value is at best equivalent if not better than a one percent increase in the PDS subsidy value and the response on staple cereal consumption is markedly greater with PDS subsidy value.

To further investigate the significance of the PDS subsidy elasticities, we compute elasticities with respect to benefits received from other government schemes and different income sources.[25] Table 8 presents the elasticity estimates for total food consumption. The elasticity estimates for middaymeals are the highest, followed by pensions, in comparison to all other government benefit programs. These results are consistent with previous studies that show positive nutritional impact of midday meals (Afridi, 2010). Among the different sources of income, elasticities with respect to farm wage income, followed by income from credit, are greater.

Overall, our results suggest that elasticities with respect to PDS subsidy value are comparable to expenditure elasticities and are substantially larger than previous estimates. In addition, we show that most of the PDS subsidy income (83%) is spent on food, against non-food. Although, comparing the elasticity and MPC estimates from PDS subsidy and cash income are fairly speculative, the results provide suggestive evidence that the effect of PDS on nutrition may be greater than predicted by an assumption of fungible income sources.

6.4 Intra-household bargaining facilitates the positive impact of PDS on nutrition

We conduct a weak test on whether intra-household bargaining enables PDS to have larger impacts on nutrition. In particular, we estimate the interaction between PDS Subsidy value and intra-household bargaining measures, as specified in equation (3). The coefficient estimates are provided in Table 9. As proxies for intra-household bargaining, relevant for consumption outcomes, we consider the role of gender in decision making related to household maintenance, crop production, sale and use and credit management.

[24]However, the estimated expenditure elasticity in this study (0.235) is slightly less than previous estimates: 0.34 in Subramanian and Deaton (1996), 0.3 in Strauss and Thomas (1995), 0.24 in Kochar (2005).

[25]Benefit values for middaymeals, pensions and scholarships in the ICRISAT data are collected on a monthly basis in the Transaction Schedule only for 18 villages in the SAT region. Furthermore, it is important to note that the value of pensions is reported by households and the value of middaymeal is imputed by the ICRISAT field investigators.

Panel A, B and C report the three measures of intra-household bargaining. If women decide the resource allocation, a positive (or negative) interaction term can be interpreted as the extent to which PDS improves (or attenuates) consumption outcomes and marginal effect of PDS subsidy is sum of the coefficient on the PDS Subsidy value plus the coefficient on the interaction term, that is $\beta_1 + \beta_3$ in equation (3).

The interaction terms on nutrient intake are positive for all three intra-household bargaining measures, which imply that intra-household bargaining plays a facilitating role in improving nutrition through the PDS. Results on expenditures are consistent. As shown in Panel A, households where women decide on household maintenance spend 94% (= 0.78+0.16) of the PDS income on food expenditures, as against 62% (=0.78-0.16) when men decide. More importantly, expenditures decrease on temptation goods such as alcohol and cigarettes and other non-essentials like cell phone use. On the other hand, expenditures on energy and children's education increases.

Overall, the results are consistent with a model in which some households treat resources as not completely fungible across food and non-food budgets. As a result, households in which women control the food budget spend the PDS transfer predominantly in the form of food and other items preferred by women.

7 Conclusion

In this paper, we examine whether the world's largest in-kind food subsidy program India's PDS improves household nutrition. Using state-level changes in the program that occurred after the National Food Security Act of 2013, we show that increases in the generosity of in-kind staple food transfers substantially improved nutrition In particular, staple food subsidies "crowded-in" consumption of diverse food items, and consequently increased food consumption in terms of quantities and total calorie, protein and fat intake. Our results suggest that households reduce market purchase of staple cereals and use the extra saving to purchase more nutritious food such as pulses, milk and milk products, fruits and vegetables. These results imply that PDS provides more flexibility in consumption patterns for beneficiary households, who benefit not only from the provision of subsidized cereal but also in terms of overall food intake.

Furthermore, we find that PDS beneficiaries consume 83% of the subsidy's transfer value in the form of food, suggesting that the transfer does not cause them to substantially reduce their expenditures on non-subsidized food. We argue that intra-household bargaining may explain these results, as we find that households where women decide on resource allocations spend greater proportion of their PDS income on food expenditures.

Our results have important implications for the Indian policy debate around the effectiveness of the NFSA and the PDS program. The PDS has been criticized on the grounds that the program is poorly targeted, does not reach the intended beneficiaries and hence

may have little impact on nutrition. Furthermore, critics contend that PDS encourages only empty calories, and thus may crowd-out more nutritious food items and not improve dietary diversity(Desai and Vanneman, 2015; Gulati et al., 2012). Our results suggest that these criticisms are not generally valid. Given the constraints of our study area, our results show that the NFSA and state-level PDS initiatives effectively reached the intended beneficiaries and had a positive impact on household nutrition.

As an alternative to PDS, many policy makers have suggested a replacement of PDS with cash transfers. Although in theory, cash transfers are more efficient, the PDS has an intricate political economy in reform that garners huge political support and is often featured in election manifestos. As a consequence, many state governments have focused on improving the efficiency of the PDS program and have refrained from any form of replacement and no state government in India has showed interest in replacing PDS with cash transfers. Only three union territories, administered by the central government, implemented direct benefit transfer program on a pilot basis starting in September 2015. However, preliminary assessments suggest that implementation quality remains an issue (only 65-67% of beneficiaries reported received cash benefits) and that it costs beneficiaries more to collect their cash benefits than collecting food rations (Muralidharan et al., 2017).

Therefore, in light of the debate over the effectiveness of PDS, our results suggest that PDS is an effective tool in addressing household nutrition in India and any replacement of the PDS program demands careful consideration.

