Abstract

Would households be able to buy more subsidized grains from a food-based safety-net program if the difference between prices in the program and in the open market were to increase? This is an important question for safety-net programs anywhere, but particularly so for the Public Distribution System (PDS) of grains in India—world's largest food-based safety-net program. Price difference between the PDS and the open market can result in diversion of grains to open markets—an entitlement-snatching effect. Drèze and Sen (2013), however, posit the opposite—an entitlement-fetching effect, where an increase in arbitrage increases the value of the PDS entitlement that raises the stakes in PDS for eligible beneficiaries. This results in a rise in accountability and ultimately an increase in household purchases of grains from the PDS. We test these two competing hypotheses using multiple panel datasets: . We find both entitlement-snatching and entitlement-fetching effects. In states where welfare programs are better governed, the Drèze and Sen (2013) conjecture holds. —Where welfare programs are poorly run, i.e. in states like Bihar and Jharkhand—the opposite pattern exists; households' purchase of subsidized grains recedes with greater arbitrage.

Keywords: public distribution system, corruption; arbitrage; social safety-nets, National Food Security Act

1. INTRODUCTION

Food subsidy programs in developing countries are often rife with corruption and pilferage (Mehta and Jha 2014). The most common form of corruption is the diversion of food away from the intended beneficiaries. An important question is whether this diversion increases or decreases with the price differential between the market and the price in the program. This matter was at the heart of the debate around India's National Food Security Act (NFSA) in 2013. NFSA significantly increased the price arbitrage in India's public distribution system (PDS) by promising a monthly ration of 25 kg of coarse cereals, wheat, or rice at INR1, 2, or 3 per kg, respectively, to nearly two-thirds of all households. This change implies that the average price in the open market was now six to seven times higher than the subsidized price in the PDS.

The standard economic intuition suggests that price controls distort signals and create incentives for unintended transactions (Sowell 2000). Further, these unintended transactions increase in magnitude as the incentive (the arbitrage) increases (Banerjee, Mullianathan, and Hanna 2012). In the case of the PDS, a greater incentive for backdoor sales that deny or diminish entitlements to the designated beneficiaries is one such unintended transaction. The incidence of such transactions is expected to rise with the price wedge between subsidized and nonsubsidized food.

Conversely, Drèze and Sen (2013) argue that the increase in arbitrage may also have an opposite effect. This is because the stakes of the beneficiaries are higher when the PDS price is comparatively low; that is, when there are greater gains to be made from arbitrage. With higher stakes in the PDS, the price wedge mobilizes the beneficiaries to seek their entitlements more actively and definitively. Hence, Drèze, and Sen (2013) contend that the increase in this wedge leads to an increased accountability and, ultimately, reduced corruption.

In this paper, we test these two opposing arguments using data from different panel household surveys, the India Human Development Survey (IHDS), and the Village Dynamics in South Asia (VDSA). Using these different datasets allows us to probe the question of arbitrage and corruption in the food safety-net program from many different angles. We employ methods that address multiple issues of identification—for example, those related to individual/household level unobserved heterogeneity and endogeneity, as well as that of seasonality.

The Government of India (a federal agency) sets the retail price of subsidized items sold through the PDS. But some state governments use their own budgetary resources to reduce prices even further. Market prices of grains included in the PDS can also vary across states. Thus, there exists interstate variation in the effective arbitrage potential.

A simple measure of corruption in the PDS is the mismatch between what is released in the system and what is the uptake based on household consumption data. From household data aggregates, if total uptake falls below the amount of released grains, it is tantamount to corruption in the form of leakage or grain diversion. In this context, if Drèze and Sen's (2013) conjecture were true, we should see a negative relationship between arbitrage potential and the level of leakage.

Summary findings show that the diversion of rice and wheat from the PDS decreased from 54 percent in 2004–2005 to 38 percent in 2011–2012, even as arbitrage potential increased sharply. Further, in any given year, the extent of diversion of grains was generally lower in states where the arbitrage potential was higher. At a summary level, the state-level data on leakage and the household-level data on quantity of rice and wheat purchased from the PDS appear to support the Drèze and Sen (2013) hypothesis.

However, it is possible that this trend occurs because states that exert more effort controlling leakages could also be making the PDS more generous, for example, by topping up the federal subsidy. The arbitrage potential, greater uptake, and, therefore, lower leakages could all coincide. Also, arbitrage is lower when households buying more from the PDS buy cheaper grains from the market as well. In this case also, one would see a negative relationship between arbitrage and the household purchase of PDS grains and, possibly, a rejection of the Drèze and Sen (2013) argument, albeit spuriously.

To mitigate concerns about the potential biases discussed above, we use household panel data from the IHDS and the VDSA. The two longitudinal datasets allow us to address relevant issues of unobserved factors. The IHDS is a nationally representative survey of more than 41,000 households. The same households were interviewed in 2004–2005 and 2011–2012 to create a panel.[1] In an analysis using IHDS data, we estimate a negative and statistically significant association between the amount of cereals purchased from the PDS and the arbitrage potential using models that can control for unobserved household-level factors. This is the opposite of the Drèze and Sen (2013) conjecture.

Thus, the IHDS panel shows that households (are allowed to) buy smaller quantities of rice and wheat from PDS shops when arbitrage increases. Does the IHDS panel negate the Drèze and Sen (2013) conjecture? Our analysis based on IHDS panel shows that the answer is not straightforward; heterogeneity exists across different states. An increase in arbitrage has a positive effect on households' purchase of PDS grains in some states (where PDS is better managed [Khera 2011a]), while the opposite holds in some other states.

We then exploit the setting of a natural experiment that, given the timeline, was recorded in the IHDS data. Households in India are classified into three income categories for the purpose of targeting PDS benefits: above the poverty line (APL) households, below the poverty line (BPL) households, and *Antyodaya* or (AAY) households, which are the poorest of the poor. APL households pay the highest price for PDS grains; Antyodaya households, the lowest; and BPL, somewhere in between. A small fraction of households in the IHDS sample were reclassified from one category to another between the two rounds of the survey. Our analysis shows that households that switched from APL to BPL or AAY status purchased larger quantities of grains from the PDS, as the value of their entitlement increased significantly. Thus, an analysis based on IHDS data suggests a more nuanced and varied relationship between arbitrage and average quantity of grains that households purchase from the PDS.

Analysis using IHDS data goes some distance in addressing the issue of unobserved heterogeneity at the household level. It is possible that in the seven years between the two IHDS rounds, the market price of cereals increased and the PDS generally improved (or deteriorated) simultaneously. This could lead to potential bias in our estimates. To address this issue, we employ high-frequency data on household consumption from the VDSA, which provides monthly information on purchases of rice and wheat from PDS shops and the open market for more than 1,000 households between 2009 and 2014 in 7 states of India. We use data from 2009 to 2012 for Bihar, Jharkhand, Karnataka, and Telangana (old Andhra Pradesh). The high frequency of VDSA data makes it ideal to understand the relationship between our variables of interest because of the following reasons:

1. VDSA collected independent price data every month for each village in the sample. This data allows us to control for purchase month of the year fixed effects, which accounts for seasonality in both PDS purchase and the consumption of cereals.
2. Further, it is unlikely that the PDS governance regime will change at such high frequency i.e. in the VDSA data.

Overall, our results show that a rise in the market price or an increase in arbitrage potential because of a greater wedge between the market price of cereals and the PDS price leads to a significant reduction in the quantity of PDS rice and wheat that households are able to buy in Bihar and Jharkhand (entitlement-snatching). At the same time, quite an opposite relationship is found in Karnataka and Telangana (entitlement-fetching). What could explain the opposite effects of arbitrage across states? Bihar and Jharkhand are known as states where the PDS is very poorly managed, while Karnataka and Telangana rank among the states with a better PDS (Khera 2011a).

Thus, our analysis suggests that whether an increase in arbitrage potential for the food dealers leads to more corruption and leakage of cereals from the PDS (entitlement-snatching) or increases in household purchases of subsidized cereals (entitlement-fetching) depends on the quality of governance in the PDS. In states where the PDS is better governed, the latter effect dominates. Households in these

[1] See http://www.ihds.umd.edu/data.html for more documentation on the IHDS data.

states tend to claim more of their entitlement, as it becomes comparatively valuable and diversion decreases. In cases of poorly managed states, the exact opposite effect seems to hold, where dealers divert more and households receive less when the value of the entitlement rises.

Our results can be of great significance to food-based social safety-net programs across the world—and especially in India, where the government has significantly increased the budget allocation to the PDS (from 0.7 percent to more than 1 percent of the GDP [Mishra 2013]). For a large section of the population, grains are now provided at a much lower price to achieve food and nutritional security under the NFSA. A key argument for passage of the NFSA was that a universal, or near-universal, provision of inexpensive grains under the PDS would improve the functioning of the system. Our results show that such an association is not straightforward. Lowering the price of grains by the PDS may actually have an opposite effect, unless there is commensurate improvement in grain management.

The rest of the paper proceeds as follows. Section 2 discusses the background and institutional setting of the PDS in India during the study period, while Section 3 describes the data sources and lays out the methods we employ in our investigation. Our findings and results are presented in Section 4. Section 5 ties together our results with the existing literature, and Section 6 provides a conclusion.

2. BACKGROUND AND HYPOTHESIS

India's PDS is the largest food safety-net program in the world. In 2011–2012, more than 550 million people purchased subsidized rice and/or wheat from the large network of "fair price shops" (FPS') of the PDS.[2] In September 2013, the NFSA was signed into law. The NFSA expanded the scale of the PDS even further by entitling over 800 million people to 5 kg of subsidized cereal per month at a very low price.[3]

As with any government intervention that involves a price distortion, the risk of unintended consequences remains. The PDS has a reputation for being poorly implemented with extremely high rates of pilferage, referred to as "leakages" in the literature (Drèze and Khera 2015; Khera 2011b; Drèze, Himanshu, and Sen 2015). Leakages refer to the amount of rice and wheat released by the Food Corporation of India (FCI) that does not reach PDS beneficiaries at delivery points.

