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The Impacts of Reforms to the Public Distribution System in India's Chhattisgarh on Food Security

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Abstract

Although a rapidly growing developing country, India has a larger food-insecure population than all of Sub-Saharan Africa. Given the prevalence of chronic malnutrition, the Government of India spent nearly 1 percent of the gross domestic product in the past year on the Public Distribution System (PDS), its system of subsidies for food grains and other essential commodities. Despite the importance of effective food aid in the country, a large share of PDS food grains do not reach their intended beneficiaries. However, the Indian State of Chhattisgarh instituted a number of PDS reforms in the early and mid-2000s in an effort to improve the distribution of PDS food grains. We find that both PDS consumption and food security improved in response to the reforms.

Keywords: Food security, India, Chhattisgarh, Public Distribution System, National Food Security Act

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What Is the Issue?

India is a rapidly growing developing country, but has a larger food-insecure population than all of Sub-Saharan Africa. Given the prevalence of chronic malnutrition, India is engaged in a prolonged debate about increasing expenditures on its national food aid program, the Public Distribution System (PDS). India spent nearly 1 percent of its gross domestic product on the PDS in 2012, and that amount likely will increase under the National Food Security Act (NFSA) of 2013, which became law in September 2013.

The PDS historically has been criticized as being highly inefficient. However, the State of Chhattisgarh is among those that have improved distribution of PDS food grains through a number of reforms, some well-publicized (post-2004) and some less publicized (pre-2004). PDS reforms, similar to the post-2004 reforms implemented in Chhattisgarh, have been implemented in other States and helped to serve as a basis for the NFSA. In this study, we estimate the impact that pre- and post-2004 reforms had on PDS consumption and on rates of food insecurity.

What Did the Study Find?

Our quantitative assessment of food security in Chhattisgarh showed:

- Consumption of PDS grains increased greatly between 1999/2000 and 2009/10; the average calories per capita obtained from PDS rice increased by 880 percent.
- PDS consumption began to increase before the first of the post-2004 reforms, and continued to increase after the post-2004 reforms. It is difficult to predict whether other States implementing only certain aspects of Chhattisgarh's post-2004 PDS reforms would share Chhattisgarh's success—the existence of a prior, upward trend in PDS consumption makes this prediction even more difficult.

- An improvement in food security and nutritional outcomes in Chhattisgarh occurred between 1999/2000 and 2004/05, primarily among low-income households that were most likely eligible for the largest subsidies.

- Even as the PDS food grains' availability continued to expand in Chhattisgarh, there was no improvement in food security between 2004/05 and 2009/10. All regions across India had a marked increase in food insecurity in response to the global financial and food price crises during this latter period.

Based on these findings, we conclude that the major reforms in Chhattisgarh were likely successful at improving the performance of the PDS and helped reduce the food-insecure population. The case of Chhattisgarh shows that improving the PDS in States where the system operates less efficiently is both possible and can effectively help trim rates of food insecurity. However, the improvements did not shelter poor residents of Chhattisgarh from rising food prices or the global financial crisis in the late 2000s more than other food-aid recipients in the rest of the country. In order to target households experiencing sudden economic duress, improvements in the PDS would need to continue at both the national and State levels.

How Was the Study Conducted?

Using consumer expenditure surveys conducted by the Government of India in 1999/2000, 2004/05, and 2009/10, ERS researchers estimated PDS consumption and overall calorie consumption in Chhattisgarh and States bordering Chhattisgarh. The researchers then computed changes in consumption to estimate how food security and PDS consumption changed in Chhattisgarh between each survey. Those changes in Chhattisgarh were compared to what occurred in border States to account for shocks or changes in national policy that might be contributing to the observed trends.

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Introduction

Despite improvements in the availability and stability of food supplies across the world, recent estimates suggest there are approximately 870 million malnourished people in the world (FAO, 2012a; Fan, 2012; Meade and Rosen, 2013). Given the difficulty for so many households to reliably obtain adequate sustenance on their own, a number of researchers, policymakers, and other commentators have focused on measuring different aspects of malnourishment, analyzing methods to better deliver food assistance, and analyzing the effects of food assistance on a variety of household outcomes (FAO, 2012b; Barrett, 2002; and Behrman and Deolalikar, 1998).

India long has made provisions to help maintain adequate access to food through the Public Distribution System (PDS), which is designed to sell primarily rice, wheat, sugar, and kerosene to poor households at subsidized rates. The Central Government procures PDS food grains from farmers across India and then distributes the rice and wheat to individual State governments. States in turn are responsible for distributing PDS commodities to households through a network of Fair Price Shops (FPSs). Prior to 1997, the program was available to all households and was primarily designed to stabilize food prices and secure the availability of food following high food prices and food shortages in the 1950s and 1960s (Radhakrishna et al., 1997). In 1997, the PDS was changed into the Targeted Public Distribution System, which targeted large food subsidies to India's poorest households (Government of India (GOI), Ministry of Consumer Affairs, 2002).

The PDS has been widely criticized for a number of reasons. Primarily, the program has been criticized as being highly inefficient. Estimates suggest that approximately 41 percent of subsidized grains did not reach their intended beneficiaries in 2010 (Dreze and Khera, 2011).[1] However, the design of the PDS has also been criticized for excluding a large number of food-insecure and poor households from subsidized food grains based on the designation of the poverty line (GOI/Ministry

[1]The term "efficiency" is used herein to refer to the share of the entitled rations that households are actually able to receive. Although we are not able to measure actual purchases of PDS commodities, we analyze noisy measures that are correlated with this unobservable variable. Specifically, we analyze the amount of PDS calories consumed by households (intensive margin). However, all results are identical if we analyze the share of households consuming any PDS grains (extensive margin). Although these measures are not ideal, they are likely sufficient to detect changes in PDS efficiency. In surveys, households in Chhattisgarh are especially likely to consume their whole ration of PDS rice, as it is the staple food of Chattisgarh and the allotted rations are not sufficient to meet a household's demand for rice (Puri, 2012). Thus higher values of PDS consumption are likely associated with higher availability of PDS grains. Furthermore, all other studies of PDS consumption using consumer expenditure data from the National Sample Survey Organization (NSSO) utilize similar measures of PDS consumption (GOI/Ministry of Statistics and Programme Implementation, 2007; Deaton and Dreze, 2009; Jha and Ramaswami, 2010; and Khera, 2011a).

of Consumer Affairs, 2002). These two factors help to explain why, despite spending nearly 1 percent of a rapidly rising gross domestic product (GDP) on maintaining the PDS (Sharma, 2012), India still accounts for nearly 40 percent of the world's food-insecure population (UN/FAO, 2012a; Fan, 2012; Meade and Rosen, 2013).