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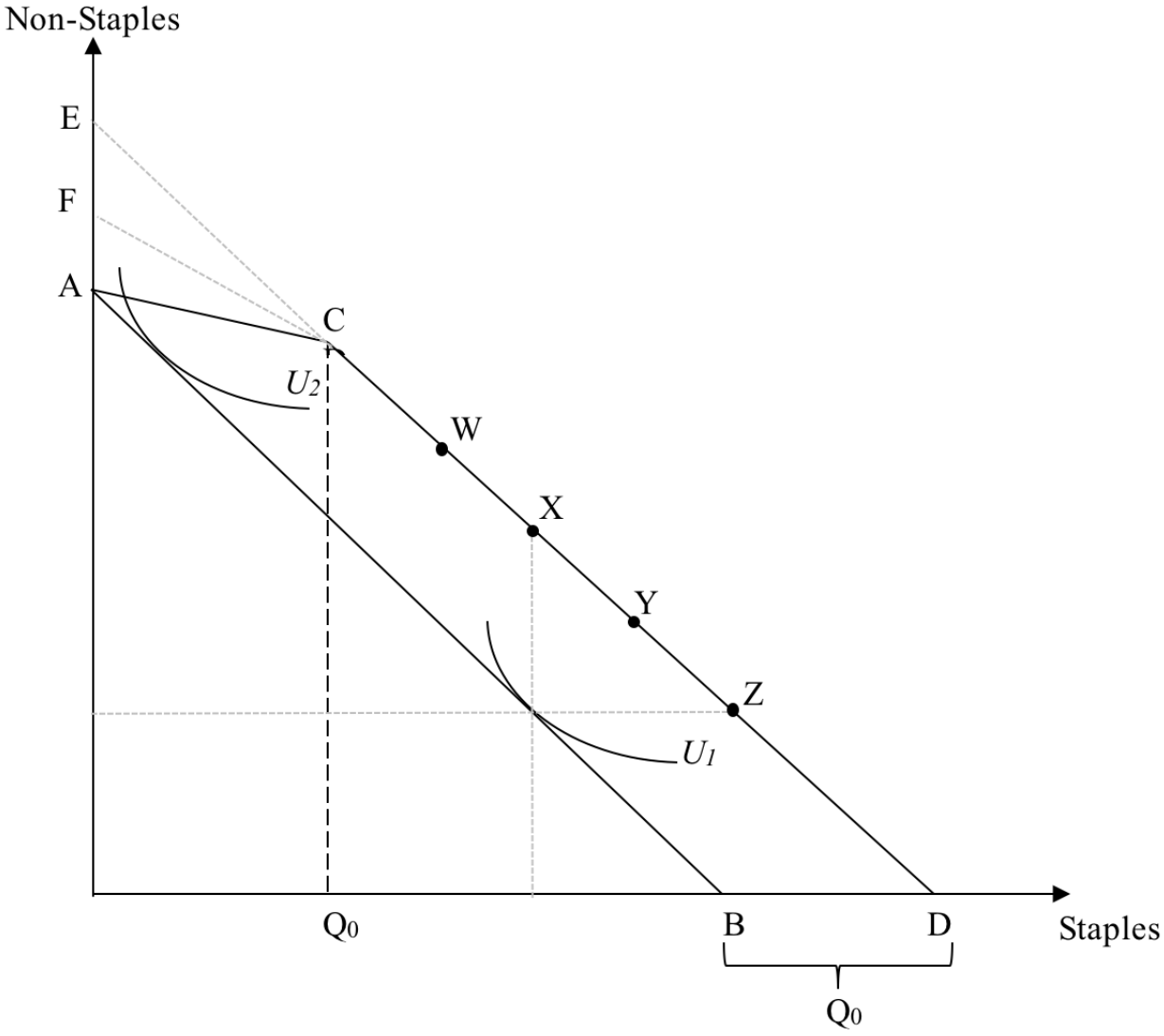


Figure 1: In-kind staple food vs Non-staple consumption

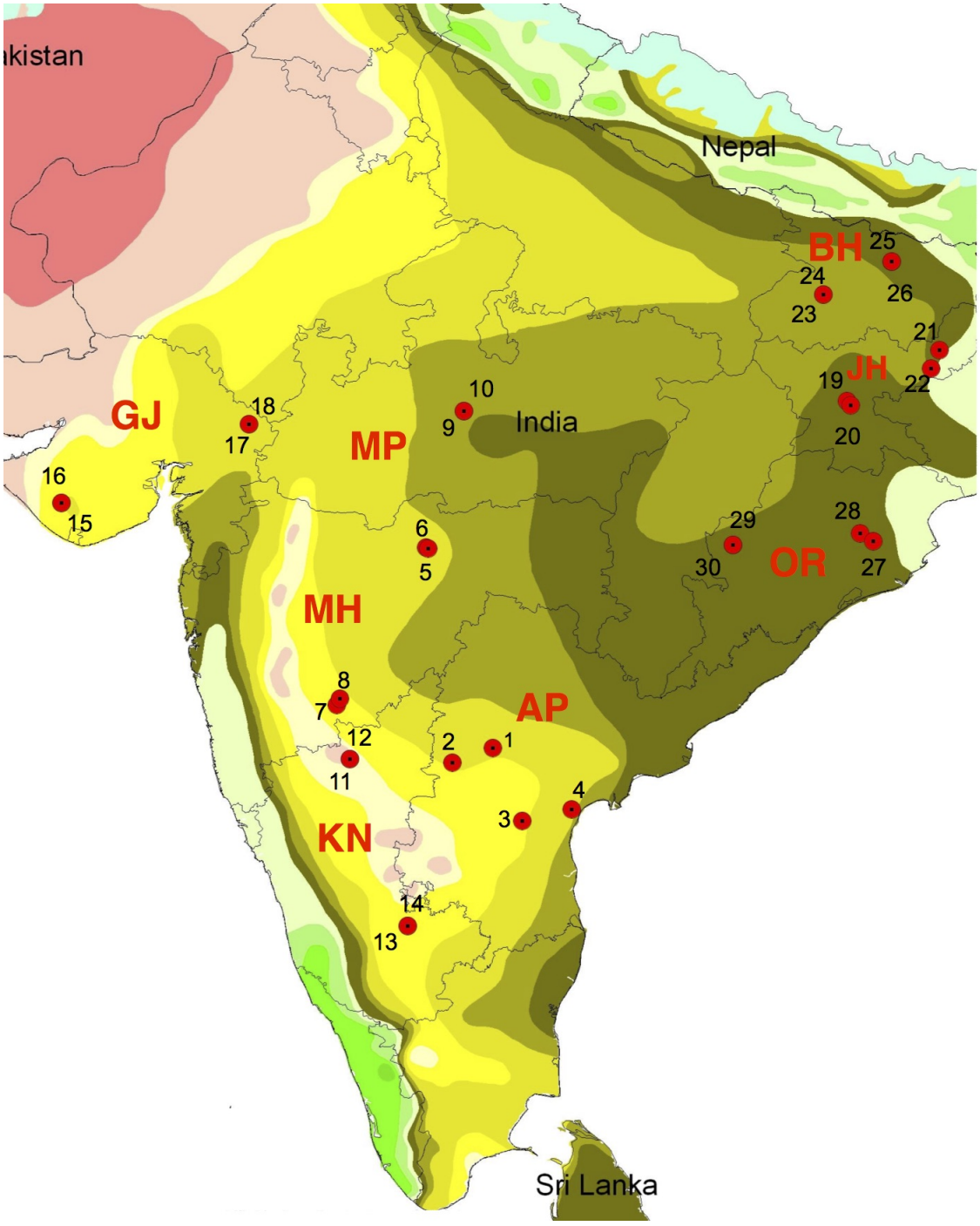


Figure 2: Location of ICRISAT VDSA villages 30 villages across 8 states

Table 1: Summary Stats

	AAY	BPL	APL/NoCard	Total
Number of HHs	105	579	533	1217
Number of members in the HH	4.706	4.724	5.040	4.861
	(2.125)	(2.238)	(2.377)	(2.296)
Nutrient and Calorie intake				
Calorie intake (Kcals)	2115.7	2032.5	2009.1	2029.7
	(740.9)	(794.8)	(746.3)	(770.1)
Protein intake (gms)	56.61	52.06	54.04	53.31
	(22.43)	(21.92)	(21.18)	(21.69)
Fat intake (gms)	39.21	37.92	46.74	41.84
	(19.53)	(35.99)	(25.96)	(31.07)
Consumption Quantity (in Kgs)				
Total Staple Cereals	12.82	11.46	10.43	11.13
	(5.886)	(5.546)	(5.608)	(5.648)
Quantity of pds grain consumed	7.259	5.400	1.183	3.742
	(3.905)	(3.883)	(2.511)	(4.067)
Pulses	1.066	1.035	0.964	1.007
	(0.704)	(0.811)	(0.677)	(0.748)
Expenditure and Income (in 2010 value)				
Food expenditure	558.2	596.7	715.6	644.7
	(236.4)	(305.3)	(359.1)	(330.6)
Non-food expenditure	518.7	667.3	757.5	693.4
	(1708.2)	(3221.9)	(3394.4)	(3197.9)
Total expenditure	1077.3	1264.7	1475.6	1339.4
	(1760.8)	(3278.9)	(3477.1)	(3267.4)
Implict PDS Subsidy	198.9	127.1	10.54	83.05
	(131.2)	(69.42)	(22.64)	(91.77)
Income total	1567.4	2243.5	2680.4	2375.9
	(4128.6)	(16946.8)	(13784.3)	(14878.5)

Standard deviation in parentheses. All values, except number of HHs and household size, represent the adult equivalent per household. Nutrient and Calorie intake is measured daily per-adult equivalent. Consumption quantity, expenditure and income is measured monthly per-adult equivalent.