Estimates of leakages are based on matching NSS-CES data, particularly that relate to household purchases from the PDS, with "offtake" data from the FCI. Recent estimates show that in 2011–2012, 41.7 percent of the 41.3 million metric tons of rice and wheat released by the FCI to state governments for the PDS did not reach households (Drèze and Khera 2015). Yet, even this high level of leakage represents an improvement from the 54 percent leakage estimates from 2004–2005 (Himanshu and Sen 2013).

Some states are usually credited with better grain management than others, and leakages in those states are lower as well. For example, Tamil Nadu and Chhattisgarh, the poster states for a well-functioning PDS, had a leakage of less than 10 percent compared to Uttar Pradesh, West Bengal, Assam, Madhya Pradesh, Rajasthan, Punjab, and Gujarat; in these states leakage was in excess of 50 percent. Yet, on average, the aggregate trends show that PDS leakage has been reduced, against the backdrop of an inflationary period of cereal prices (Kishore and Chakrabarti 2015).

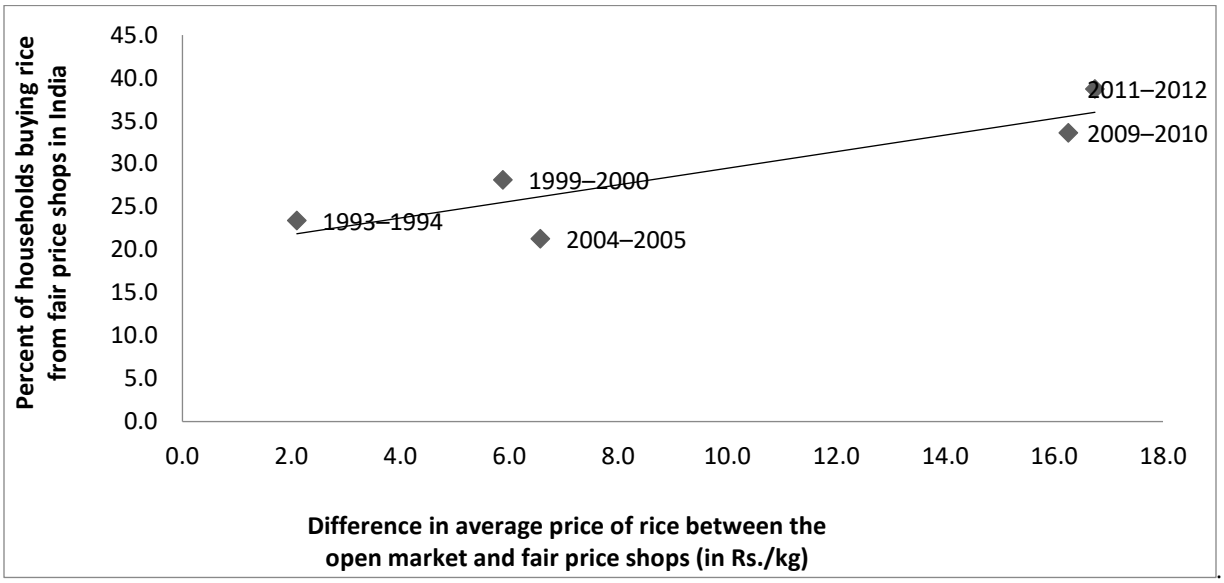
Figure 2.1 shows that PDS "access," as measured by the percentage of households that purchased grains from the PDS in a given month, changes according to arbitrage potential. There appears to be a positive relationship between the number of households who access the PDS and an increase in arbitrage potential over time. The only break in this trend is between 1990–2000 and 2004–2005, when the PDS transitioned into a targeted scheme. The PDS was, in fact, rechristened as the Targeted Public Distribution System (TPDS).

Targeting, however, resulted in more opacity, high exclusion errors, and a less generous system overall (Himanshu and Sen 2011; Khera 2011b). Thus, fewer households were able to access the PDS, even when there was an increase in arbitrage potential. Since 2004–2005, however, the PDS has become more generous and open, and it appears that more households are able to access it for cheaper grains when faced with higher open-market prices.

[2] According to NSSO consumer expenditure data based on latest round (68th), approximately 44.1 percent of India's households reported purchasing rice or wheat from the PDS in the previous month. India's population was 1.25 billion, as per the 2011 Indian census.

[3] The NFSA entitles all beneficiaries of the PDS to 5 kg/month of rice/wheat/coarse grains at INR 3/2/1 per kg, respectively.

Figure 2.1 Increase in use of fair price shops with rising price difference between market and central issue prices



Source: Data taken from the Consumption Surveys, rounds 50, 55, 61, 66, and 68 (NSSO various years).

The years between 2004–2005 and 2011–2012 saw a sharp rise in the price of rice and wheat, accompanied by an increase in the quantities purchased from the FPS. Table 2.1 shows that in the five years between 2004–2005 and 2009–2010, the nominal price of rice and wheat nearly doubled in the open market. This price rise continued in 2011–2012. A recent study suggests that a 10 percent increase in prices, on average, causes a welfare loss of 5 percent to 6 percent of monthly income in rural areas, and of 3 percent to 4 percent in urban areas of India (Weber 2014). A similar study from Mexico finds that in situations where a sharp increase in prices results in welfare losses, food subsidies can reverse the regressive nature of price increases. However, they may cause some price distortion as well (Attanasio et al. 2013).

Table 2.1 Cereal prices and procurement from the PDS between 2004–2005 and 2011–2012

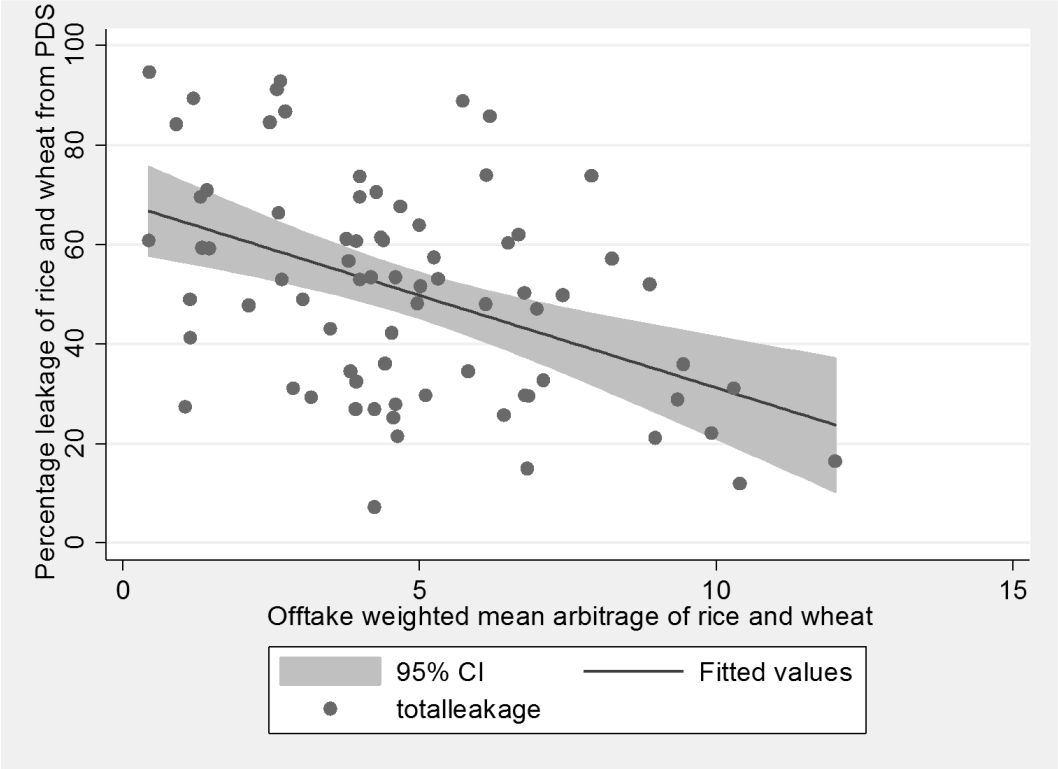
Variable	2004–2005	2009–2010	2011–2012
Average price of rice (INR/kg)	11.85	20.34	22.23
Average price of wheat (INR/kg)	9.73	16.09	16.99
Average price of PDS rice (INR/kg)	5.77	4.86	4.91
Average price of PDS wheat (INR/kg)	5.37	6.37	6.5
Average quantity of PDS rice (kg/person/month) purchased	1.05	1.56	1.79
Average quantity of PDS wheat (kg/person/month) purchased	0.25	0.52	0.62
Average percentage households purchasing PDS rice	20.77	32.36	38.85
Average percentage households purchasing PDS wheat	8.14	21.63	26.16
Average percentage leakage of rice	41.5	33.4	32.6
Average percentage leakage of wheat	74.9	64.2	57.4
Monthly per-capita consumption expenditure (INR)	851.50	1493.74	2050.87

Source: Authors estimates from CES rounds 61, 66, and 68 (various years) and Food Corporation of India data of grain offtake from the PDS 2004–2005, 2009–2010, and 2011–2012 (publisher??? various years).
Notes: PDS = public distribution system.

In India, both the percentage of households accessing the PDS for rice and wheat and the per capita quantity of grains purchased from the FPS increased between 2004–2005 and 2009–2010—just when prices rose sharply in the open market (Table 2.1). The combined effect of changes on both the extensive (purchases between market and the PDS) and the intensive (greater uptake of the PDS) margins resulted in a steady decline in diversion of rice and wheat during this period.