Despite the historically poor PDS performance, some States have shown improvements in the distribution of PDS food grains (Khera, 2011b). However, the causes of the recent improvement are not well understood, and thus it is difficult to understand how best to improve the PDS in States where it still operates poorly. The immediacy of the issue is further exacerbated by the National Food Security Act (NFSA), which will dramatically expand the amount of households entitled to food grains distributed by the existing PDS.[2]

Chhattisgarh is one of the States where the distribution of PDS food grains improved in recent years (Khera, 2011b). The State's experience makes it an especially salient case study. The State was formed in November 2000 by taking a number of primarily poor and rural districts from the State of Madhya Pradesh.[3] Given the relative poverty of the region, the State has a higher incidence of food insecurity than the rest of India (Government of India (GOI), National Sample Survey Organization, 2007).

Beginning in early 2001 and continuing throughout the decade, Chhattisgarh began implementing a series of reforms to the manner in which it distributed PDS food grains. However, the reforms implemented by the State government beginning in late 2004 have received the most attention and are often credited for the improvement in the PDS in Chhattisgarh (Dreze and Khera, 2010). These well-publicized reforms came in two major waves. First, the management of shops that sell PDS commodities and the delivery of grains to those shops were significantly altered in December 2004, and later, in 2007, the State dramatically expanded the list of households that were eligible for grains at the lowest rates and reduced the rate at which PDS grains were sold. Tinkering with these reforms over time, Chhattisgarh also introduced auditing and transparency mechanisms for the delivery and receipt of PDS goods.

Recent surveys conducted in Chhattisgarh demonstrate that the PDS is operating much more efficiently than it was earlier in the decade (Khera, 2011b; Puri, 2012). Based on the changing perceptions of the PDS in the State, many government officials, scholars, and observers have called on other States to emulate the post-2004 reforms instituted in Chhattisgarh, and many provisions from these reforms have been included in the current proposals to expand the PDS.[4]

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[2]In its present form, the NFSA would increase the monthly entitlement of food grains to 5 kilograms (kg) per person for "priority" households and 35 kg per household for Antyodaya Anna Yojana (AAY) households, which are the poorest of the poor households. It would expand the fraction of eligible households to include up to 75 percent of the rural population and 50 percent of the urban population.

[3]See appendix 2 for a map of India highlighting Chhattisgarh and bordering States.

[4]See the National Food Security Act, accessed June 2013. http://www.thehindu.com/multimedia/archive/01404/Summary_of_the_Nat_1404267a.pdf

Haryana and Punjab have implemented pilot programs based on Chhattisgarh's experience. [5, 6] Even the Supreme Court has questioned why Chhattisgarh cannot serve as a model for the rest of the country. [7] Furthermore, a number of provisions in the post-2004 reforms have been incorporated into NFSA to help address inefficiencies in States where the PDS operates poorly. A number of politicians have even gone further and called on the Government of India to make the NFSA incorporate more aspects of the post-2004 reforms by increasing coverage and rations and lowering prices.

However, it is important to note that there were a number of reforms to the PDS in Chhattisgarh prior to the well-publicized reforms described above that could have helped contribute to the turnaround in the PDS performance. In particular, there was an increase in the number of Fair Price Shops as the State government began to issue licenses to private merchants in 2001. Additionally, Chhattisgarh began to implement the Decentralized Procurement (DCP) scheme in 2002 by directly purchasing PDS food grain from State farmers. This latter scheme was continued by the next State government.

Trying to investigate the effect the post-2004 reforms had on food security and also the role the reforms played in the turnaround of the PDS, this report further investigates the changes in food consumption in Chhattisgarh during the reform period. We analyze food security and PDS consumption obtained from the 1999/2000 (55th)[8], 2004/05 (61st), and 2009/10 (66th) rounds of the Consumer Expenditure surveys conducted by the National Sample Survey Organization (NSSO). In particular, we compare consumption of PDS grains and the share of the food-insecure population after the reforms in Chhattisgarh to pre-reform levels in the State. We also compare the changes in PDS consumption and overall calorie consumption in Chhattisgarh to changes in States bordering Chhattisgarh to account for regional and national shocks that might be affecting consumption during the time period.

We find that PDS consumption has increased over the past decade in Chhattisgarh overall, and that this increase is much larger than the changes in border States. Despite this gain in PDS consumption following the large reforms to the PDS in the State, it is difficult to attribute all of the increase in PDS consumption to the post-2004 reforms. We find that the increase in PDS participation started to occur *before* the well-publicized reforms were implemented, which suggests prior reforms and other factors were helping to drive a large portion of the improvement in Chhattisgarh. It would be difficult to predict whether other States implementing only certain aspects of Chhattisgarh's post-2004 PDS reforms would share Chhattisgarh's success; the existence of a prior, upward trend in PDS consumption makes this prediction even more difficult.

Additionally, we find that as the availability of PDS food grains greatly expanded in Chhattisgarh, there was an improvement in average calorie consumption and a decrease in the share of the population consuming less than 2,100 calories per day between 1999/2000 and 2004/05. However, even as the availability of PDS food grains continued to expand between 2004/05 and 2009/10, we find little

[5]For one example, see *The Economist* (accessed March 2013) http://www.economist.com/blogs/feastandfamine/2012/10/rural-india

[6]Accessed March 2013, http://articles.economictimes.indiatimes.com/2010-07-12/news/27568498_1_pds-food-law-food-subsidy-bill

[7]Accessed March 2013, http://timesofindia.indiatimes.com/india/supreme-court-seeks-centres-response-on-chhattisgarh-pds-model/articleshow1/18804758.cms

[8]The 1999/2000 (55th) round was completed before the creation of Chhattisgarh.

evidence of an improvement in food security during this period as the global financial crisis and the escalation of food prices drastically affected nutrition across the entire country.

Thus, the turnaround in the PDS in Chhattisgarh did reduce the food-insecure population in the State. Given the poor performance of the PDS before the turnaround in Chhattisgarh, improving the PDS in States where it operates less efficiently is both possible and can effectively help trim rates of food insecurity. However, this improvement did not shelter the State from the rising food prices or the financial crisis better than the rest of the country, and continued improvement is necessary in both national and State policies in targeting households experiencing sudden economic duress.