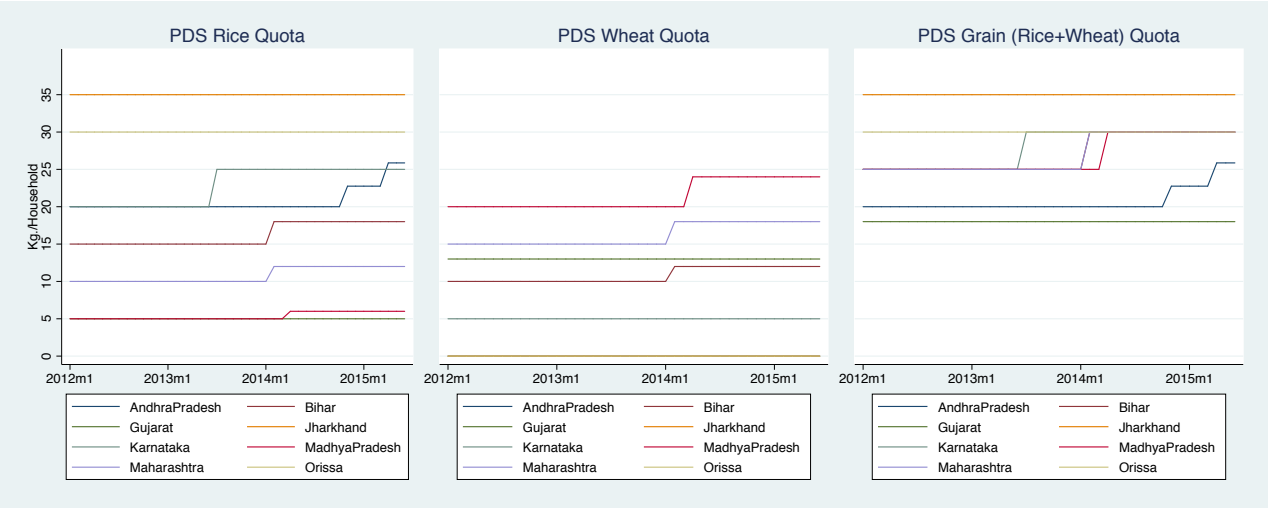


Figure 3: PDS quantity entitlement for BPL households from 2012 to 2015

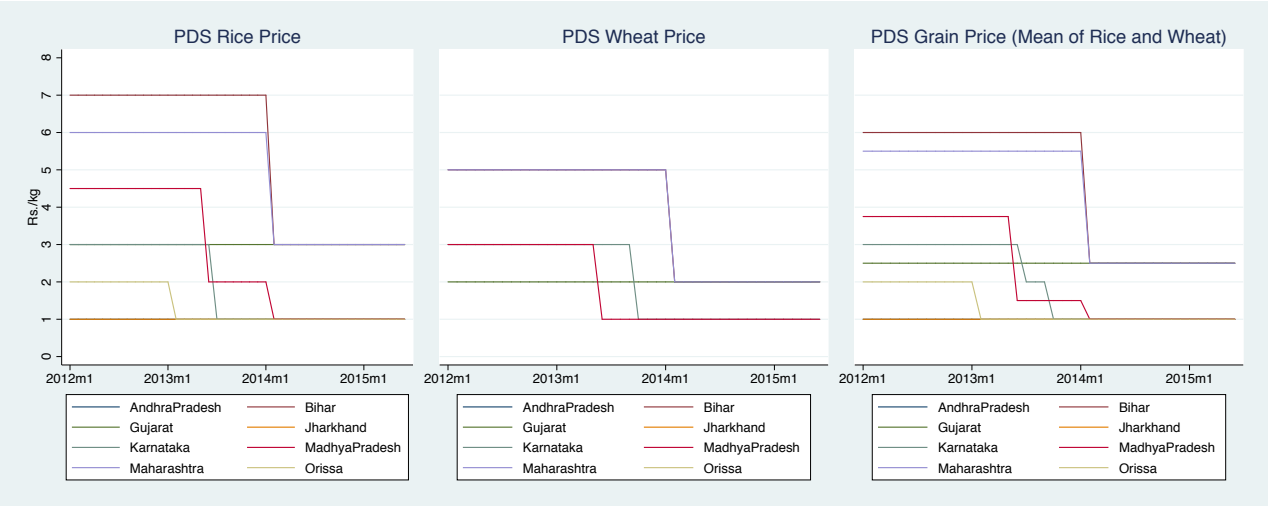


Figure 4: PDS price entitlement for BPL households from 2012 to 2015

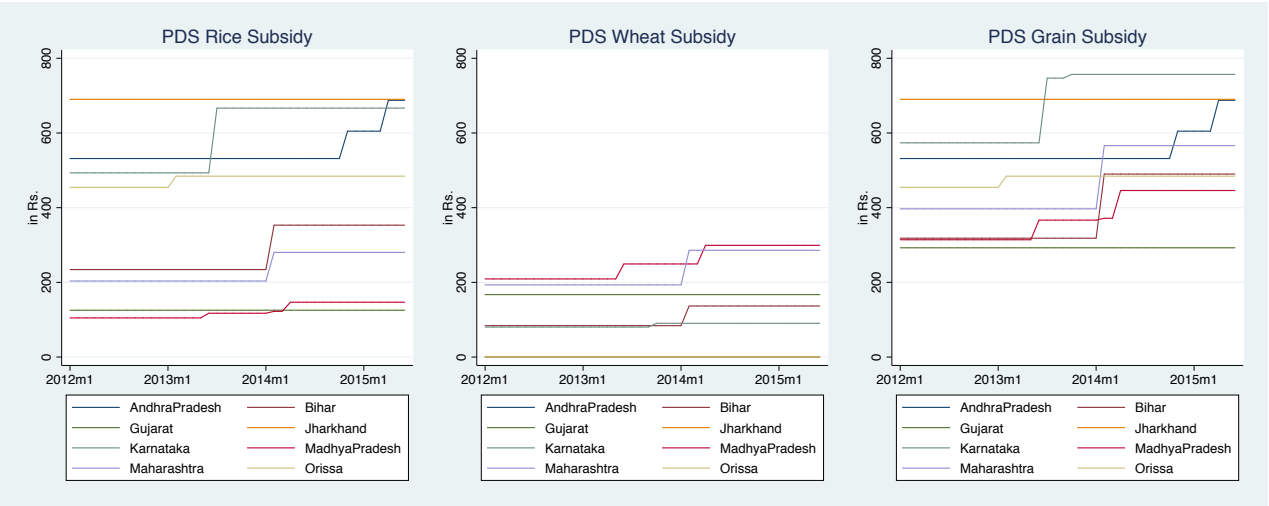


Figure 5: PDS implicit subsidy entitlement for BPL households from 2012 to 2015

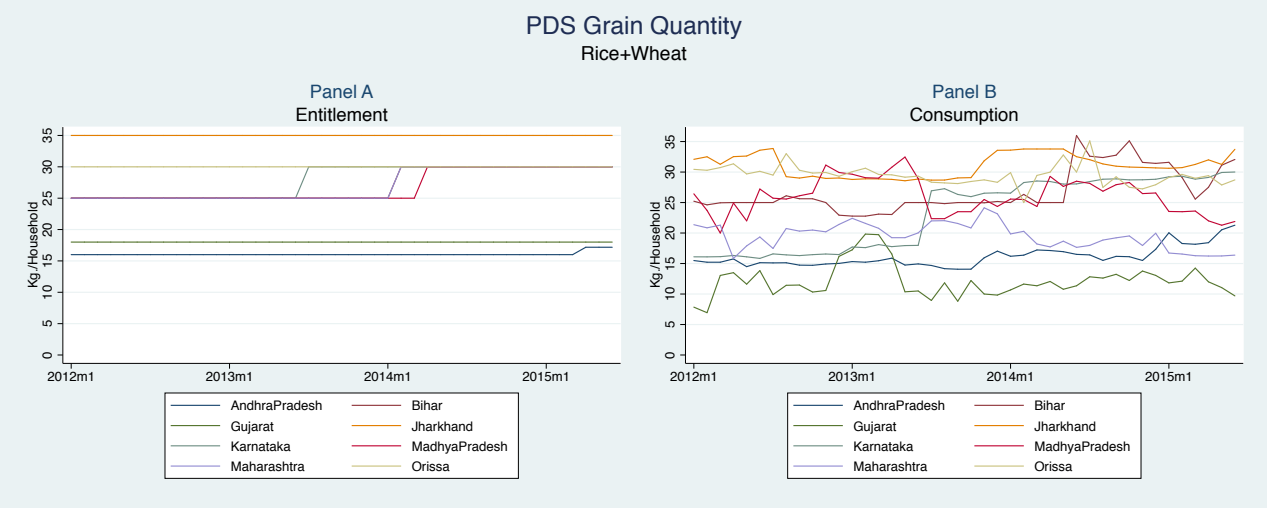


Figure 6: PDS Grain Quantity Entitlement vs Consumption for BPL households from 2012-15

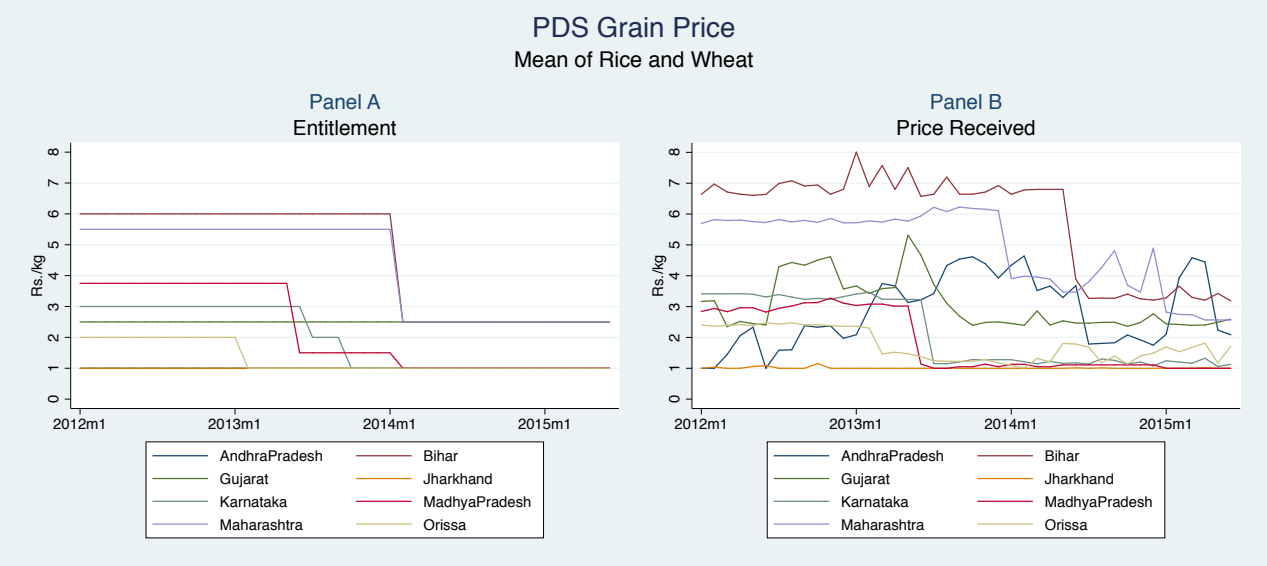


Figure 7: PDS Grain price Entitlement vs Consumption for BPL households from 2012-15

Table 2: PDS Take-up (N=36,894)

	PDS entitlement received
Rice	
Quantity entitlement	0.588***
	(0.096)
Price entitlement	0.795***
	(0.106)
Wheat	
Quantity entitlement	0.464***
	(0.123)
Price entitlement	0.979**
	(0.437)
Staple Cereals (Rice and wheat)	
Quantity entitlement	0.551***
	(0.100)
Price entitlement	0.833***
	(0.171)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression.

Table 3: Impact of PDS subsidy on food consumption (N=36,894)

	Quantity (in grams)	Value (in 2010 Rs)
Staple Cereals (Rice and Wheat)		
All sources (Market +PDS+Home)	22.656***	-0.021
	(2.929)	(0.024)
Purchase from PDS only	26.357***	-0.019