Figure 2.2 plots the percentage of total quantity of grains (rice plus wheat) diverted from the PDS in each state against the arbitrage potential across three rounds of the NSSO-CES. It shows a clear negative correlation between arbitrage and diversion. Here, arbitrage potential is estimated as the weighted mean of price differences for rice and wheat, where the weight equals the share of rice and wheat in the total offtake from the Food Corporation of India (FCI). The relationship between arbitrage potential and leakage, as apparent in Figure 2.2, was used as an argument to advocate for the provision of grains at very low prices in the PDS in the run-up to the NFSA (Himanshu and Sen 2011; Drèze and Sen 2013). While these observations and correlations are suggestive, an impact study is necessary to offer evidence of causality between arbitrage potential and the leakages/diversion from the food distribution system. Doing so certainly requires analysis of household purchase of grains from the PDS (that is, by employing disaggregated data).

Figure 2.2 Leakage from PDS versus arbitrage at the state level



Source: Authors estimates from NSS-CES rounds 61, 66, and 68 (NSS various years) and Food Corporation of India data of grain offtake from the PDS 2004-05, 2009-10, and 2011-12 (NSSO various years).
Notes: CI = Confidence interval; PDS = public distribution system. totalleakage= Total leakage of cereal grains from PDS

Hypothesis

The simultaneous increase in the market price of grains and the reduction in diversion from the PDS runs counter to what the standard economic theory predicts. As discussed earlier, food subsidy can lead to unintended transactions, the magnitude of which can increase as the incentive (the arbitrage) increases (Banerjee, Mullainathan, and Hanna 2012). The Drèze and Sen (2013) proposition argues for the opposite effect (that is, a positive relationship between arbitrage potential and uptake of the PDS). A theoretical model of pilferage by Mehta and Jha (2014) also predicts ambiguous effects in this context. The authors contend that arbitrage opportunities are higher when subsidies are large, but anti-graft measures rely greatly on providing citizens with an incentive to combat corruption. Therefore, pilferage rates need not rise as price subsidies increase. These two views form the bases for our hypotheses underlying the link between arbitrage potential and uptake of subsidized food.

Simple calculations show that the value of the PDS entitlement doubled as a percent of per capita expenditure between 2004–2005 and 2009–2010.[4] These changes provide an ideal setting to study the empirical link between subsidies and realized purchases of subsidized food.

The sharp rise in the price of cereals during this period allows us to exploit large price variations to trace the direction and magnitude of the effect of change in arbitrage potential on PDS purchase. Based on three different datasets (details in the next section), we try to answer two interrelated questions in this paper:

1. Does an increase in arbitrage decrease the diversion of grains in the PDS?
2. If not, under what context does the standard economic intuition continue to hold?

[4] From Table 2.1 using the formula: Value of subsidy = ((Open market price minus PDS price)*PDS quantity purchased)/ Monthly expenditure

((11.85-5.77)*1.05) + ((9.73-5.37)*0.25) / 851.80 = 9.12 + 1.09 / 851.80 = 1.2 percent of MPCE in 2004-05

((20.34-4.86)*1.56) + ((16.09-6.37)*0.52) / 1493.74 = 24.14 + 8.09 / 1493.74 = 2.1 percent of MPCE in 2009-10

3. DATA AND METHODS

Most existing studies on leakage in the PDS use state-level aggregate household purchase of PDS rice and wheat, and the total release from the FCI (Himanshu and Sen 2013; Khera 2011b; Drèze and Khera 2015). As discussed above, the gap between release and uptake by households is the measure of leakage.

However, it is possible that the price wedge increased and corruption was plugged because of other factors, and that these were not related in a causal way. Hence, changes related to the governance of the PDS in different states (reduced or increased leakage) could have happened simultaneously, but the former did not cause the latter. If so, regressing leakages or average quantity of grains purchased by households from PDS shops against arbitrage potential can return statistically significant coefficients. Yet, those can clearly be biased. We try to overcome this problem by employing more disaggregated data from different sources to test the competing theories on arbitrage potential and leakage in the PDS. Table 3.1 summarizes the key features of the four datasets used in this paper.

Table 3.1 Key features of data sets used in the study

Variable	FCI	NSS-CES	IHDS	VDSA
Sample size	156	327,161	69,264	26,825
Geographic coverage	29 states	35 states	35 states	4 states – Bihar, Jharkhand, Karnataka and Telangana
Time period	2004–2005, 2009–2010, 2011–2012	2004–2005, 2009–2010, 2011–2012	2004–2005, 2011–2012	2008–2014
Outcome used	Rice and wheat offtake	Rice and wheat purchases from PDS	Rice and wheat purchases from PDS	Rice and wheat purchases from PDS
Predictors variables used	None available	Market price, PDS price	Market price, PDS price, star states, ration card switchers	Market price, PDS price
Controls used	None available	Season, occupation, education, caste, religion, access to amenities, expenditure, residence, household size	Household fixed effects, ration card, reason for not having a card, household assets, expenditure, household size, residence	Household fixed effects
Representative	Yes- State level	Yes - National and state level	Yes - National	No
Type	Aggregate	Repeated cross-section at household level	Panel at household level	Panel at household level

Source: Authors construction.
Notes: FCI = Food Corporation of India; NSS-CES = National Sample Survey: Consumer Expenditure Survey; IHDS = Indian Human Development Survey; VDSA = Village Dynamics in South Asia; PDS = Public Distribution System.

First, we use household-level data on the purchase of rice and wheat from PDS shops and from other sources in the thick rounds of the CES carried out by the NSSO. Thick rounds of CESs are carried out by NSSO every five years. They are referred to as such because they survey almost twice the number of households as do the annual "thin" rounds. We use data from the 61st, 66th, and 68th rounds conducted in 2004–2005, 2009–2010, and 2011–2012 respectively. The NSSO-CES sample is representative not only at the national but also at the state level. Therefore, we can use NSSO data to estimate total household purchase of PDS grains in a given state in every round.

Following Gulati et al (2012), we compare the estimated household purchase of PDS grains with the total quantity of rice and wheat that the state collected from the FCI in that period. We test the relationship between the amount of grains diverted from the PDS in states and the arbitrage potential between the median market prices and the average subsidized price of grains using data from all three rounds of the NSSO-CES. Throughout the study, we use nominal or current prices to measure arbitrage. The arbitrage for both rice and wheat increased over time across all the examined states of India, even in real terms. Therefore, our results would not change qualitatively, even if we were to measure arbitrage in real prices.

We estimate both POLS regressions (equation 1) and regressions with state fixed effects and time trend (equation 2).

$$Leakage_{tsc} = \alpha + \beta arbitrage\ potential_{tsc} + \varepsilon_{tsc} \quad (1)$$

$$Leakage_{tc} = \alpha + \beta arbitrage\ potential_{tc} + \gamma_s + \mu_t + \varepsilon_{tc} \quad (2)$$

where '$Leakage$' is the percentage of grain diverted from the PDS for cereal c (rice or wheat) in state s and year t and "arbitrage potential" is the difference between the median price of the grain in the open market and in the PDS. γ_s controls for state fixed effects, and μ_t controls for the time trend. ε_{tsc} is the error term. The coefficient β on arbitrage is the coefficient of interest. We call β, the "arbitrage effect." We run regressions separately for rice and wheat, and for rice and wheat together. We estimate arbitrage as the weighted average of arbitrage for rice and wheat, where weight equals the share of the grain in the total offtake of rice plus wheat from the FCI by a specific state in a particular period.

From Leakage to Household Purchase of PDS Grains

Estimates of the leakage of grains from the PDS are available only at the national and state levels. Additional disaggregated data of grain allocation to the PDS are not available. Hence, while employing disaggregated data, instead of looking at the impact of arbitrage potential on leakage, we examine its impact on the amount of cereals purchased by the household from PDS shops.

The monthly quota of PDS rations is less than the households' total consumption of rice or wheat for most households. Also, for various reasons, most households do not buy their full quota of grains. Therefore, holding other things (such as seasonality in consumption patterns) constant, most households increase the quantity purchased from the PDS, if grains become cheaper in the PDS and/or more expensive in the open market.

If we find that the household purchase of PDS grains decreases with an increase in arbitrage potential, there is a basis to assume that the household is possibly (unfairly) not getting its full quota. Thus, looking at households' purchase of PDS cereals provides an indirect, but credible, indicator of increase (or decrease) in diversion of gains—that is, corruption in the PDS. All of the analyses in this paper, except the results shown in Figures 2.1 and Figure 2.2 and in Table 3.4 and Table 3.5, use household purchase of cereals as the outcome variable. We estimate the following model with unit-level NSS-CES data to estimate the arbitrage effect on household purchases of PDS rice or wheat

$$PDSpurchase\ _{tisv} = \alpha + \beta arbitrage\ potential\ _{tsv} + \delta X_{ti} + T_t + S_s + \varepsilon_{tisv} \quad (3)$$

where $PDSpurchase_{tisv}$ is the average monthly purchase of rice or wheat (in kg) from the PDS by household i in year t, and $arbitrage\ potential_{tsv}$ is the difference between the average price of grain in the open market and the PDS in a village or hamlet (the primary sampling unit in NSSO) v in year t. T_t and S_s represent NSS-round and state fixed effects, respectively. X_{ti} is a set of household controls that includes: (1) self-employed in non-agriculture; (2) occupation as agricultural laborer; (3) occupation as other rural laborer; (4) self-employed in agriculture; (5) self-employed in urban areas; (6) labor in urban areas; (7) scheduled tribes; (8) scheduled caste; (9) other backward classes; (10) Hindus, Muslims, and Christians; (11) monthly per capita consumer expenditure (INR); (12) household size (number of people); (13) household dependency ratio; (14) household sex ratio; (15) maximum years of education attained by males in the household; (16) maximum years of education attained by females in the household; (17) percentage of urban population; (18) households with access to LPG (fuel- Liquefied Petroleum Gas); and (19) households with access to electricity. Standard errors are clustered at the state level.

As discussed above, we measure arbitrage as the difference between the market price of a cereal and its price in the PDS. Though individual households are often assumed to be price takers, the price a household pays for a cereal in the open market may vary with the income level (Deaton and Dupriez 2011). Wealthier households for example may buy more expensive varieties of rice and wheat. In addition, they are less likely to buy cereals from the PDS or to buy smaller quantities. As a result, using market price reported by the household to measure arbitrage effect could result in biased estimates. Hence, we use the average market price of a grain in the village to mitigate the possible bias produced by the purchase behavior of households unrelated to arbitrage.