However, despite finding positive nutritional benefits of the expansion of PDS food grains, this study ignores the potential adverse effects that PDS procurement of food grains has on agricultural markets. Many suggest that the Government-mandated Minimum Support Price (MSP) is set both to provide income support to farmers and to stabilize food prices, and that the former motivation often dominates the latter given the persistently high MSP (Rakshit, 2003). Some studies suggest that these interventions in agricultural markets actually harm the overall economy by depressing investment in agricultural sectors (Kumar et al., 2003). Whatever effects Government procurement of food grains has on agricultural markets, the effects are likely to be magnified given the potential increase in the procurement under the NFSA, and a number of policymakers are concerned about the ramifications for agricultural markets (Gulati et al., 2012).

Reforms in Chhattisgarh and Bordering States

Changes to PDS delivery in Chhattisgarh began shortly after the State's formation in late 2000. In June 2001, the State government began to grant licenses to own and operate FPSs to private parties under the Sarvajanik Nagrik Poorti Vitran (SNPV) Scheme. The number of FPSs in the State doubled between 2001 and 2004, of which nearly 60 percent were privately owned and operated.[9] There was a corresponding increase in complaints against the practices of PDS shops. Of the 1,525 cases registered against FPSs in this period, approximately 1,200 were against private dealers (GOI/ Department of Food and Public Distribution, 2006). The State Advisor for the Supreme Court investigated these complaints and issued a report indicting the role of private dealers in the PDS.

Chhattisgarh also restructured its system of procurement for PDS rice. In 2002, Chhattisgarh began to participate in the DCP scheme, in which State governments procure rice and wheat directly from local farmers at the MSP and are reimbursed for the cost of the rice by the Central Government. From 2002 to 2010, rice procurement rose from 1.5 million metric tons to 5.1 million metric tons, an increase of 340 percent.[10, 11]

In 2004, a committee led by the Principal Secretary of Food and Civil Supplies investigated food security issues for vulnerable communities in tribal districts in Chhattisgarh.[12] The committee's investigation led it to cancel private FPS licenses in six tribal districts in the State and to turn private FPSs over to community groups to operate.[13] The State government then promulgated the 2004 Public Distribution (Control) Order, which discontinued the operation of FPSs by private dealers everywhere in the State and permitted operation only by local village or small-town governments (Gram Panchayats), cooperative societies, self-help groups, and forest protection committees.

The Order contained a number of other reform provisions: delivery to FPSs should take place by the first week of the month, allocations amounts to FPSs should be disclosed to Gram Panchayats and other local bodies, and inspections and social audits should take place within specified intervals. The Government subsequently introduced measures to increase the financial viability of FPSs by providing an interest-free loan of 75,000 rupees (Rs) for each FPS and increasing the commission on items sold from Rs 8 to Rs 45 per quintal. By 2009, the number of FPSs in Chhattisgarh had grown to 10,400.[14]

Chhattisgarh also increased the coverage of the PDS. The Mukhyamantri Khadyann Sahayata Yojana (MKSY) scheme, launched in April 2007, provided ration cards to households that were below the poverty line (BPL) in either the 1991 or 1997 BPL surveys but were excluded from the 2002 survey. This scheme increased the number of individuals who were eligible to receive rations by nearly 2 million people, which is nearly 8 percent of the total population of the State. Finally, there were a number of smaller reforms that occurred after 2004, including computerization of records, sending "short message service (SMS) alerts" via mobile phone to report grain movements

[9]There were 8,637 total FPSs in 2004, of which 5,049 were privately owned.

[10]Accessed June 2013, www.ipc-undp.org/conference/south-south-learning-event/presentations/Samir%20Garg.pdf

[11]States bordering Chhattisgarh did not increase direct procurement of rice as much as Chhattisgarh over the period under analysis.

[12]Accessed June 2013, http://planningcommission.nic.in/reports/genrep/health/SSS_goodprac.pdf

[13]The districts were Surguja, Koriya, Jashpur, Kanker, Dantewada, and Bastar.

[14]Accessed June 2013, http://pib.nic.in/newsite/erelease.aspx?relid=74180

to citizens who registered to receive them, using electronic weighing machines for rations, visibly marking households to indicate the rations they were receiving, and publicly displaying a list of all ration card holders at the FPS.

Stakeholders in Chhattisgarh credit the reforms implemented after 2004 with improving the PDS in the State over the past decade (Puri, 2012). Approximately 95 percent of survey respondents in 2009-10 reported receiving their full grain ration, and the vast majority of respondents reported that they did not receive poor quality grains, that the FPSs had a fixed operating schedule, and that they were overwhelmingly happy with the operation of the PDS (Khera, 2011b). Despite this improvement in the PDS, the process of reform continues. One example is the passage of the Food Security Act of 2012 by the Chhattisgarh State government.

Data and Estimating Household Calorie Consumption

In order to assess the impact of PDS reforms, this report compares PDS and overall calorie consumption in Chhattisgarh after the post-2004 reforms to consumption in Chhattisgarh prior to those reforms. While this comparison provides suggestive evidence of the contribution of post-2004 reforms, some of the measured change in PDS consumption might be due to a secular trend or shocks common to the entire region or the country as a whole. Therefore, we also need to compare this change in PDS consumption to changes in border States to make sure that policy changes or other shocks to the entire country are not driving the results.[15]

This study relies on household estimates of consumption from PDS sources and overall calorie consumption obtained from consumer expenditure surveys conducted by the NSSO. The NSSO conducts annual surveys on a range of topics, and conducts a more detailed survey of both consumption and employment every 5 years. This report utilizes three of these larger consumption surveys—1999/2000 (55th), 2004/05 (61st), and 2009/10 (66th) rounds—each of which surveyed over 100,000 households across all of India.

Each consumption survey provides quantity and value of consumption of approximately 170 separate food items, along with the sources of each food item (e.g., homemade, purchased, etc.), and information on meals consumed outside the household. Each survey reports quantities and values of PDS rice, wheat, sugar, and kerosene consumed separately from the rest of household consumption. Additionally, the survey reports a range of household and individual characteristics, including the number of household members, where the household is located, and the education and age of household members.