	(3.099)	(0.022)
Without PDS (Market + Home)	-3.516**	0.018
	(1.576)	(0.022)
Purchase from market only	-1.370	-0.060**
	(1.370)	(0.030)
From Home production only	-2.085**	-0.021
	(1.053)	(0.016)
Other food types		
Pulses	1.897***	0.092***
	(0.337)	(0.021)
Coarse cereal	3.499	0.011
	(2.849)	(0.035)
Milk and milk products	6.620*	0.140**
	(3.376)	(0.066)
Fruits	-	0.042***
		(0.013)
Vegetables	-	0.081*
		(0.047)
Eggs	3.967	0.010
	(2.589)	(0.007)
Meat	0.198	0.031
	(0.256)	(0.031)
Sugar and spice	1.629**	0.099**
	(0.716)	(0.042)
Oils	0.777*	0.048
	(0.405)	(0.031)
Other food items	-	0.136***
		(0.032)
Meals outside	-	0.213***
		(0.047)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.

Table 4: Effect of PDS subsidy value on energy and nutrient intake (N=36,894)

	Energy (Kcal)	Protein (mg)	Fat (mg)
Staples (Rice and wheat)	2.529***	63.628***	5.795***
	(0.301)	(7.819)	(0.830)
Staples from PDS	2.920***	69.087***	6.038***
	(0.232)	(6.393)	(0.479)
Staples except PDS	-0.483	-13.419	-1.425
	(0.437)	(11.335)	(1.147)
Non-staple food	1.766***	42.371***	62.207***
	(0.366)	(9.094)	(14.938)
Total Food	3.287***	76.156***	47.576***
	(0.444)	(11.145)	(13.496)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.