Note that there is a large variation in the capacity of Indian states to implement development and welfare schemes (Besley and Burgess 2001), which extends to the PDS. Further, it is possible that the popularity of the PDS in states is correlated with the market price of rice or wheat in that state. State fixed effects in equation (3) control for the time-invariant state characteristics. Figure 2.1 shows that over the last few years, the PDS has improved across India, but with significant interstate variations in the extent of improvement. Chhattisgarh, Himachal Pradesh, and Odisha are among the outstanding states in this respect (Kishore and Chakrabarti 2015). We use state-specific time trend to control for such generalized improvement in the PDS over time.

Using three rounds of NSSO-CES data provides a rich set of controls for household characteristics, facilitating the parsing of the arbitrage effect on household purchases of cereals from the PDS. However, endogeneity issues can remain since the nature of data is that of repeated cross-section of households. While the arbitrage values increased from 2004–2005 to 2011–2012, the management regime of the PDS also changed in some states. All such changes cannot be accounted for by linear state-specific time trends. Similarly, many households switched from the APL to the BPL category in this period. This switch changes the arbitrage value for the households, over and above the average increase in arbitrage in a particular area. Therefore, the potential of omitted variable bias exists using the repeated cross-section data.

We try to address these issues by using the household-level panel data from the IHDS.[5] The IHDS contains a consumption expenditure module that collected information on households' purchase of rice and wheat from the PDS and other sources, as did the NSSO-CES. We used data from the CES module of the IHDS to estimate the arbitrage effect on PDS purchases for the same households over a seven-year period that corresponds closely with the 61st and the 68th rounds of the NSSO used above. IHDS data allows us to control for unobserved household-level heterogeneity by including household fixed effects (equation 4).

$$PDSpurchase_{it} = \beta arbitrage_{it} + \rho_i + T_t + \varepsilon_{it} \quad (4)$$

Where $PDSpurchase_{it}$ is the average monthly purchase of rice or wheat (in kg) from the PDS by household i in year t and $arbitrage_{it}$ is the difference between the average price of grain in the open market in a primary sampling unit and the PDS price faced by the household i in year t. ρ_i controls for the

[5] See http://www.ihds.umd.edu/data.html for more documentation on the IHDS data.

household fixed effects, and T_t controls for common national time trend. ε_{it} is the random error. In another variant of this model, we add an interaction term between a dummy variable for states with an improved PDS and the arbitrage value.

The improved PDS dummy takes the value of 1 for Chhattisgarh, Himachal Pradesh, Odisha, and Tamil Nadu in period 2 only, and zero for these four states in period 1 and for all other states in both periods 1 and 2 (equation 5). These four states implemented major PDS reforms between 2004–2005 and 2009–2010 (Kishore and Chakrabarti 2015). The interaction term captures whether the arbitrage effect on the PDS purchase by households is different in states where the PDS is governed more effectively. Finally, the household panel data allow us to control for the switch in the ration-card status (APL, BPL, or Antyodaya) of a household from one period to another (equation 6)—something we could not do with the repeated cross-section from the NSSO-CES.

$$PDSpurchase_{it} = \beta MarketPrices_{it} + \alpha_i + T_t + \theta Marketprice_{it} * ReformedPDS + \varepsilon_{it} \quad (5)$$

$$PDSpurchase_{it} = \beta Marketprice_{it} + \alpha_i + T_t + \theta Marketprice_{it} * ReformedPDS + \pi SwitchtoBPL + \varepsilon_{it} \quad (6)$$

where *ReformedPDS* is the dummy variable discussed above. *SwitchtoBPL* in equation 6 is a dummy variable that takes the value of 1 in period 2 for households whose ration-card status changed from APL, to BPL, or to AAY, and zero otherwise. This switch entails a significant increase in the wedge between market prices and PDS prices for the beneficiary household.

Note that there was a gap of seven years between the two rounds of the IHDS, during which both the arbitrage levels and the PDS changed a great deal. Given the possibility of omitted variables because of other changes in the PDS, we resort to high-frequency data on households' purchase of cereals from the VDSA. This allows us to test for the causal relationship between arbitrage and offtake from the PDS with much less concern about parallel changes in the functioning of the PDS. The VDSA coordinated by ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) collected monthly data on households' purchase of rice and wheat from the PDS and other sources for more than 1,000 households across seven states of India between 2009 and 2014.

VDSA data also allows us to control for any seasonality in household consumption or purchase behavior. We could not do so with the IHDS panel because households were not necessarily surveyed in the same month of the year in both rounds, and the two rounds of surveys were separated by a gap of seven years.

Further, unlike the NSSO and the IHDS, the VDSA collected independent price data every month for each village in the sample. Thus, we do not have to be concerned about the endogeneity of market prices paid by households or by their PDS purchase behavior. We estimate two sets of regressions with the VDSA data: one for households in Karnataka and Telangana, which are reputed to have a well-governed PDS, and another for households in Bihar and Jharkhand, whose PDS is known to be less well governed. We use regressions very similar to those used in equation 4, but this time we also add a month-of-the-year dummy to control for seasonality in household purchases or consumption behavior (equation 7). The VDSA data allow us to identify the causal impact of changes in arbitrage or of the market price of cereals on PDS purchases in the short-term [6].

$$PDSpurchase_{it} = \beta arbitrage_{it} + \alpha_i + T_t + \theta monthof\ theyeardummy + \varepsilon_{it} \quad (7)$$

[6] In the short term, arbitrage values change mainly because of fluctuations in the market price.

Descriptive Statistics and Results

Table 3.2 presents the summary of the key household characteristics in each round of the NSSO-CES. Per capita consumption of PDS rice and wheat increased by 70 percent and 147 percent, respectively, between 2004–2005 and 2009–2010. Average arbitrage potential due to the wedge between market and PDS prices for both cereals also increased sharply in this period. At the same time, we can observe an improvement in most indicators, such as access to LPG and electricity, as well as monthly expenditure over the seven-year study period.

Table 3.2 Descriptive statistics from the Consumption Expenditure Survey samples

	(1) Mean/%	(2) Mean/ %	(3) Mean/ %
Variable	**2004–2005**	**2009–2010**	**2011–2012**
Per-capita consumption of rice (kg/month) from PDS	1.055	1.557	1.792
Arbitrage of rice (INR)	2.917	8.785	10.83
Per-capita consumption of wheat (kg/month) from PDS	0.252	0.518	0.623
Arbitrage of wheat (INR)	1.376	4.863	6.573
Self-employed in non-agriculture	14.3	14.4	15
Agricultural labor	9.28	6.5	4.81
Other rural labor	6.92	10.2	8.61
Self-employed in agriculture	22.4	16.5	16.5
Self-employed in urban areas	14.2	15.5	15.4
Labor in urban areas	4.61	5.52	5.3
Tribes	13.2	13	13.4
Caste	16.1	16.2	15.4
Other backward classes	37.1	37.6	39.3
Hindu households	76.4	76.2	75.8
Islamic households	11.9	12.3	12.9
Christian households	6.87	6.91	6.95
Monthly per-capita consumer expenditure (INR)	848.8	1493.7	2050.9
Household size (no. of people)	4.898	4.646	4.574
Household dependency ratio	0.669	0.58	0.561
Household sex ratio	1.104	1.085	1.09
Maximum years of education attainted by males in the household	7.819	9.259	9.586
Maximum years of education attainted by females in the household	6.201	7.643	8.029
Percentage urban population	36.3	41.4	41.3
Households with access to LPG (fuel)	28.3	38.8	42.8
Households with access to electricity	73.6	82.2	87.1
Observations	124451	100855	101662

Source: Consumption Expenditure Data corresponding to years 2004-2005, 2009-2010, and 2011-2012 (NSSO various years).
Notes: INR = Indian National Rupee; PDS = Public Distribution System. LPG=Liquefied Petroleum Gas.

Table 3.3 presents summary values for household characteristics from the two rounds of the IHDS data. The IHDS data show similar trends in arbitrage values for rice and wheat, and an increase in the average quantity of these grains purchased by households. In addition, IHDS data indicate a large increase in the fraction of AAY and BPL households, and a corresponding decline in APL households. Nearly one-fourth of all APL households and households with no ration cards in the first round of the IHDS were reclassified as BPL or Antyodaya (poorest of the poor) households in the second round.

Further, in the latter period, fewer households reported not being able to get a ration card due to bureaucratic obstacles.

Table 3.3 Descriptive statistics from IHDS samples

Variable	Round 1 2004-2005	Round 2 2011–2012
Total PDS rice consumed per household per month (kg)	5.072	10.69
Market price of rice consumed per household per month (INR/kg)	11.48	21.27
Difference between market and PDS price of rice consumed per household per month	6.158	16.81
Total PDS wheat consumed per household per month (kg)	2.184	6.696
PDS mean price of wheat consumed per household per month (INR/kg)	5.102	6.030
Difference between market and PDS price of wheat consumed per household per month	4.410	9.334
Household has AAY card	2.48	8.61
Household has BPL card	34.4	47.0
Household has APL card	47.4	40.5
Star states: Himachal Pradesh, Chhattisgarh , Odisha, Tamil Nadu	19.3	22.1
Star state interaction with market price of rice	2.118	4.626
Households that changed over to an AAY card from no card, BPL card or APL card		7.34
Households that changed over to a BPL card from no card or APL card		18.7
Households that changed over to an APL card from no card		5.04
Ration card not possessed because of bureaucratic reasons	7.11	2.75
Total number of assets possessed by the household	11.66	15.01
Month per-capita consumption expenditure	881.8	2171.5
Household size	5.316	4.857
Urban areas	31.5	32.8
Highest education level achieved by adults in the household (years)	7.369	7.962
Observations	34,643	34,621

Source: Indian Human Development Survey data corresponding to years 2004-2005 and 2011-2012 (Desai et al. 2005; Desai et al. 2012).