In order to convert quantities of food consumed to calorie values, this report utilizes the average calories contained in each of these food items as reported in Gopalan et al. (1989).[16] Thus, these surveys yield simple estimates of calories consumed from PDS rice, wheat, and sugar. However, there are a number of difficulties in estimating overall household calorie consumption, which is used in performing quantitative assessments of food security in Chhattisgarh before and after the reform period. First, inaccuracies may arise in converting purchases of processed foods into calories terms. Many of the processed food categories, such as "Salted Refreshment," "Cake/Pastry," and "Other Processed Food," are difficult to match to precise nutritional information. Additionally, because some of these vague food items come in a variety of different forms and it is difficult to report quantities, the data set only reports the value of a number of processed food categories.[17]

In order to estimate calories contained in these sources, we follow Deaton and Subramanian (1996), where we first calculate the amount of nonprocessed calories consumed per rupee spent on those food items. We then assume that processed foods are twice as expensive as nonprocessed calories,

[15]Although we only report comparisons between Chhattisgarh and the border States, the results are identical regardless of comparison region. In particular, the results are robust to using either all of Madhya Pradesh, or bordering districts as the comparison region.

[16]In certain instances, it is difficult to match the survey code to the more detailed foods that are recorded in *Nutritive Value of Indian Foods*. However, in most cases, the difference in calories is likely to be small (e.g., matching up particular forms of rice, nearly all calorie values are identical, so any error is likely inconsequential).

[17]Although it is difficult to estimate how many calories were consumed from processed foods, the baseline estimation strategy in this report estimates that households consume approximately 5 percent of overall calories in the form of processed foods.

and then obtain an estimate of calories from processed foods by multiplying the value spent on processed foods by one-half of the calories the household obtains from per rupee spent on nonprocessed foods.

Second, household members consume meals outside the home, and the calories consumed in these meals must be accounted for in order to accurately compute the actual number of calories consumed by household members. For example, if poorer households are more likely to eat meals at their place of employment, then looking only at food items purchased is likely to understate their caloric intake. While the NSSO data set provides detailed information on the number of meals received by household members outside of the household, it is still necessary to devise a method to accurately assign a caloric value to those meals.

Using methodology introduced by Deaton and Subramanian (1996), the calories contained in meals consumed outside the household are estimated by analyzing how many fewer calories the household consumes for every additional meal consumed. Using simple regression techniques, the most complete estimate suggests that households consume 475 fewer calories for each meal consumed outside the household, and we add the figure to household calorie consumption for each meal that is consumed outside the household. Although the approach is far from ideal and introduces a significant amount of measurement error into estimates of food insecurity (Tandon and Landes, 2011), a number of other studies use similar approaches (Deaton and Dreze, 2009). (See appendix 1, "Estimating Calories Contained in Meals Consumed Outside the Household.")

Lastly, we cannot account for calories prepared by the household, but given to nonhousehold members. Although the 2004/05 and 2009/10 rounds of the consumption surveys report the number of such meals, the 1999/2000 round does not. Thus, to use a consistent estimate of calorie consumption throughout the analysis, we simply ignore the number of meals given to nonhousehold members. Although this represents a significant difficulty in accurately estimating household calorie consumption, the majority of households do not give any meals to nonhousehold members. This is especially true for poorer and food-insecure households.[18]

Estimates of total household calorie consumption are obtained by adding nonprocessed calories consumed, the estimate of processed calories consumed, and also the estimate of calories consumed in meals outside the household. Once the baseline estimates of total calorie consumption are calculated, calorie intake totals for individuals are computed in order to permit comparisons with individual consumption benchmarks. Table 1 reports daily consumption per person, separated by survey.[19]

Consistent with other estimates of calorie consumption in India, table 1 suggests that calorie consumption is decreasing and food insecurity is increasing from 1999/2000 to 2009/10 (Government of India (GOI), National Sample Survey Organization, 2007; Deaton and Dreze,

[18]All results are discussed in later sections are identical if we estimate calories given to nonhousehold members in the 2004/05 and 2009/10 surveyed households similarly to the estimation strategy for calories consumed in meals consumed outside the household, but ignore such meals in households surveyed in 1999/2000. In such estimations, time dummies across all households would help to absorb the difference in estimation strategies across rounds. However, for simplicity, we focus on the results using the estimation strategy discussed in the text.

[19]These estimates are not intended to be interpreted as population estimates. The surveys are stratified by whether a household resides in a rural or urban area, and further stratified by income group. Rather than weighting each household appropriately to arrive at a population estimate, we simply report the sample average pooled across rural and urban areas, as well as pooled across income stratification.

Table 1
Baseline estimate of average calories consumed in Chhattisgarh and border States

Variable	*Average daily sample household calorie consumption by survey*		
	(1) Average per capita calories per day	(2) Share of sample who are food-insecure	Observations
1999-2000 round	2,201.2 (19.5)	.521 (.010)	47,340
2004/05 round	2,069.7 (18.6)	.599 (.013)	48,236
2009/10 round	1,929.0 (16.6)	.675 (.011)	39,503

Note: Estimates calculated using the 1999/2000, 2004/05, and 2009/10 rounds of the National Sample Survey. Standard errors clustered by district are reported in parentheses.

Source: USDA, Economic Research Service analysis.

2009). However, this is not necessarily the case. The amount of the diet that is essentially unobservable to researchers—consumption of processed foods and food away from the home—is also increasing over this time period. Small changes in assumptions used to derive calorie consumption from these sources could result in large changes to overall calorie consumption, and thus it is difficult to discern whether food security is improving, worsening, or not changing over this time period (Tandon and Landes, 2011). (See box, "Data Concerns.")

Data Concerns

There are a number of data concerns with the empirical strategy discussed in the text. First, data limitations force us to use the PDS calories consumed by source. Ideally, we would have preferred to have analyzed actual PDS purchases rather than a noisy measure of those purchases to measure availability of PDS food grains. Such measures could be a problem if, for example, households prior to or after the reform were less likely to use their PDS ration, and thus are miscategorized as not participating in the PDS. However, surveys suggest that households use most of their ration of rice, as it is the staple good of the region (Puri, 2012). Additionally, the robustness of our estimates to multiple control groups to estimate what PDS consumption would have been in absence of the reforms in Chhattisgarh helps to limit this concern that omitted factors are differentially driving the decision whether to consume any of the PDS ration in the treatment and control groups. Regardless, all other studies using NSSO consumption data are forced to rely on similar measures (National Sample Survey Organization, 2007; Deaton and Dreze, 2009).

Secondly, the NSSO consumer expenditure surveys are stratified by whether a household resides in a rural or urban area and further stratified by relative affluence rather than a random sample. However, population estimates for both rural and urban areas can only be constructed at the State and national levels. In this instance, we are not able to construct population estimates for groups of districts that would later form Chhattisgarh in the 1999/2000 round.