Table 5: MPC food and non-food, out of PDS Subsidy and total expenditure (N=36,894)

	PDS Subsidy	Expenditure
Food expenditure		
Food total (Home+Purchase+gifts)	0.825***	0.127***
	(0.262)	(0.017)
Food total (without PDS and Midday meal)	0.808***	0.127***
	(0.267)	(0.017)
Food from purchase (with PDS)	0.527**	0.064***
	(0.196)	(0.010)
Food from purchase (without PDS)	0.505**	0.063***
	(0.190)	(0.010)
Food from home production	0.035	0.020***
	(0.071)	(0.005)
Non-Food expenditure		
Non-food total	0.116	0.842***
	(0.527)	(0.025)
Grinding and Milling expenditure	0.017***	0.001***
	(0.006)	(0.000)
Medical (domestic & hospital) expenditure	0.086	0.071***
	(0.072)	(0.007)
Educaton	-0.022	0.060***
	(0.067)	(0.008)
Cell phone use	0.066***	0.004***
	(0.012)	(0.001)
Cosmetics	0.045***	0.005***
	(0.015)	(0.000)
Energy expenditure (LPG, kerosene)	0.020**	0.001**
	(0.007)	(0.000)
Drugs (Alcohol, Toddy, Tobacco)	0.002	0.013***
	(0.069)	(0.002)
Travel (Petrol, vehicle, etc)	0.045	0.034***
	(0.068)	(0.005)
Clothes	0.003	0.054***
	(0.055)	(0.005)
Ceremonies, marriage expenses	0.019	0.062***
	(0.066)	(0.006)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.

Table 6: Elasticities of energy and nutrient intake with respect to PDS subsidy value and expenditure (N=36,894)

	Panel A : PDS Subsidy			**Panel B : Total Expenditure**		
	Energy (Kcal)	Protein (mg)	Fat (mg)	Energy (Kcal)	Protein (mg)	Fat (mg)
Total Food	0.285***	0.273***	0.222***	0.211***	0.225***	0.271***
	(0.034)	(0.032)	(0.040)	(0.023)	(0.024)	(0.031)
Staple food (Rice and wheat)	0.317***	0.303***	0.284***	0.173***	0.179***	0.191***
	(0.045)	(0.047)	(0.055)	(0.022)	(0.024)	(0.029)
Non-staple food	0.220***	0.204***	0.215***	0.350***	0.384***	0.355***
	(0.044)	(0.045)	(0.048)	(0.034)	(0.037)	(0.031)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.

Table 7: Elasticities of calories, proteins and fats with respect to other Income sources

	Kcal	Protein	Fat	N
Other Government benefits				
Middaymeals	0.114***	0.103***	0.087***	7961
	(0.014)	(0.014)	(0.013)	
Pensions	0.096***	0.098***	0.124***	5561
	(0.025)	(0.024)	(0.028)	
Scholarships and Relief	-0.001	0.000	-0.004	684
	(0.006)	(0.006)	(0.009)	
All benefits, expect PDS	0.014***	0.012***	0.016***	15381
	(0.003)	(0.003)	(0.003)	
Income sources				
Farm wage Income	0.029***	0.027***	0.015**	15184
	(0.006)	(0.006)	(0.007)	
Non-Farm wage Income	-0.007	-0.002	0.012	24218
	(0.006)	(0.006)	(0.008)	
NREGA wages income	-0.003	-0.007	-0.007	1643
	(0.010)	(0.010)	(0.010)	
Credit (formal and informal)	0.016***	0.016***	0.015***	4765
	(0.003)	(0.003)	(0.004)	
Loans (formal and informal)	0.009***	0.010***	0.007***	13314
	(0.002)	(0.002)	(0.002)	
Income from Crop and livestock	0.004	0.004*	0.008**	27656
	(0.002)	(0.002)	(0.003)	
Total Income	0.008***	0.009***	0.011***	29003
	(0.002)	(0.002)	(0.002)	

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with row headings representing regressor variables in natural logarithm and column heading representing dependent variables in natural logarithm.

Table 8: Intra-household bargaining as a facilitator of nutrition through PDS (N=34941)

	Panel A Household Maintainence			**Panel B** Crop production, sale and use			**Panel C** Credit management		
	PDS Subsidy	IH Bargaining	Interaction	PDS Subsidy	IH Bargaining	Interaction	PDS Subsidy	IH Bargaining	Interaction
Nutrient intake									
Total Calorie intake (in kcals)	3.840***	-58.250*	0.473*	4.368***	-66.076**	0.751***	3.892***	25.219	0.179
	(0.595)	(34.527)	(0.275)	(0.763)	(31.835)	(0.279)	(0.655)	(37.406)	(0.360)
Total Protein intake (in milli gms)	95.313***	-1579.460*	11.280	108.957***	-2042.303**	19.561**	97.801***	380.026	4.864
	(15.081)	(905.332)	(7.314)	(19.720)	(899.156)	(7.648)	(16.603)	(1056.374)	(10.132)
Total Fat intake (in milli gms)	58.633***	-922.014	9.440	70.022***	-1718.503*	14.847*	56.932***	1031.574	-5.516
	(15.512)	(835.111)	(6.358)	(18.841)	(900.366)	(8.021)	(16.733)	(917.194)	(8.424)
Expenditures									
Food expenditures total	0.781***	-24.737**	0.161*	0.897***	-16.332	0.171	0.820***	6.238	0.050
	(0.200)	(11.860)	(0.093)	(0.250)	(14.832)	(0.115)	(0.213)	(14.326)	(0.128)
Spending on non-essentials									
Cell and land line phone bill	0.025*	3.459**	-0.028***	0.031	-1.069	0.002	0.035**	-2.518	0.015
	(0.015)	(1.439)	(0.011)	(0.019)	(2.226)	(0.015)	(0.016)	(1.809)	(0.013)
Drugs expenditure (Alcohol, Tobacco)	0.029	1.172	-0.064**	-0.047	2.429	-0.026	-0.002	1.488	-0.019
	(0.047)	(2.820)	(0.025)	(0.061)	(4.656)	(0.037)	(0.056)	(4.161)	(0.036)
Spending on essentials									
Energy expenditure (Charcoal, Kerosene)	0.022***	-0.453	0.011**	0.020***	-0.343	-0.003	0.012**	-0.303	-0.002
	(0.006)	(0.489)	(0.005)	(0.007)	(0.521)	(0.005)	(0.005)	(0.437)	(0.004)
Medical domestic & hospital expenditure	0.328	6.057	-0.094	0.279	3.172	0.011	0.309	-5.103	-0.024
	(0.313)	(28.788)	(0.190)	(0.324)	(25.545)	(0.165)	(0.301)	(31.981)	(0.174)
Education (Fees, books)	-0.051**	-8.269	0.035	0.017	-17.423**	0.127***	-0.027	-10.003*	0.079**
	(0.024)	(5.773)	(0.031)	(0.038)	(6.820)	(0.041)	(0.028)	(5.527)	(0.033)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with row headings representing regressor variables in natural logarithm and column heading representing dependent variables in natural logarithm.