Notes: AAY = Antyodya Anna Yojana; BPL = Below Poverty Line; APL = Above Poverty Line; INR = Indian National Rupee; PDS = Public Distribution System.

Both Tables 3.2 and 3.3 show significant changes in household characteristics over the seven-year period. We add available household controls in regressions with the NSSO data, and use household fixed effects to control for time-invariant household characteristics when using IHDS panel data. As discussed above, we are also able to control for the change in ration-card status in IHDS data.

Leakage of Rice and Wheat from PDS: State-Level Results from NSSO and FCI Data

States received 25.24 million metric tons (MT) of rice and wheat from the FCI in 2004–2005 for the PDS. NSSO-CES data suggest that of this amount, only 12.1 million MT (or 48 percent) reached households. The rest (13.14 million MT) was diverted to the black market. Diversion of grains from the PDS as a percentage of the total offtake decreased from 52 percent in 2004–2005 to 46.9 percent in 2009–2010. However, the total quantity of subsidized grains diverted increased from 13.14 million MT to 19.86

million MT. Between 2009–2010 and 2011–2012, diversion from the PDS fell by another 3 percentage points, while the total quantity diverted further increased to 21.95 million MT. Thus, the total quantity of subsidized cereals allocated to the PDS increased between 2004–2005 and 2011–2012, and a greater share of this increased allocation reached households. Even as household purchases of PDS cereals increased, the quantity of cereals diverted from the system also increased.

How did the leakage of rice and wheat from the PDS change across states over the three NSSO rounds as arbitrage potential in the PDS changed? Table 3.4 shows the results from a series of POLS and FE (fixed effects) regressions between leakage (expressed as a percentage of total offtake of grains) and arbitrage. A simple POLS regression (column 1) shows that a 1-rupee increase in arbitrage is associated with reduction in diversion by 1.5 percentage points. The coefficient is also statistically significant. Later, we introduce a survey round dummy (column 2) to measure the relationship between arbitrage and diversion across states in a given year.

The interstate comparison also shows a positive relationship. Column 3 shows the same relationship across years within a state. Again, over time, the diversion from the PDS decreases as arbitrage increases. The relationship between arbitrage and diversion remains negative, but becomes statistically insignificant when we introduce both time and state fixed effects (column 4).. Finally, we added total cereal offtake as a control, but found that it did not change the results qualitatively, with a very small coefficient of 0.001 (column 5).

In sum, the analysis of state-level data on arbitrage and leakage seems to support the Drèze and Sen (2013) conjecture that an increase in the value of entitlements leads to greater access and use of the PDS, resulting in an overall decline in leakage.

Table 3.4. Models for leakage from PDS on arbitrage: State level

Dependent Variable = Percentage of total off-take Leaked from PDS	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	Pooled - OLS	**Pooled - OLS**	**State FE**	**State FE**	**State FE**
arbitrage	-1.52***	-1.52**	-1.29**	-1.00	-1.07
	(0.41)	(0.54)	(0.42)	(0.66)	(0.66)
year=2004					
year=2009		1.42		-2.34	-2.77
		(6.99)		(6.80)	(6.81)
year=2011		-0.66		-5.00	-5.76
		(7.33)		(7.31)	(7.36)
offtake					0.00
					(0.00)
Constant	64.29***	64.11***	45.92***	46.45***	46.26***
	(4.41)	(4.63)	(10.56)	(10.69)	(10.69)
R squared	0.08	0.08	0.45	0.45	0.46
N	156	156	156	156	156

Source: Consumption expenditure data corresponding to years 2004–2005, 2009–2010, and 2011–2012 (NSSO various years) and offtake data for 2004, 2009, and 2011 (Food Corporation of India 2016).

Notes: Standard errors in parentheses. FE= Fixed effects. OLS= Ordinary least squares; PDS = Public Distribution System. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

Change in Arbitrage and Household Purchase of PDS Grains: Results from NSS Unit-Level Data

Analysis of state-level data on diversion of grains from PDS, while useful, does not help elucidate the effect of change in arbitrage on the quantity of subsidized grains households are allowed to purchase. We need to analyze household-level data for this purpose. We start by creating a repeated cross-section of household data from three NSSO rounds and use possible fixed effects. Table 3.5 presents results from this analysis.

In columns (1) and (2), we regress the per capita average quantity of rice and wheat purchased from the PDS against arbitrage and a rich set of household controls. The POLS regressions show that, as arbitrage increases by 1 rupee, the purchase of rice from the PDS goes up by 0.1 kg per capita per month and the purchase of wheat increases by 0.05 kg per capita per month. Introducing year fixed effects to the POLS model (columns 3 and 4) does not lead to qualitative differences in the results. The arbitrage effect on PDS purchase of rice and wheat becomes a smaller order of magnitude once we add time-invariant state characteristics (columns 5 and 6) in the earlier models.

The arbitrage effect obtained is robust to the introduction of state-specific time trends. Therefore, our analysis of the repeated cross-section data from the NSSO-CES appears to support the Drèze and Sen (2013) hypothesis. A 10-rupee increase in arbitrage is associated with an increased PDS purchase of rice and wheat by 0.4 to 0.5 kg/month/person. This increase is approximately 15 percent of the average quantity of rice purchased from the PDS in 2004–2005, and nearly 80 percent of the average wheat purchased from the PDS. Since, analysis with repeated cross-section data is fraught with problems of endogeneity or omitted variable bias, next we analyze this relationship using the household panel dataset from the IHDS.

Table 3.5 Models for per-capita consumption of rice / wheat (kg/month) from PDS on arbitrage with controls: NSS unit-level data

Variable	(1) Rice	(2) Wheat	(3) Rice	(4) Wheat	(5) Rice	(6) Wheat	(7) Rice	(8) Wheat
Arbitrage of rice (Rs./kg)	0.10***		0.10***		0.04**		0.04***	
	(0.01)		(0.02)		(0.01)		(0.01)	
Arbitrage of wheat (Rs./kg)		0.05**		0.04**		0.04***		0.05***
		(0.01)		(0.01)		(0.01)		(0.01)
Dummy for season October to December	-0.04+	0.00	-0.04+	0.00	-0.01	0.00	-0.01	-0.00
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Dummy for season January to March	-0.06+	-0.01	-0.06+	-0.00	-0.02	-0.01	-0.02	-0.01
	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
Dummy for season April to June	-0.09**	-0.01	-0.09*	-0.01	-0.03	-0.01	-0.03	-0.01
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
Dummy for self-employed in non-agriculture	0.16	-0.01	0.16	-0.02	0.23**	0.03	0.23***	0.04*
	(0.10)	(0.04)	(0.10)	(0.04)	(0.08)	(0.02)	(0.05)	(0.02)
Dummy for agricultural labor	0.73***	0.10	0.74***	0.11	0.79***	0.21*	0.78***	0.21***
	(0.19)	(0.12)	(0.19)	(0.12)	(0.14)	(0.08)	(0.10)	(0.05)
Dummy for other rural labor	0.62***	0.24**	0.62***	0.22**	0.55***	0.21***	0.55***	0.21***
	(0.16)	(0.07)	(0.15)	(0.07)	(0.12)	(0.05)	(0.08)	(0.04)
Dummy for self-employed in agriculture	-0.13	-0.09*	-0.13	-0.08*	-0.09	-0.12**	-0.08	-0.11***
	(0.10)	(0.04)	(0.10)	(0.04)	(0.09)	(0.04)	(0.06)	(0.03)
Dummy for self-employed in urban areas	0.12	0.08**	0.12	0.08**	0.23***	0.07**	0.23***	0.07***
	(0.07)	(0.02)	(0.07)	(0.02)	(0.06)	(0.02)	(0.04)	(0.01)

Table 3.5 Continued

Variable	(1) Rice	(2) Wheat	(3) Rice	(4) Wheat	(5) Rice	(6) Wheat	(7) Rice	(8) Wheat
Dummy for labor in urban areas	0.55**	0.12*	0.55**	0.10*	0.47***	0.15**	0.47***	0.15***
	(0.15)	(0.05)	(0.16)	(0.05)	(0.12)	(0.05)	(0.08)	(0.03)
Dummy for tribes	0.96**	0.07	0.96**	0.04	0.30*	0.15*	0.30***	0.15***
	(0.33)	(0.10)	(0.33)	(0.10)	(0.11)	(0.06)	(0.08)	(0.04)
Dummy for caste	0.15	0.17**	0.15	0.16**	0.06	0.20***	0.08+	0.20***
	(0.14)	(0.06)	(0.15)	(0.06)	(0.06)	(0.05)	(0.04)	(0.03)
Dummy for other backward classes	0.15	-0.11	0.15	-0.11	-0.00	0.05+	0.01	0.06**
	(0.24)	(0.08)	(0.24)	(0.08)	(0.05)	(0.03)	(0.04)	(0.02)
Dummy for Hindu households	-0.36	-0.04	-0.36	-0.04	-0.04	0.02	-0.03	0.01
	(0.50)	(0.09)	(0.50)	(0.09)	(0.06)	(0.04)	(0.06)	(0.03)
Dummy for Islamic households	0.18	-0.08	0.18	-0.10	0.12	-0.02	0.13	-0.03
	(0.85)	(0.09)	(0.85)	(0.09)	(0.36)	(0.05)	(0.22)	(0.04)
Dummy for Christian households	0.33	-0.33**	0.33	-0.33**	-0.13	-0.03	-0.13	-0.02
	(0.74)	(0.09)	(0.74)	(0.09)	(0.11)	(0.04)	(0.10)	(0.03)
Monthly per-capita consumer expenditure	-0.00*	-0.00	-0.00*	-0.00*	-0.00*	-0.00+	-0.00**	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Household size (no. of people)	-0.09***	-0.02+	-0.09***	-0.01+	-0.05***	-0.03***	-0.05***	-0.03***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Household dependency ratio	-0.31***	-0.04*	-0.31***	-0.04*	-0.26***	-0.06***	-0.26***	-0.06***
	(0.07)	(0.02)	(0.07)	(0.02)	(0.06)	(0.02)	(0.04)	(0.01)
Household sex ratio	0.08***	0.01	0.09***	0.01	0.07***	0.02***	0.07***	0.02***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)	(0.01)	(0.00)
Highest year of education attained by males in the household	-0.05***	-0.01*	-0.05***	-0.01*	-0.04***	-0.01**	-0.04***	-0.01***
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)
Highest year of education attained by females in the household	-0.03*	-0.02**	-0.03*	-0.02***	-0.04***	-0.01***	-0.04***	-0.01***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Dummy for urban areas	-0.23+	-0.12	-0.23+	-0.10	-0.19+	-0.06+	-0.19**	-0.06*
	(0.12)	(0.08)	(0.11)	(0.08)	(0.10)	(0.03)	(0.07)	(0.02)
Dummy for households with access to LPG (fuel)	-0.17	-0.12**	-0.17	-0.13**	-0.34***	-0.15**	-0.34***	-0.14***
	(0.12)	(0.04)	(0.12)	(0.04)	(0.09)	(0.04)	(0.06)	(0.03)
Dummy for households with access to electricity	0.28	0.07	0.27	0.05	-0.12	-0.02	-0.15+	-0.01
	(0.21)	(0.09)	(0.21)	(0.09)	(0.10)	(0.03)	(0.09)	(0.03)
Year=66			-0.01	0.18**	0.39**	0.15**		
			(0.14)	(0.05)	(0.13)	(0.05)		
Year=68			0.07	0.24***	0.60***	0.21***		
			(0.17)	(0.06)	(0.15)	(0.05)		
Constant	1.76**	0.67***	1.75**	0.61***	1.97***	0.54***	2.31***	0.63***
	(0.63)	(0.12)	(0.62)	(0.12)	(0.25)	(0.07)	(0.19)	(0.06)
State fixed effects	No	No	No	No	Yes	Yes	No	No
Year-state fixed effects	No	No	No	No	No	No	Yes	Yes
R-squared	0.16	0.07	0.16	0.07	0.10	0.08	0.09	0.06
N	326,968	326,968	326,968	326,968	326,968	326,968	326,968	326,968