Although PDS calories are potentially affected differently by the PDS reforms across income and whether a household resides in a rural or urban area, we are trying to detect changes in PDS consumption rather than overall PDS consumption. Thus, if the stratification is identical across surveys, it is not necessary to re-weight observations to arrive at a population estimate of PDS consumption. The relative size of the rural/urban sample is determined by the share of the population that is rural in the 1991 Census for the 1999/2000 round, and by the share that is rural in the 2001 Census for the 2004/05 and 2009/10 rounds. Thus, differential trends in growth of urban areas could potentially drive differences in average PDS consumption across a pooled sample of rural and urban households. Furthermore, the stratification on relative affluence is slightly different between the 1999/2000 round, and the other two surveys.

Despite these small differences in sampling procedure, all trends discussed in the main text are identical when divided up by rural and urban areas, and all patterns discussed below are identical if we restrict the analysis to particular second-stage strata within which there is random sampling of households (i.e., nonaffluent households in the rural sector, nonaffluent households in the urban sector, affluent households in the rural sector, etc.). Thus, for simplicity we present means for the pooled sample throughout.[1]

[1]All results broken up by rural/urban households and further broken up by the second-stage income stratification are available from the authors upon request.

Public Distribution System Consumption Changes Between 1999 and 2009

Table 2 presents the overall changes in daily PDS consumption in Chhattisgarh relative to border States between 1999/2000 and 2009/10. Each of the four panels of the table reports a "difference-in-difference" estimate of average household PDS consumption for one of the four PDS commodities tracked by the NSSO consumer expenditure survey—rice, wheat, sugar, and kerosene.[20] A "difference-in-difference" estimate presents how much more PDS consumption grew in Chhattisgarh than in border States. The comparison of Chhattisgarh's growth to that of border States is important to help capture national and regional trends in PDS consumption that are unrelated to the reforms in Chhattisgarh.

Specifically, the table reports average PDS consumption for 1999/2000 and 2009/10 separately for each region in columns (1) and (2). Column (3) of each panel reports the difference between the average consumption in each time period for each region; whereas, the third row of each panel reports the difference between average PDS consumption in Chhattisgarh and border States for each individual survey. The bottom right cell presented in bold font reports the difference-in-difference estimate of PDS consumption. In words, it represents the difference in the growth in PDS consumption between each region. For example, in the first panel, the difference-in-difference estimate reports that daily PDS consumption in Chhattisgarh increased by 1,090.4 (1,352.1 less 261.8) more calories than daily PDS consumption increased in border States.

A number of patterns emerge from the estimates presented in table 2. First, aside from rice, there are few differences in changes in consumption of PDS commodities between Chhattisgarh and border States. None of the difference-in-difference estimates are large in magnitude, and the estimated standard errors are much larger relative to the point estimates. Thus, the rest of the report focuses on PDS rice consumption, which is the staple food for households in Chhattisgarh.

Second, table 2 also demonstrates that PDS participation in Chhattisgarh was far lower than in border States prior to the formation of the State. Households in Chhattisgarh consumed 162 fewer daily calories from PDS rice (315.7 calories per day less 153.7 calories per day), and had significantly lower consumption of all other PDS commodities. Third, we see that PDS rice consumption in Chhattisgarh increased from approximately 154 calories/day to 1,506 calories/day over this time period, which represents a dramatic 880-percent increase. And lastly, this growth in Chhattisgarh is much larger than in bordering States, where PDS rice consumption increased by approximately 261.8 calories/day. As discussed in the example above, this represents an increase of approximately 1,090 calories/day more in Chhattisgarh than in border States, and the estimate is statistically significant at the 1-percent level.

Further investigating trends in PDS rice consumption during this time period, table 3 reports PDS rice consumption separated by region and survey, but incorporates estimates from the survey conducted in 2004/05. The table also reports the change in PDS rice consumption between 1999/2000 and 2004/05, and the change between 2004/05 and 2009/10. Furthermore, the table reports the differences in this growth between Chhattisgarh and the growth in border States.

[20]Although we report average consumption throughout, similar patterns are observed utilizing other variables. In particular, all results are identical when analyzing the share of households consuming any PDS rice, the share of households consuming any PDS wheat, etc.

Table 2
Differences in daily household Public Distribution System (PDS) consumption

PDS rice	1999/2000 round	2009/10 round	Difference 1: (column 2 – column 3)	Observations
		Calories consumed per household per day		
Chhattisgarh	153.7 (14.7)	1,505.9 (51.6)	1,352.1*** (77.8)	4,524
Border States	315.7 (30.5)	577.5 (38.7)	261.8*** (24.5)	82,181
Difference	-162.0*** (34.6)	311.5*** (110.5)	**1,090.4***** **(75.4)**	-

PDS wheat	1999/2000 round	2009/10 round	Difference 1: (column 2 – column 3)	Observations
		Calories consumed per household per day		
Chhattisgarh	78.3 (18.2)	164.2 (38.3)	85.9* (40.4)	4,524
Border States	132.7 (14.5)	292.2 (19.6)	159.5*** (22.1)	82,181
Difference	-63.4*** (19.4)	-92.4*** (37.6)	**-73.6*** **(43.1)**	-

PDS sugar	1999/2000 round	2009/10 round	Difference 1: (column 2 – column 3)	Observations
		Calories consumed per household per day		
Chhattisgarh	160.7 (15.6)	55.900 (2.530)	-104.80*** (13.90)	4,524
Border States	135.0 (4.47)	31.900 (2.680)	-103.10*** (4.35)	82,181
Difference	-50.6*** (41.6)	-.675*** (.293)	**-1.72** **(13.40)**	-

PDS kerosene	1999/2000 round	2009/10 round	Difference 1: (column 2 – column 3)	Observations
		Liters consumed per household per day		
Chhattisgarh	.084 (.002)	.047 (.002)	-.038*** (.003)	4,524
Border States	.093 (.004)	.065 (.002)	-.028*** (.005)	82,181
Difference	-.018*** (.004)	-.015*** (.003)	**-.009** **(.006)**	-

Note: This table reports PDS consumption broken up by region and survey, as well as the differences in consumption over time (column 3), and also the differences between the growth between regions in the bottom righthand cell in bold. Statistical significance reported for each of the differences presented in the table. * Denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level. Standard errors clustered by district are reported in parentheses. Estimates calculated using the 1999/2000, 2004/05, and 2009/10 rounds of the National Sample Survey. Standard errors clustered by district are reported in parentheses.