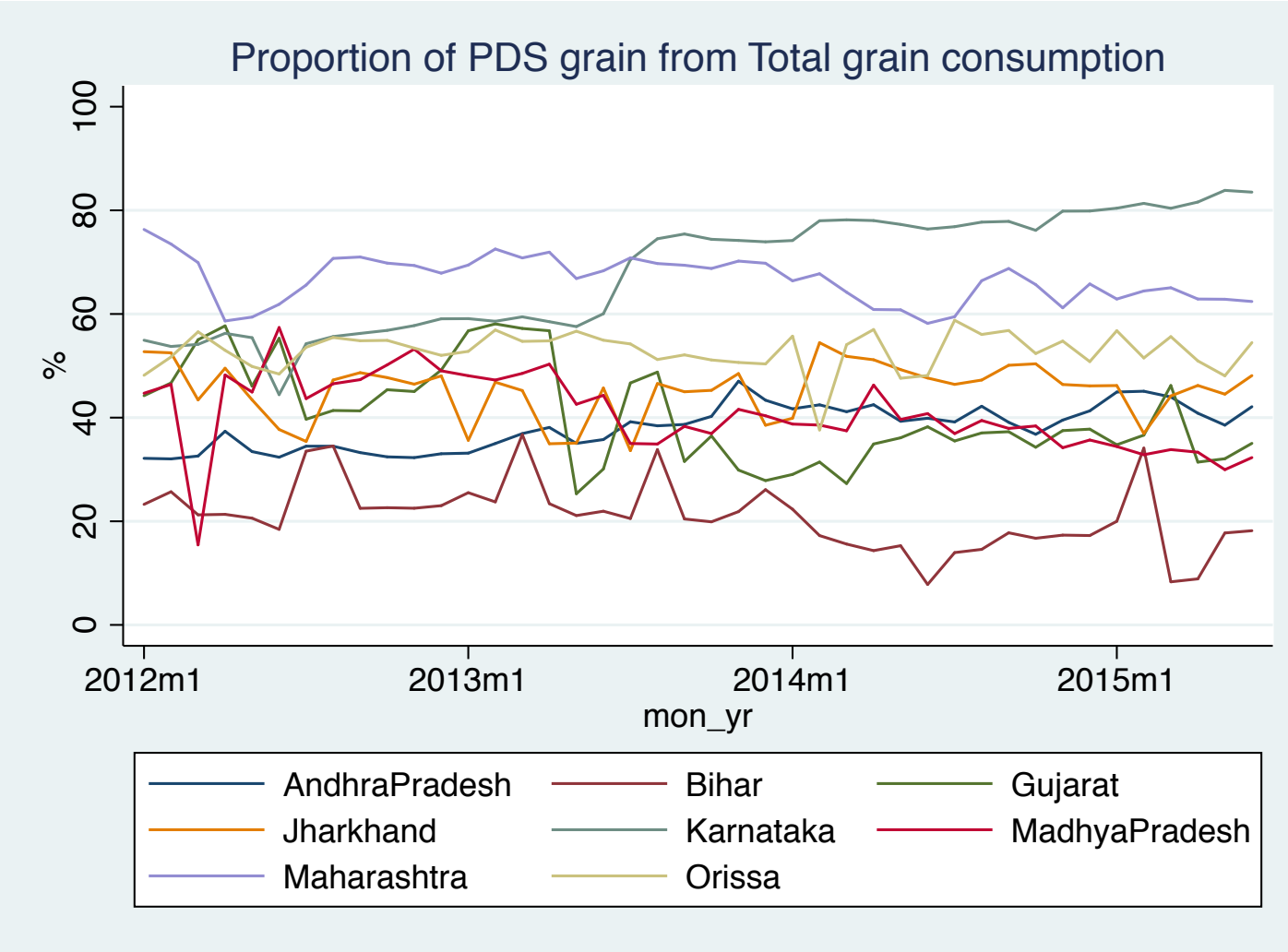


Figure A1: Proportion of PDS grain out of Total grain consumption, By State

Table A1: PDS Policy Matrix

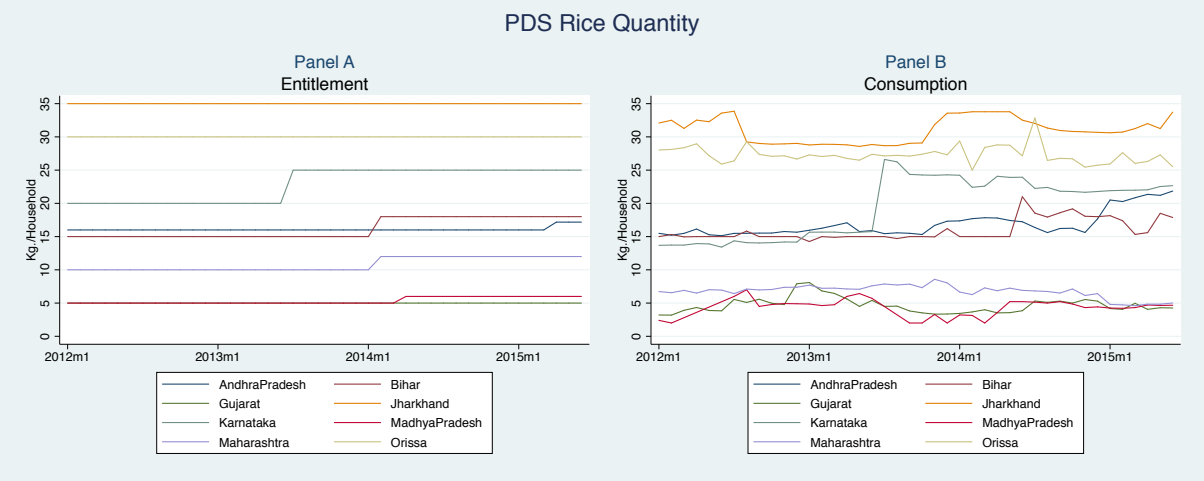
		PRE-NFSA (Before 2013)			POST-NFSA (After 2013)			
		Item	Quantity	Price	Quantity	Price	Quantity	Price
					Oct-14		**Apr-15**	
Andhra Pradesh†	AAY	Rice	35kg	Rs 2/kg	-	-	-	-
	BPL	Rice	4kg/member (Max 20kg/HH)	Rs 2/kg	6kg/member (No ceiling)	-	5kg/member (No ceiling)	-
		Wheat	No Wheat					
					NFSA - Nov-14			
Bihar	AAY	Rice	21kg	Rs 3/kg	-	-		
		Wheat	14kg	Rs 2/kg	-	-		
	BPL	Rice	15kg	Rs 7/kg	3kg/member	Rs 3/kg		
		Wheat	10kg	Rs 5/kg	2kg/member	Rs 2/kg		
Gujarat	AAY	Rice	16kg	Rs 3/kg	No changes			
		Wheat	19kg	Rs 2/kg				
	BPL	Rice	5 kg	Rs 3/kg				
		Wheat	13 kg	Rs 2/kg				
Jharkhand	AAY	Rice	35kg	Re 1/kg	No changes			
	BPL	Rice	35kg	Re 1/kg				
		Wheat	No wheat					
					Anna Bhagya Yojana Jul-13		**Anna Bhagya Oct-13**	
Karnataka	AAY	Rice	29kg	Rs 3/kg	-	Rs 1/kg	-	Rs 1/kg
		Wheat	6kg	Rs 2/kg	-	Rs 2/kg	-	Rs 1/kg
	BPL	Rice	4kg/member	Rs 3/kg	27 kg	Rs 1/kg	27 kg	Rs 1/kg
		Wheat	1 kg/member (Max 25kg/HH)	Rs 3/kg	3 kg (30kg/HH)	Rs 3/kg	3 kg (30kg/HH)	Rs 1/kg
					NFSA Feb-2014			
Maharashtra	AAY	Rice	15kg or 10kg	Rs 3/kg	-	-		
		Wheat	20kg or 25 kg	Rs 2/kg	-	-		
	BPL	Rice	15kg	Rs 6/kg	2kg/member	Rs 3/kg		
		Wheat	20kg	Rs 5/kg	3kg/member (5kg/member)	Rs 2/kg		
	APL	Rice	5kg	Rs 9.6/kg	-	-		
		Wheat	10kg	Rs 7.2/kg	-	-		
					Jul-13		**Apr-14**	
Madha Pradesh					**Mukhyamantri Annapurna Scheme**		**NFSA**	
	AAY	Rice	5kg	Rs 3/kg	-	Rs 2/kg	-	-
		Wheat	30kg	Rs 2/kg	-	Rs 1/kg	-	
	BPL	Rice	1 to 5kg	Rs 4.5/kg	5kg	Rs 2/kg	1kg/member	Rs 1/kg
		Wheat	15-20kg (Max of 20 kg/HH)	Rs 3/kg	20kg	Rs 1/kg	4kg/member (5kg/member)	Rs 1/kg
					Feb-13			
Orissa	AAY	Rice	35kg	Rs 2/kg	-	Rs 1/kg		
	BPL	Rice	25kg	Rs 2/kg	-	Rs 1/kg		
		Wheat	No wheat for BPL					
	APL (sometimes)	Wheat	10kg	Rs 7/kg	-	-		