Source: Consumption expenditure data corresponding to years 2004–2005, 2009–2010, and 2011–2012 (NSSO various years).
Notes: Standard errors in parentheses. Standard errors clustered at the state level. $^{+}\ p < 0.10$, $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

4. RESULTS FROM THE IHDS PANEL DATA

Regression results from the IHDS panel are shown in Tables 4.1 through 4.3. We control for household fixed effects and survey year dummy in all regressions with IHDS data. Columns 1 and 2 in Table 4.1 show estimates of equation 4 for rice and wheat, respectively. IHDS shows the opposite result: household purchase of PDS rice and wheat decreases significantly when the market price of these grains increases. We use market price, instead of arbitrage, because the PDS price is fixed by the government for different card types. IHDS lets us control for type of card – AAY, BPL or APL - therefore the change in arbitrage comes mainly from the change in the market price of grains.[7] Our results using IHDS data are the opposite of those we obtained from the NSSO-CES data. What explains the difference in the results?

Table 4.1 Impact of increase in arbitrage on purchase of PDS rice and wheat—IHDS data

Variables	(1) Kg of rice from PDS	(2) Kg wheat from PDS
Market price of rice	**-0.07^{+}**	
	(0.04)	
Market price of wheat		**-0.12***
		(0.06)
Year (2011)	3.77***	2.70***
	(1.06)	(0.60)
AAY card	10.97***	9.35***
	(2.47)	(1.96)
BPL card	8.56***	4.53***
	(1.22)	(1.14)
APL card	1.07^{+}	1.01*
	(0.63)	(0.42)
No card due to bureaucratic reasons	-1.41**	-0.36
	(0.54)	(0.29)
Assets	-0.06	-0.01
	(0.06)	(0.05)
Consumption expenditure (INR)	-0.00	-0.00*
	(0.00)	(0.00)
Household size	0.19	0.18***
	(0.16)	(0.05)
Urban resident	-0.11	-0.26
	(0.66)	(0.59)
Constant	1.65^{+}	0.36
	(0.90)	(0.72)
Household FE	**YES**	**YES**
R-squared	0.21	0.14
Number of observations	69,211	69,137

Source: IHDS Data corresponding to years 2004–2005 and 2011–2012 (Desai et al. 2005; Desai et al. 2012).

Notes: Standard errors in parentheses. Standard errors clustered at the state level. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. FE= Fixed effects. AAY = Antyodya Anna Yojana; BPL = Below Poverty Line; APL = Above Poverty Line; INR = Indian National Rupee; PDS = Public Distribution System. LPG=Liquefied Petroleum Gas.

[7] We find qualitatively similar results even when we use arbitrage as the independent variable.

Using the IHDS data we are also able to test one of the predictions of the Mehta and Jha (2014) model. The authors contend that arbitrage opportunities are higher when subsidies are large, but anti-graft measures rely greatly on providing citizens with incentives to combat corruption. Therefore, pilferage rates need not rise as price subsidies increase. From the literature on the PDS, we know that some states in India are better at keeping checks on entitlements and delivery of grains than others (Khera 2011a; Kishore and Chakrabarti 2015; Chakrabarti and Rajkhowa 2015; Drèze and Khera 2013). Drèze and Sen (2013) refer to these "star" states as "new-style" PDS states. Among these are Himachal Pradesh, Chhattisgarh, Odisha, and Tamil Nadu.

These four states have a reputation for low exclusion errors, regular supply, relatively small leakages, increased accountability, quality cereals, and a political will to enforce reforms. In Table 4.2, we test if an increase in arbitrage has a different effect in star states where the PDS is administered more effectively. We do so by estimating equation 5, with an interaction term between states with reformed PDS and the market price. We find that the interaction term has a positive and statistically significant coefficient for rice. The coefficient on the interaction term is larger than the coefficient on the market price of rice. Thus, an increase in arbitrage leads to a reduced purchase of rice from the PDS in other states. However, in states with a reformed PDS, an increase in arbitrage leads to a rise in the household purchase of PDS rice. The effect is small and statistically not significant for wheat because three out of four of these states deliver only rice through their PDS.

In columns 3 and 4, we estimate the same model, but this time instead of classifying states into star states and other states, we interact market prices of grains with individual state dummies. Uttar Pradesh is taken as the reference state in these regressions. Results are similar as in columns 1 and 2 of the table. Rise in market price of rice or wheat leads to a significant decline in household purchase of these grains from PDS shops in states like Uttar Pradesh, Bihar and Jharkhand while in states like Himachal Pradesh, Odisha and Tamil Nadu and also in erstwhile Andhra Pradesh, Karnataka and Kerala, we see an opposite effect. In these states an increase in market price of grains leads to a significant increase in household purchase of grains from PDS.

Table 4.2 Impact of increase in arbitrage in states with reformed and non-reformed PDS

	(1)	(2)	(3)	(4)
Variables	**Kg of rice from PDS**	**Kg of wheat from PDS**	**Kg of rice from PDS**	**Kg of wheat from PDS**
Market price of rice	**-0.10****		**-0.26***	
	(0.03)		**(0.11)**	
Reformed state * market price rice	**0.38*****			
	(0.07)			
Reformed state * market price wheat		**0.07**		
		(0.17)		
Market price of wheat		**-0.14***		**-0.10**
		(0.06)		**(0.08)**
Reformed PDS states				
Himachal Pradesh*market price			0.37***	0.83***
			(0.04)	(0.03)
Odisha*market price			0.65***	-0.08**
			(0.01)	(0.03)
Chhattisgarh *market price			0.67***	-0.03*
			(0.01)	(0.01)
Tamil Nadu *market price			0.64***	0.06
			(0.05)	(0.05)
Reforming PDS states				
Andhra Pradesh*market price			0.51***	-0.05
			(0.04)	(0.05)
Karnataka *market price			0.43***	0.01
			(0.03)	(0.04)

Kerala *market price			0.38***	0.06
			(0.04)	(0.05)
Un-reformed PDS states				
Bihar*market price			0.05***	-0.01
			(0.01)	(0.01)
Jharkhand *market price			0.24***	-0.11***
			(0.02)	(0.03)
Gujarat *market price			0.04	0.05
			(0.04)	(0.04)
West Bengal *market price			-0.01	-0.04
			(0.02)	(0.03)
Uttar Pradesh (reference state)			**0.00**	**0.00**
Year (2011)	3.48***	2.75***	3.86***	1.93***
	(0.83)	(0.59)	(1.00)	(0.43)
AAY card	10.65***	9.27***	6.91***	7.58***
	(2.39)	(1.94)	(2.02)	(2.20)
BPL card	8.41***	4.50***	4.27***	4.97***
	(1.31)	(1.13)	(0.94)	(1.35)
APL card	1.02+	1.01*	-3.21***	-0.90
	(0.53)	(0.41)	(0.86)	(0.55)
No card due to bureaucratic reasons	-1.66*	-0.42	-5.48***	-2.03**
	(0.66)	(0.33)	(1.17)	(0.62)
Assets	-0.07	-0.01	-0.24***	-0.16***
	(0.05)	(0.05)	(0.05)	(0.04)
Expenditure (INR)	-0.00	-0.00*	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Household size	0.26+	0.18***	0.34**	0.18***
	(0.15)	(0.05)	(0.13)	(0.05)
Urban	-0.19	-0.26	-0.31	0.16
	(0.54)	(0.57)	(0.49)	(0.37)
Constant	1.21	0.36	6.62***	3.29***
	(0.78)	(0.71)	(1.57)	(0.95)
Household FE	YES	YES	YES	YES
Observations	69,211	69,137	69,230	69,156
R-squared	0.26	0.14	0.30	0.21
Number of households	34,643	34,643	34,643	34,643

Source: Indian Human Development Survey data corresponding to years 2004-2005 and 2011-2012 (Desai et al. 2005; Desai et al. 2012).