Source: USDA, Economic Research Service analysis.

Table 3
Differences in average daily household Public Distribution System (PDS) rice consumption

PDS rice	1999/2000 round	2004/05 round	2009/10 round	Difference 1: (column 2 – column 1)	Difference 2: (column 3 – column 2)
			Calories consumed per household per day		
Chhattisgarh	153.7 (14.7)	639.9 (115.7)	1,505.9 (51.6)	486.2*** (121.1)	866.0*** (158.1)
Border States	315.7 (30.5)	328.4 (31.9)	577.5 (38.7)	12.8 (18.2)	249.1*** (21.8)
Difference 1: Row 1 – row 2	-162.0*** (34.6)	311.5*** (110.5)	928.4*** (88.9)	**473.5***** **(112.3)**	**616.9***** **(146.3)**

Notes: This table reports PDS consumption broken up by region and survey, as well as the differences in consumption over time (columns 3 and 4), and also the differences between the growth between regions in the bottom righthand cells in bold. Statistical significance reported for each of the differences presented in the table. * Denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level. Standard errors clustered by district are reported in parentheses.

Source: USDA, Economic Research Service analysis.

Table 3 demonstrates that much of this growth in PDS rice consumption reported in table 2 occurred before 2004/05. Between 1999/2000 and 2004/05, PDS rice consumption increased by approximately 486 calories/day, and then further increased between 2004/05 and 2009/10 by 866 calories/day. The bottom right-hand cells reported in bold demonstrate that these remarkably large increases in PDS rice consumption in Chhattisgarh were larger than the increases in bordering States in each time period. For example, rice consumption grew by approximately 473.5 more calories/day in Chhattisgarh than in border States (486.2 less a decrease of 12.8) between 1999/2000 and 2004/05.[21]

Additionally, table 3 also demonstrates that PDS rice consumption was growing across all border States between 2004/05 and 2009/10. This is likely due in part to the global rise in food prices and also the onset of the global financial crisis later in the period (Dev, 2009). This significant negative income shock across the country probably led to an increase in the number of houses qualifying for subsidized PDS grains, as well as an increase in the willingness of households to consume a potentially inferior product (Rao, 2000).

[21]Between 2004/05 and 2009/10, a few States neighboring Chhattisgarh implemented a few reforms to the PDS by reducing prices of PDS grains (Khera, 2011a). However, when restricting the analysis to border States that did not implement any PDS reforms during this latter time period, the results are very similar to the estimates presented in table 3.

Accounting for Household Characteristics and the Baseline Empirical Strategy

However, it is important to make sure that the trends being discussed above are robust to absorbing household and region-level heterogeneity. In particular, we re-create these difference-in-difference estimates by estimating the following Ordinary Least Squares regression:

$$PDS\_Consumption_{irt} = \tau_r + \beta_1 CT_{irt} + \beta_2 Post_{irt} + \beta_3 (Post_{irt} * CT_{irt}) + \beta_4 ControlVars_{irt} + \varepsilon_{irt}$$

where PDS_Consumption refers to daily household calories obtained from PDS rice for household i, in region r, at time t; CT denotes an indicator equaling one if the household resided in Chhattisgarh; Post denotes an indicator equaling one if the observations comes from the second period under analysis; ControlVars denotes household control variables[22]; and ε denotes an error term that captures all factors that affect PDS Consumption that are not already included in the equation.

Based on this empirical specification, we can re-create estimates of the differences in the growth of PDS consumption between Chhattsigarh and border States displayed in tables 2 and 3. In particular, based on the time periods used in the estimation, estimates of β_3 represent the difference-in-difference estimate (i.e., the change in PDS Consumption in Chhattisgarh less the change in PDS Consumption in border States).

Specifically, if only households from the 1999/2000 and 2004/05 surveys are included, and the households from the 2004/05 survey are considered the "Post" survey (i.e., Post=1 if the household comes from the 2004/05 survey and Post=0 for households from the 1999/2000 survey), then β_3 is an estimate of the difference in PDS growth between Chhattisgarh and border States between 1999 and 2004. However, if only households from the 2004/05 and 2009/10 surveys are included, and households in the 2009/10 round are considered the "Post" round, then β_3 is an estimate of the difference in PDS growth between Chhattisgarh and border States between 2004 and 2009.

This estimation strategy is very flexible and allows us to compare growth in PDS consumption between Chhattisgarh and border States over multiple time periods. The advantage of the above specification relative to tables 2 and 3 is that the more complete specification with district fixed effects, time dummies, and household-level control variables helps absorb unobserved heterogeneity and makes sure that these differences are not being driven by some other sort of household, time, or regional characteristic. In all comparisons discussed in the rest of the report, variants of the above specification are estimated.

Using the above specification, we estimate the differences in the growth of PDS consumption between each of the three rounds in table 4. Columns (1) and (3) estimate a sparse specification with no district fixed effects or control variables; columns (2) and (4) add these factors. In these specifications, we can see that the estimates in columns (1) and (3) are exactly the difference-in-difference estimators presented in table 3. Average PDS rice consumption increased by

[22]Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had a below poverty line card (BPL) in the 2004/05 round, for whether the household is self-employed, two indicators for whether the household belongs to a Scheduled Caste or a Scheduled Tribe, and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist).

Table 4
Differences in the growth of Public Distribution System (PDS) rice consumption in Chhattisgarh relative to border States

	Difference between 1999/2000 and 2004/05 rounds		Difference between 2004/05 and 2009/10 rounds	
	Consumption of PDS rice (calories/day)			
	(1)	(2)	(3)	(4)
Chhattisgarh* post	473.5*** (112.3)	438.0*** (91.6)	616.9*** (146.3)	735.9*** (132.1)
District fixed effects and control variables	N	Y	N	Y
Observations	96,356	96,356	88,381	88,381

Note: This table estimates the difference-in-difference estimator for PDS rice consumption. Columns (1) and (2) use observations from the 1999/2000 and 2004/05 rounds of the National Sample Survey Organization (NSSO) consumer expenditure survey, and columns (3) and (4) use observations from the 2004/05 and 2009/10 rounds. Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had a below-poverty-line card in the 2004/05 round, for whether the household is self-employed, two indicators for whether the household belongs to a Scheduled Caste or a Scheduled Tribe, and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist). Standard errors clustered by district are reported in parentheses; * denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level.