†Andhra Pradesh decreased Rice price to Re. 1/kg in Nov-11

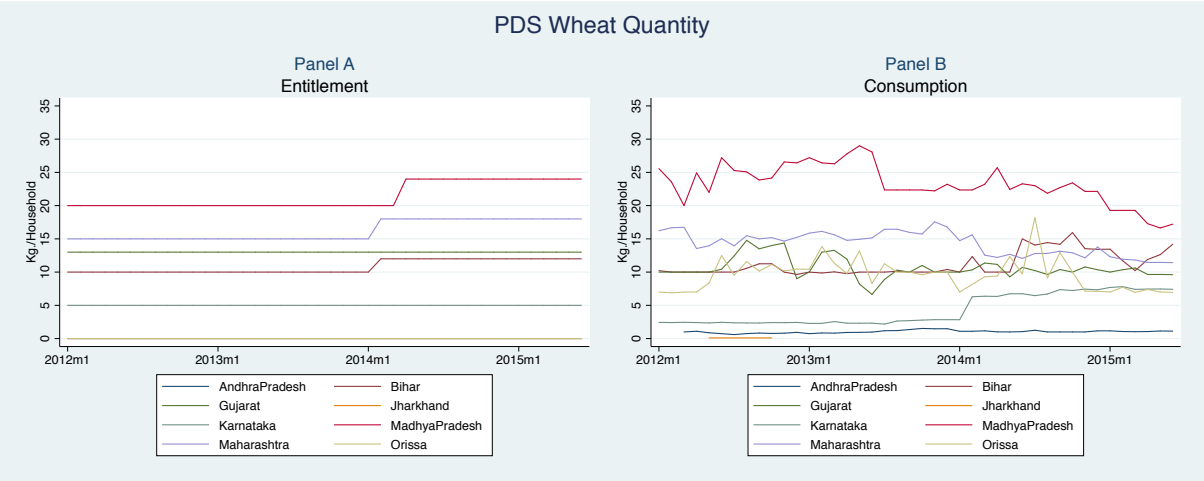
‡ Madhya Pradesh reduced Rice price to Re 1/kg in Feb-14.

Table A2: Household resource allocation decisions by gender

	Frequency tabulations (in percentages)		
	Male only	Both	Female only
Assets			
Land	45	49	6
Credit	47	47	6
Livestock	32	59	8
Inputs			
Labor	22	65	13
Fertiliser	57	39	3
Outputs			
Production	39	58	4
Sale Quantity	40	55	5
Fodder	36	60	4
Others			
HH maintenance	13	59	27
Child's education	22	71	7
Migration	41	52	6

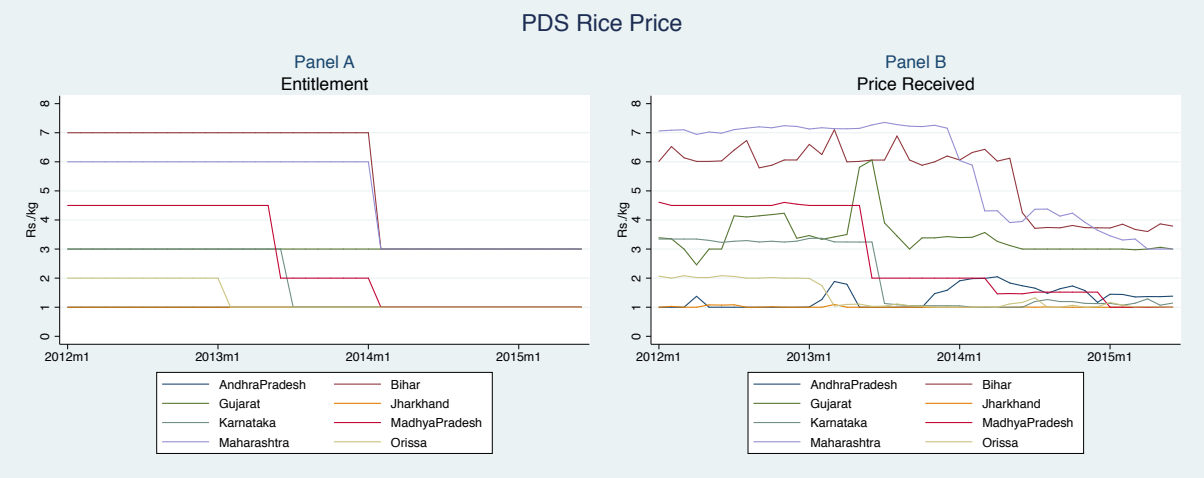


(a) PDS Rice Quantity

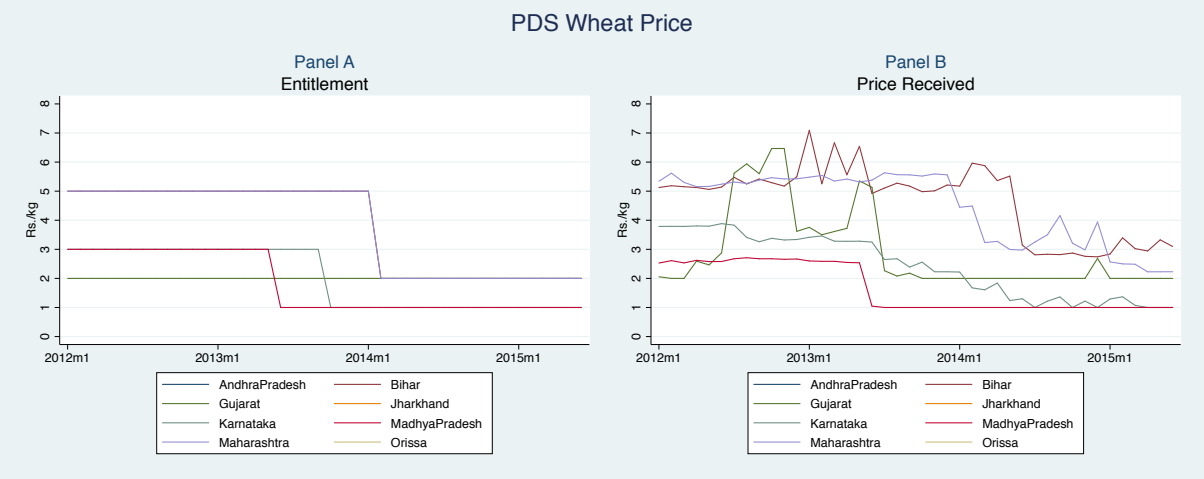


(b) PDS Wheat Quantity

Figure A2: PDS Quantity Entitlement vs Consumption for BPL households from 2012-15