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. FE = fixed effects. AAY = Antyodya Anna Yojana; BPL = below poverty line; APL = above poverty line; INR = Indian National Rupee; PDS = public distribution system. Only selected state coefficients shown in columns 3 and 4. For full table refer to Appendix A1.

Apart from the change in market price, arbitrage for a household could also increase if its ration-card status changes. BPL and Antyodaya households are entitled to larger quantities of subsidized rice and wheat at a cheaper price than APL households. As discussed earlier, the card status of a large number of household changed from having no card or an APL card only to BPL and AAY cards. A switch from no card or an APL card to a BPL or an AAY card leads to a significant increase in household purchases of PDS rice and wheat (columns 1 and 2, Table 4.3). The increase in the PDS purchase is an order of magnitude smaller for households who switch from no card to an APL card. This is not surprising, as the PDS prices are significantly higher for APL cardholders.

Table 4.3 Impact of change in ration-card status on PDS purchases

Variables	Kg of rice from PDS	Kg of wheat from PDS
Market price of rice	-0.11**	
	(0.04)	
Reformed PDS* market price of rice	0.40***	

	(0.08)	
Market price of wheat		-0.13*
		(0.05)
Reformed PDS* market price of wheat		0.09
		(0.16)
Switch to AAY	6.27**	7.80***
	(2.24)	(2.21)
Switch to BPL	4.98***	5.03***
	(1.08)	(1.41)
Switch to APL	-2.69**	-1.12*
	(0.96)	(0.46)
Assets	-5.18***	-2.45***
	(1.14)	(0.55)
Expenditure (INR)	-0.21**	-0.07
	(0.07)	(0.06)
Household size	-0.00	-0.00*
	(0.00)	(0.00)
Urban	0.26+	0.18***
	(0.14)	(0.05)
Year (2011)	3.78***	2.27***
	(0.86)	(0.47)
Constant	6.81***	3.43***
	(1.59)	(0.97)
Household FE	YES	YES
Observations	69,230	69,156
R-squared	0.26	0.15
Number of households	34,643	34,643

Source: Indian Human Development Survey data corresponding to years 2004-2005 and 2011-2012 (Desai et al. 2005; Desai et al. 2012).

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. FE= fixed effects. AAY = Antyodya Anna Yojana; BPL = below poverty line; APL = above poverty line; INR = Indian National Rupee; PDS = public distribution system.

Analysis of IHDS data thus leads to a more nuanced understanding of the impact of change in arbitrage on household purchases of PDS grains. Normally, increased arbitrage leads to reduced household purchases of grains from PDS. However, in states where the PDS has been reformed and is relatively better governed, the effect is opposite and in line with the Dreze Sen Proposition. Further, comparing households whose ration-card status changed with those whose status did not change shows that a significant increase in the value of PDS entitlement indeed leads to a large increase in the quantity of grains purchased from the PDS, irrespective of the governance regime. However, we should keep in mind that households whose card status changed favorably may be systematically different from other households. Therefore, the impact evident in Table 4.4 may not be due entirely to the increase in the value of PDS entitlement per se.

As discussed above, panel data from the IHDS allow us to more rigorously analyze the arbitrage effect, but there is a seven-year gap between its two rounds. We, thus employ the monthly consumer expenditure surveys carried out by the VDSA in Bihar, Jharkhand, Karnataka, and Telangana between 2009 and 2012.

We present results from estimating equation 7 with VDSA data from Bihar and Jharkhand in Table 4.4a and from Karnataka and Telangana in Table 4.4b. In addition to household, state, and year fixed effects, VDSA data allow us to control for seasonality in household consumption and purchase behavior by adding month-of-the-year fixed effects. Results from Bihar and Jharkhand suggest that the market price is negatively related to household purchases from the PDS. All coefficients on market price are negative and statistically significant. We run the same regressions with arbitrage and find similar results—higher arbitrage reduces household purchases of PDS rice and wheat in Bihar and Jharkhand. We find the opposite results when we run the same regressions with data from Telangana and Karnataka. Here, an increase in arbitrage leads to an increase in household purchases of PDS rice.

Thus, analysis of both household panel datasets—IHDS and VDSA—suggests that the impact of arbitrage on households' access to subsidized grains is context specific. Higher arbitrage could hurt consumers of a social safety-net program if it is not well managed and monitored. On the other hand, in regions with reasonably well governed safety-net programs, households' utilization of the entitlement increases with the increase in arbitrage, as suggested by Drèze and Sen (2013) and by Mehta and Jha (2014).

Table 4.4a Models for per-household consumption of rice/wheat (kg/month) from PDS on arbitrage or market price in Jharkhand and Bihar: VDSA data

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	**Rice**	**Wheat**	**Rice**	**Wheat**	**Rice**	**Wheat**
Market price (Rs./kg)	-0.0348**	-0.0852***	-0.0398**	-0.174***		
Price arbitrage (Rs/kg)					-0.0460***	-0.0741**
Year		0.270***	-0.041	0.665***	0.0838	0.479**
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Month of the year FE	No	Yes	Yes	Yes	Yes	Yes
Sub-sample of only households that ever used PDS in the sample	No	No	Yes	Yes	Yes	Yes
Sub-sample of only households from Bihar	No	Yes	No	Yes	No	Yes
Constant	10.85***	0.343	18.33***	0.884	19.68***	1.273
Observations	11424	5,670	6552	2,122	5,651	2,114
R-squared	0.002	0.014	0.017	0.035	0.02	0.036
Number of unique households	322	162	184	60	180	60

Source: Village Dynamics in South Asia (VDSA) micro-data for Bihar and Jharkhand collected by ICRISAT

Notes: $^{+}\ p < 0.10$, $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$. FE= Fixed effects; PDS = Public Distribution System; VDSA = Village Dynamics in South Asia

Table 4.4b Models for per-household consumption of rice (kg/month) from PDS on arbitrage or market price in Karnataka and Telangana: VDSA data

	(1)	(2)	(3)	(4)	(5)
Variable	**Rice (kg/month)**				
Market price of rice (Rs./kg)	0.237***	0.242***	0.0624***		
Price arbitrage rice (Rs/kg)				0.489***	0.500***
Year	-3.291***	-3.338***	-1.849***	-4.208***	-4.291***
Household FE	Yes	Yes	Yes	Yes	Yes
Month of the year FE	Yes	Yes	Yes	Yes	Yes
Sub-sample of only households that ever used PDS in the sample	No	Yes	Yes	No	Yes
Constant	43.31***	43.91***	31.43***	49.00***	49.85***
Observations	15,401	15,167	14,238	15,401	15,167
R-squared	0.129	0.13	0.098	0.137	0.14
Number of unique HHs	373	367	366	373	367

Source: Village Dynamics in South Asia (VDSA) micro-data for Andhra Pradesh and Karnataka collected by ICRISAT

Notes: $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. FE= Fixed effects; PDS = Public Distribution System; VDSA = Village Dynamics in South Asia.

5. DISCUSSION

Rice and wheat are staple food grains in India, and have small negative price elasticity values and small positive income elasticities (Jha and Srinivasan 1999). Grains from the PDS and other sources are close substitutes for one another. Therefore, households purchase more from the FPS when the relative price is lower in the PDS vis-à-vis the open market—if they are allowed to do so. PDS dealers and other officials responsible for managing the system have opposite incentives. They want to divert more grains from the system when arbitrage increases.

The net impact of an increase in arbitrage on the delivery of subsidized food depends on the relative bargaining power of the two groups: the beneficiaries of the scheme and the agents responsible for grain management. If consumers are not organized and the government is not responsive to their needs, PDS managers may steal more when arbitrage goes up. In such a situation, an increase in the value of PDS entitlement of households may actually hurt them. This is what we see from VDSA data in Bihar and Jharkhand. However, if the government is more adept and monitors grain delivery in the PDS, the probability that a corrupt PDS official will be penalized increases. Then PDS officials will be less likely to divert grains even if potential returns from diversion go up as seen in case of well governed systems. Consumers benefit from an increase in the value of PDS entitlement, in the so called new-style PDS states (Drèze and Khera 2015; Kishore and Chakrabarti 2015).[8]

What Does a Responsive New PDS Entail?

Managing a PDS successfully requires extensive changes. The necessary reforms to arrive at the so-called new PDS are multifaceted. The modifications that are needed for such a large-scale program can be best understood through an example.

In 2007–2008, the Government of Chhattisgarh computerized the whole food grain supply chain from procurement of paddy at 1,532 purchase centers to transportation of PDS commodities to 10,416 FPS for further distribution to 3.7 million ration cardholders. The Unified Ration Card database was prepared, and ration cards were printed using the existing database of cardholders. Only those ration cards that have a unique number and a bar code printed through that database are now valid in Chhattisgarh. Information regarding allocations, stocks, issue, and sales for each FPS is now available on the central server. At least 10 percent of this data is physically verified by the staff of the food department every month, and action is taken against any FPS making false declarations.

Citizen awareness and participation in the public delivery system is a major check against diversion and leakage. Hence, a citizen interface website has been created on which complaints can be lodged and suggestions given. The website also provides a method of citizen participation to check diversion of trucks carrying PDS commodities to FPS from the warehouse. Citizens can register their mobile numbers on this website by selecting one or more FPS of their interest, for participation in the monitoring of the PDS. A call center with a toll-free number is operational. The complaints received by the center are entered in the system immediately after receipt, and the complaint number is given to the complainant for further use.

All registered complaints, either through the call center or the website, can be viewed by logging onto the inbox of the particular officer concerned. The officer is required to enter the details of the enquiry report and the action taken. Complaint redress is monitored at the directorate and secretariat levels to ensure a timely resolution. Whenever PDS commodities are dispatched to an FPS from the warehouse, a Short Message Service (SMS) is sent to all the mobile numbers registered for that FPS. The

[8] The new-style PDS combines low prices and near-universal targeting, with increased administrative effort to ensure timely availability of food grains in their FSP and to control diversion of highly subsidized grains to the open market (Drèze and Sen 2013).