Source: USDA, Economic Research Service analysis.

approximately 473.5 more calories/day in Chhattisgarh relative to border States between 1999/2000 and 2004/05, and average consumption increased by approximately 616.9 more calories/day between 2004/05 and 2009/10.

However, in columns (2) and (4), we also see that accounting for time-invariant district fixed effects and for time-varying household-level control variables in the same specifications hardly affect the estimate of β_3. The magnitude of the estimates are similar across specifications, and the estimates actually become slightly more precise and continue to be significant at the 1-percent level.[23] These estimates suggest that the simple effects we present in the text are likely not capturing the effects of omitted household variables or unrelated time or regional trends.

Although tables 2-4 show significant increases in PDS consumption in Chhattisgarh relative to border States, it is difficult to attribute all these changes to the post-2004 reforms. In particular, the first of the post-2004 reforms was written in December 2004, which was midway through the 2004/05 round of the NSSO consumer expenditure survey. The survey was conducted between June 2004 and June 2005, with 1,393 households in Chhattisgarh surveyed in 2004 and 1,403 surveyed during 2005.[24]

Given the timing of the survey, we also estimate the difference in the growth of PDS rice consumption between Chhattisgarh and other regions of India prior to the implementation of the 2004 PDS reform, as well as any reform implemented afterwards. Specifically, we re-estimate the baseline regression specification discussed above, but restrict the observations in the 2004/05 round to households that were surveyed in 2004.

[23]Precision refers to the size of the estimated standard error.

[24]In order to address issues of seasonality, the sampling of households from income and sector strata were identical in the 6 months of the survey conducted in 2004 and the 6 months of the survey conducted in 2005.

We present these estimates in table 5. Column (1) estimates a sparse specification with only the variable of interest and lower order terms, and column (2) adds district fixed effects and control variables. These results demonstrate that the increase in PDS consumption in Chhattisgarh began before any of the post-2004 reforms were implemented. Using the most complete specifications in column (2), PDS rice consumption increased by 576.5 more calories/day in Chhattisgarh than in border States. This increase is actually larger than the estimate reported in column (2) in table 4 using all observations from the 2004/05 round.

Krishnamurthy et al. (2013a) further investigates the causes for the improvement in Chhattisgarh's PDS. First, the study demonstrates that it is not due to the formation of a smaller and newer State, as there were not similar improvements to the PDS in other States formed at the same time as Chhattisgarh (Jharkhand and Uttarakhand). Second, the results provide evidence that the improvement began before the 2003 elections when a new State government was elected, suggesting the cause of the turnaround was not solely the result of political targeting of that particular government that went on to implement all of the post-2004 reforms.

Table 5
Differences in the growth of Public Distribution System (PDS) consumption before the 2004 reform

	Difference between Chhattisgarh and border States 1999/2000 to 2004	
	Consumption of PDS rice (calories/day)	
	(1)	(2)
Chhattisgarh* post	612.4*** (130.2)	576.5*** (113.2)
District fixed effects and control variables	N	Y
Observations	71,759	71,759

Notes: This table estimates the difference-in-difference estimator for PDS rice consumption. Households from the 1999/2000 round and households surveyed in 2004 in the 2004/05 round of the National Sample Survey Organization (NSSO) consumer expenditure survey are used. Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had a below-poverty-line card in the 2004/05 round, for whether the household is self-employed, two indicators for whether the household belongs to a Scheduled Caste or a Scheduled Tribe, and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist). Standard errors clustered by district are reported in parentheses; * denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level.

Source: USDA, Economic Research Service analysis.

Composition of Households Consuming PDS Grains

In addition to analyzing changes to PDS consumption of rice during this time period (i.e., 1999-2010), we also investigate changes to the amount of calories obtained per rupee spent on PDS rice. Different types of households are entitled to different prices for PDS grains, and thus changes to calories obtained per rupee spent on PDS grains would be consistent with changes to the types of households receiving PDS grains. Furthermore, between 2004/05 and 2009/10, PDS rice prices were reduced in Chhattisgarh for BPL households, and there was an expansion of these preferential rates to households that were excluded from the largest subsidies. Thus, even with no differences in the share of PDS grains consumed by BPL and non-BPL households in this time period, we would expect the calories per rupee spent on PDS rice to increase in this latter period if the reforms were effective.

We re-estimate the baseline specification using calories per rupee spent on PDS rice as the dependent variable in table 6, and we include only households that consume any PDS rice. Estimates of β_3 now give differences in the growth of calories per rupee spent on PDS rice between Chhattisgarh and comparison regions. Columns (1) and (2) estimate the change between 1999/2000 and 2004/05, and columns (3) and (4) estimate the difference between 2004/05 and 2009/10.

We find that calories per rupee increased in Chhattisgarh relative to households in border States between 1999/2000 and 2004/05. This difference is entirely driven by a drop in calories obtained per rupee spent on PDS rice in neighboring States, whereas the variable was essentially unchanged in Chhattisgarh during this time period. Given that there did not appear to be any changes in PDS prices during this time period in either Chhattisgarh or neighboring States, the results indicate that a higher share of non-BPL households began to consume PDS rice in neighboring States.

Table 6
Differences in the growth of the calories per rupee spent on Public Distribution System (PDS) rice between Chhattisgarh and border States

	Difference between 1999/2000 and 2004/05		Difference between 2004/05 and 2009/10	
	Calories obtained per rupee spent on PDS rice			
	(1)	(2)	(3)	(4)
Chhattisgarh* post	237.5*** (41.2)	284.4*** (39.7)	570.8*** (95.8)	546.5 *** (105.5)
District fixed effects and control variables	N	Y	N	Y
Observations	19,651	19,651	21,318	21,318

Notes: This table estimates of the difference-in-difference estimator for calories per rupee spent on PDS rice. Columns (1)-(2) include households surveyed in the 1999-2000 round and households surveyed in the 2004/05 round of the National Sample Survey Organization (NSSO) consumer expenditure survey, while columns (3) and (4) include households surveyed in the 2004/05 and 2009/10 rounds. Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had a below-poverty-line card in the 2004/05 round, for whether the household is self-employed, two indicators for whether the household belongs to a Scheduled Caste or a Scheduled Tribe, and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist). Standard errors clustered by district are reported in parentheses; * denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level.

Source: USDA, Economic Research Service analysis.

However, following the 2007 price reform and expansion of BPL rates to a larger number of households, we find a large increase in the amount of calories received per rupee spent between 2004/05 and 2009/10 in columns (3) and (4). In the most complete specification in column (4), we find that calories per rupee spent on PDS rice increased by 546.5 more calories/rupee than in border States. This increase is much larger than the increase in the prior period.