(a) PDS Rice Price



(b) PDS Wheat Price

Figure A3: PDS Price Entitlement vs Consumption for BPL households from 2012-15

Table A3: Impact of PDS Subsidy on staple cereal consumption (N=36,894)

	Quantity (in grams)	Value (in 2010 Rs)
All sources (Market +PDS+Home)		
Rice	18.033***	-0.006
	(2.377)	(0.021)
Wheat	4.793***	-0.011
	(0.862)	(0.011)
Purchase from PDS only		
Rice	19.379***	-0.031
	(2.680)	(0.020)
Wheat	6.977***	0.012
	(0.805)	(0.007)
Without PDS (Market + Home)		
Rice	-1.336	-0.007
	(1.267)	(0.022)
Wheat	-2.179**	-0.030***
	(0.875)	(0.011)
Purchase from market only		
Rice	-0.379	-0.008
	(1.128)	(0.021)
Wheat	-0.991	-0.012
	(0.727)	(0.010)
From Home production only		
Rice	-0.771	-0.002
	(0.830)	(0.013)
Wheat	-1.314**	-0.019**
	(0.580)	(0.008)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.

Table A4: MPC energy and nutrient intake with respect to PDS subsidy value and expenditure (N=36,894)

	Panel A MPC with PDS Subsidy			**Panel B MPC with Expenditure**		
	Energy (Kcal)	Protein (milli gms)	Fat (milli gms)	Energy (Kcal)	Protein (milli gms)	Fat (milli gms)
Staple cereal consumption						
Rice and Wheat from PDS	2.920***	69.087***	6.038***	0.007	0.057	0.011
	(0.232)	(6.393)	(0.479)	(0.007)	(0.174)	(0.017)
Rice and Wheat except PDS	-0.483	-13.419	-1.425	0.089***	2.477***	0.229***
	(0.437)	(11.335)	(1.147)	(0.015)	(0.467)	(0.043)
Other food types						
Pulses	0.227***	15.173***	0.278	0.017***	1.134***	0.104***
	(0.042)	(3.076)	(1.586)	(0.003)	(0.181)	(0.034)
Coarse cereals	0.245	7.794	1.211	0.015***	0.484***	0.143***
	(0.201)	(6.268)	(1.756)	(0.005)	(0.144)	(0.042)
Eggs	0.005	0.379	0.379	0.000***	0.038***	0.038***
	(0.005)	(0.400)	(0.400)	(0.000)	(0.011)	(0.011)
Milk and Milk products	0.201*	7.829*	14.275*	0.017***	0.671***	1.202***
	(0.106)	(3.946)	(7.708)	(0.003)	(0.112)	(0.205)
Oils	0.341**	-0.051	38.137**	0.036***	0.000	4.042***
	(0.152)	(0.031)	(16.853)	(0.005)	(0.000)	(0.590)
Sugar	0.183**	0.046**	-	0.016***	3.994***	3.994***
	(0.084)	(0.021)		(0.003)	(0.757)	(0.757)
Vegetables	0.222**	6.364*	1.629*	0.015***	0.487***	0.085***
	(0.090)	(3.222)	(0.904)	(0.003)	(0.107)	(0.020)
Fruits	0.129***	1.299***	-0.006	0.003***	0.057***	0.013***
	(0.037)	(0.388)	(0.216)	(0.001)	(0.011)	(0.004)
Meat	0.010	2.813	-0.630	0.003***	0.625***	0.081***
	(0.012)	(2.167)	(0.578)	(0.001)	(0.095)	(0.012)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.

Table A5: MPC on energy and nutrient intake with respect to total expenditure value (N=36,894)

	Energy (Kcal)	Protein (mg)	Fat (mg)
Total Food	0.212***	6.043***	6.030***
	(0.031)	(0.909)	(0.790)
Staple food (Rice and wheat)	0.093***	2.526***	0.270***
	(0.013)	(0.401)	(0.053)
Non-staple food	0.170***	4.863***	7.259***
	(0.026)	(0.744)	(0.997)

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.

Table A6: Elasticity of calories, proteins and fats with respect to PDS subsidy value and total expenditure value (N=36,894)

	Panel A Elasticity with PDS subsidy			**Panel B Elasticity with Total Expenditure**			
	Energy (Kcal)	Protein (gms)	Fat (gms)	Energy (Kcal)	Protein (gms)	Fat (gms)	Observations
Staple cereal consumption							
Rice and Wheat from PDS	0.640***	0.635***	0.619***	0.042*	0.045*	0.050*	31205
	(0.070)	(0.071)	(0.076)	(0.022)	(0.023)	(0.027)	
Rice and Wheat except PDS	0.019	0.037	0.056	0.252***	0.254***	0.261***	31310
	(0.126)	(0.118)	(0.113)	(0.033)	(0.033)	(0.033)	
Other food types							
Pulses	0.278***	0.280***	0.197**	0.262***	0.262***	0.268***	36368
	(0.050)	(0.053)	(0.085)	(0.028)	(0.028)	(0.042)	
Coarse cereals	0.217***	0.238***	0.299***	0.166***	0.165***	0.159***	19700
	(0.076)	(0.075)	(0.096)	(0.029)	(0.030)	(0.030)	
Eggs	0.372***	0.372***	0.372***	0.129***	0.129***	0.129***	19122
	(0.095)	(0.095)	(0.095)	(0.020)	(0.020)	(0.020)	
Milk and Milk products	0.269**	0.277**	0.267**	0.249***	0.242***	0.250***	28424
	(0.102)	(0.101)	(0.103)	(0.044)	(0.043)	(0.045)	
Oils	0.245***	-	0.246***	0.248***	0.406***	0.247***	36542
	(0.082)		(0.082)	(0.028)	(0.080)	(0.028)	
Sugar	0.238**	0.238**	0.238**	0.236***	0.236***	0.236***	33802
	(0.089)	(0.089)	(0.089)	(0.031)	(0.031)	(0.031)	
Vegetables	0.388**	0.386**	0.468*	0.294***	0.305***	0.302***	36640
	(0.156)	(0.177)	(0.243)	(0.042)	(0.045)	(0.048)	
Fruits	0.843***	0.632***	0.307	0.357***	0.316***	0.325***	29969
	(0.235)	(0.180)	(0.195)	(0.055)	(0.043)	(0.037)	
Meat	0.178	0.233**	-0.232	0.336***	0.335***	0.363***	24208
	(0.127)	(0.112)	(0.281)	(0.040)	(0.042)	(0.041)	

Standard errors in parentheses. * p<0.10 ** p<0.05 *** p<0.01. Each coefficient estimate is from a separate regression with PDS subsidy value as the regressor and different food catogories as outcome variables.