SMS contains the truck number, the quantities of PDS commodities being sent by that truck, and the date and time of dispatch (Puri 2012 and Prasad et al. 2014).

Final Takeaways

Drèze and Sen (2013) argument of entitlement fetching is a plausible one. The analysis in this paper does not support this argument unconditionally. Some of our results are based essentially on short-term changes in arbitrage and, therefore, cannot capture the medium- or long-term response of high arbitrage on accountability levels in the PDS and its performance. The implementation of the NFSA across India offers an opportunity to test the Drèze-Sen (2013) hypothesis. PDS prices tend to be stickier than market prices. Consequently, arbitrage will continue to rise in the years to come. Whether this increase leads to a nationwide improvement in the performance of the PDS remains to be seen.

The issue of arbitrage and diversion is also linked to the case of universalization of the PDS. On the face of it, making the coverage universal is likely to reduce illegal diversion. As more households receive subsidized grain, their demands in the market will fall, leading to a decline in diversion. However, a substantial reduction in diversion is contingent on how much additional grain households receive through subsidized channels, which in turn depends on the extent of diversion in the first place. "Thus, a relatively honest system will remain honest on universalization. On the other hand, a relatively corrupt system will remain so even with universalization, unless it is accompanied by effective monitoring and policing of the distribution chain (see Kotwal et al 2011 for this argument)."

6. CONCLUSIONS

Overall, we find both kinds of impact of arbitrage on corruption in a food safety-net program. For the PDS, in states with high levels of accountability such as shown in the detailed example of Chhattisgarh, a higher subsidy of the safety-net may lead to an increase in transfers to households. In areas where the system is less accountable, an increase in the subsidy without an improvement in enforcement mechanisms is likely to increase the diversion of subsidized goods and reduce transfers to intended beneficiaries. This result has important policy implications for India. The low price ceiling introduced by the NFSA will likely increase arbitrage. In numerous states where the PDS remains opaque and not monitored sufficiently well, our results suggest that pilferage may remain high.

In programs such as PDS, there is a significant principal agent problem. Because of fiscal constraints, the government has little capacity to monitor from afar and local officials have perverse incentives that lead to leakages either because of lack of proper authentication of the beneficiary, or other means of subsidy diversion where the intended beneficiary do not receive their entitlements. Several commentators like Himanshu and Sen (2013) have argued for universalization of the PDS and have favored in-kind transfers over cash transfers. They attribute in kind transfers to be poverty reducing when the arbitrage potential is high. Our findings show that this is far from being straightforward.

The results in this paper make a strong case for better enforcement. To the extent that enforcement capacity is lacking, the arbitrage opportunities inherent in the in-kind transfers can result in significant diversion. This paper through examples of some states also shows that investing in the enforcement capacity can significantly strengthen a state's ability to target program beneficiaries and get more grains to the poor during times of high prices, the time during which it is most needed and also most likely to be diverted.

Evidence from other cases of subsidy disbursement in India also show that greater enforcement by identifying the beneficiaries can bring about significant reduction in subsidy costs. Barnwal (2016) provides econometric evidence regarding the impact of biometrics-based enforcement on subsidy diversion in case of cooking fuel. India's Aadhaar program seeks to cover all the 1.25 billion residents under the biometrics-based Unique Identification (UID) system. In case of cooking fuel this unique identity number helps in the authentication of beneficiaries and facilitates a centralized payments infrastructure through which benefits can be directly transferred. Something similar is being tried in case of disbursement of food subsidy as well.

The inefficiency of public distribution has external effects as well. Ramaswami and Balakrishnan (2002) show that public intervention has a pervasive influence on food prices, where inefficiencies in food delivery matter to food prices. Hence inefficiency in PDS leads to demand switches towards open market. This can increase food prices and hurt the poor even when they are not major recipients of the subsidy, part of which could be due to compromised entitlements.

Finally, the limited effects of accessing PDS on nutrition outcomes can partly be explained by greater diversion in some states during times of high prices. As there has been a demand from several analysts to expand the portfolio of the PDS to expand new products some of which are quite dearer than cereals and have a greater wedge between PDS and open market prices, without adequate enforcement, such inclusions would result in greater diversion. Indeed, in state of Bihar, qualitative study by Pradhan (2016) shows desire for pulses to be included in the PDS, but there is a generic fear that because of possible price wedge between the market and subsidized price, they would most likely not get their ration. Not surprisingly, this fear is comparatively high among weaker sections comprising poor and lower castes.

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APPENDIX

Table A1 Impact of state context on PDS purchases

	(1) Kg of rice from PDS	(2) Kg of wheat from PDS
Market price of rice consumed per household per month (INR/kg)	-0.26*	
	(0.11)	
Jammu_Kashmir_price_rice	0.84***	
	(0.05)	
Himachal_price_rice	0.37***	
	(0.04)	
Punjab_price_rice	0.02	
	(0.05)	
Chandigarh_price_rice	0.19*	
	(0.08)	
Uttaranchal_price_rice	0.19***	
	(0.03)	
Haryana_price_rice	0.04	
	(0.06)	
Delhi_price_rice	0.12*	
	(0.06)	
Rajasthan_price_rice	-0.00	
	(0.05)	
Bihar_price_rice	0.05***	
	(0.01)	
Sikkim_price_rice	0.35***	
	(0.04)	
Arunachal_price_rice	0.56***	
	(0.04)	
Nagaland_price_rice	0.00	
	(0.03)	
Manipur_price_rice	0.33***	
	(0.02)	
Mizoram_price_rice	0.92***	
	(0.03)	
Tripura_price_rice	0.81***	
	(0.01)	
Meghalaya_price_rice	0.46***	
	(0.02)	
Assam_price_rice	0.37***	
	(0.02)	
West_Bengal_price_rice	-0.01	
	(0.02)	
Jharkhand_price_rice	0.24***	
	(0.02)	
Orissa_price_rice	0.65***	
	(0.01)	
Chhatishgarh_price_rice	0.67***	
	(0.01)	
Madhya_Pradesh_price_rice	-0.05*	
	(0.02)	
Gujarat_price_rice	0.04	
	(0.04)	
Daman_Diu_price_rice	0.16***	
	(0.04)	
Dadra_price_rice	0.50***	
	(0.03)	
Maharashtra_price_rice	0.09***	
	(0.03)	
Andhra_price_rice	0.51***	
	(0.04)	
Karnataka_price_rice	0.43***	
	(0.03)	
Goa_price_rice	0.34***	
	(0.05)	
Kerala_price_rice	0.38***	
	(0.04)	

Tamil_Nadu_price_rice	0.64***	
	(0.05)	
Pondicherry_price_rice	0.37***	
	(0.06)	
Year=2004	0.00	0.00
	(.)	(.)
Year=2011	3.86***	1.93***
	(1.00)	(0.43)
Households that changed over to an AAY card from no card, BPL card or APL card	6.91***	7.58***
	(2.02)	(2.20)
Households that changed over to a BPL card from no card or APL card	4.27***	4.97***
	(0.94)	(1.35)
Households that changed over to an APL card from no card	-3.21***	-0.90
	(0.86)	(0.55)
Ration card not possessed because of bureaucratic reasons	-5.48***	-2.03**
	(1.17)	(0.62)
Total number of assets possessed by the household	-0.24***	-0.16***
	(0.05)	(0.04)
Month per-capita consumption expenditure	-0.00***	-0.00***
	(0.00)	(0.00)
Household size	0.34**	0.18***
	(0.13)	(0.05)
Urban areas	-0.31	0.16
	(0.49)	(0.37)
Market price of wheat consumed per household per month (INR/kg)		-0.10
		(0.08)
Jammu_Kashmir_price_wheat		0.21***
		(0.03)
Himachal_price_wheat		0.83***
		(0.03)
Punjab_price_wheat		0.12***
		(0.03)
Chandigarh_price_wheat		0.17**
		(0.06)
Uttaranchal_price_wheat		0.25***
		(0.03)
Haryana_price_wheat		0.16***
		(0.02)
Delhi_price_wheat		0.14**
		(0.05)
Rajasthan_price_wheat		0.26***
		(0.01)
Bihar_price_wheat		-0.01
		(0.01)
Sikkim_price_wheat		-0.03
		(0.04)
Arunachal_price_wheat		-0.03
		(0.05)
Nagaland_price_wheat		-0.03
		(0.05)
Manipur_price_wheat		0.01
		(0.05)
Mizoram_price_wheat		-0.13***
		(0.04)
Tripura_price_wheat		-0.02
		(0.04)
Meghalaya_price_wheat		-0.10**
		(0.03)
Assam_price_wheat		-0.09**
		(0.04)
West_Bengal_price_wheat		-0.04
		(0.03)
Jharkhand_price_wheat		-0.11***
		(0.03)

Orissa_price_wheat		-0.08**
		(0.03)
Chhatishgarh_price_wheat		-0.03*
		(0.01)
Madhya_Pradesh_price_wheat		0.35***
		(0.01)
Gujarat_price_wheat		0.05
		(0.04)
Daman_Diu_price_wheat		-0.03
		(0.04)
Dadra_price_wheat		-0.00
		(0.03)
Maharashtra_price_wheat		0.26***
		(0.03)
Andhra_price_wheat		-0.05
		(0.05)
Karnataka_price_wheat		0.01
		(0.04)
Goa_price_wheat		0.16**
		(0.05)
Kerala_price_wheat		0.06
		(0.05)
Tamil_Nadu_price_wheat		0.06
		(0.05)
Pondicherry_price_wheat		0.11+
		(0.06)
Constant	6.62***	3.29***
	(1.57)	(0.95)
N	69230	69156

Standard errors in parentheses
IHDS Data corresponding to years 2004â€“2005 and 2011â€“2012 (Desai et al. 2005; Desai et al. 2012)
Standard errors clustered at the state level
FE= fixed effects. AAY = Antyodya Anna Yojana; BPL = below poverty line; APL = above poverty line; INR = Indian National Rupee; PDS = public distribution system.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$