Changes to Food Security in Chhattisgarh Relative to Border States

Given the PDS reforms in Chhattisgarh and the resulting increase in PDS rice consumption, this report estimates the impact the expansion of the PDS had on rates of food insecurity. Krishnamurthy et al. (2013b) finds that in response to the PDS expansion in Chhattisgarh, households diversified their diets and increased consumption from nongrain sources between 1999/2000 and 2004/05. This report further investigates the effect the increased availability of PDS food grains had on consumption by analyzing the change in consumption over a longer time period, 1999/2000 – 2009/2010, and also focuses on overall calorie consumption as opposed to diet diversity. Importantly, the longer time period incorporates the effects of the global financial and food crises.

We focus on two measures of food security— the share of households consuming less than 2,100 calories per person per day and the per capita daily calorie consumption. Using these variables as the dependent variable in our baseline specification, we estimate how these measures of food security changed in Chhattisgarh relative to border States. Estimates of how food security changed in Chhattisgarh between 1999/2000 and 2004/05 are reported in table 7.

Table 7
Differences in the growth of the food-insecure population 1999/2000 to 2004/05

	Share of households consuming less than 2,100 daily calories per person			*Daily calories consumed per person*		
	(1)	(2)	(3)	(4)	(5)	(6)
Chhattisgarh* post	-.036 (.041)	-.045*** (.017)	-.041** (.020)	.042 (.035)	.048*** (.016)	.048*** (.015)
District fixed effects and control variables	N	Y	Y	N	Y	Y
Exclude households receiving benefits other than PDS	N	N	Y	N	N	Y
Observations	95,576	95,576	81,223	95,576	95,576	81,223

PDS = Public Distribution System.

Notes: This table reports estimates of the difference-in-difference estimator for the share of households that consume less than 2,100 calories per person per day and the natural logarithm of total calories consumed per person per day. The table presents estimates of the differences between 1999/2000 and 2004/05, and include households surveyed in the 1999/2000 round and households surveyed in the 2004/05 round of the National Sample Survey Organization (NSSO) consumer expenditure surveys. In order to construct estimates of overall calorie consumption, it is necessary to restrict households to only those that consume positive amounts of nonprocessed calories at home. Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had a below-poverty-line card in the 2004/05 round, for whether the household is self-employed, two indicators for whether the household belongs to a Scheduled Caste or a Scheduled Tribe, and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist). Standard errors clustered by district are reported in parentheses; * denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level.

Source: USDA, Economic Research Service analysis.

All estimates in table 7 suggest that food security improved during the time period, and the most complete specifications estimated in columns (2) and (5) are statistically significant at conventional significance levels. Estimates suggest that the share of food-insecure households decreased by 4.5 percent more in Chhattisgarh than border States, and that overall calorie consumption increased by 4.8 percent more than border States during this time period. Furthermore, columns (3) and (6) exclude households receiving other forms of public support, and demonstrate that the results are not likely being driven by other forms of public support.

Table 8 further estimates how calorie consumption changed in Chhattisgarh relative to border States between 1999/2000 and 2004/05, but separates estimates by overall household expenditure. The estimates demonstrate that there was a strong increase in calorie consumption by the households with the lowest expenditure, who are most likely to be eligible for the largest PDS subsidies. Furthermore, we cannot reject the hypothesis that calorie consumption did not change for households with higher overall expenditure, who would be less likely to qualify for PDS subsidies.[25] These results are consistent with the observed improvement in food security being driven by the PDS as opposed to the formation of a new State or other factors.[26]

Table 8
Differences in the growth of the food-insecure population 1999/2000 to 2004/05 separated by expenditure

	Restrict sample to the quartile with least expenditure	Restrict sample to the quartile with second least expenditure	Restrict sample to quartile with second highest expenditure	Restrict households to quartile with highest expenditure
	Daily calories consumed per person			
	(1)	(2)	(3)	(4)
Chhattisgarh* post	.062*** (.015)	.039*** (.012)	.024 (.028)	.029 (.043)
Observations	23,894	24,001	23,958	23,723

Notes: This table reports estimates of the difference-in-difference estimator for the natural logarithm of total calories consumed per person per day. The table presents estimates of the differences between 1999/2000 and 2004/05, and include households surveyed in the 1999/2000 round and households surveyed in the 2004/05 round of the National Sample Survey Organization (NSSO) consumer expenditure surveys. In order to construct estimates of overall calorie consumption, it is necessary to restrict households to only those that consume positive amounts of non-processed calories at home. Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had a below-poverty-line card in the 1999/2000 round, for whether the household is self-employed, two indicators for whether the household belongs to a Scheduled Caste or a Scheduled Tribe, and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist). Standard errors clustered by district are reported in parentheses; * denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level.

Source: USDA, Economic Research Service analysis.

[25]A similar pattern is found when analyzing the share of the households that consume less than 2,100 calories per person per day.

[26]Ideally, we would estimate consumption changes based on the type of ration card held by the household. However, information on whether households have a ration card and what type of ration card is not available for the 1999/2000 and the 2009/10 surveys.

However, table 9 estimates how food security changed between 2004/05 and 2009/10. Over this second time period, we cannot reject the hypothesis that there was no difference in changes to food security in Chhattisgarh relative to border States. None of the estimates in table 9 are precise. Although the most complete specifications in columns (2) and (4) have signs that imply food security improved over the time period, the estimates are not statistically significant at conventional significance levels.[27]

Although it appears that food security did improve in the first period, it is difficult to explain exactly why there was little evidence of improvement in later periods, as the availability of PDS rice was still expanding. However, there were a number of concurrent negative income shocks that affected the entire country during the second time period. Both the rising food prices and the global financial crisis negatively impacted the entire country (Dev, 2009) and likely caused a significant increase in the food-insecure population. Also demonstrating that these shocks impacted food security and household food consumption, the results discussed in previous sections show that there was a large increase in PDS consumption across all of India between 2004 and 2009, as grains of inferior quality were likely made more attractive in response to the negative income and price shocks. Combined, the large negative income and price shocks between 2004/05 and 2009/10 experienced across India likely overwhelmed the improvements in the PDS in Chhattisgarh during that time period.

Table 9
Differences in the growth of the food-insecure population 2004/05 to 2009/10

	Share of households consuming less than 2,100 daily calories per person		*Daily calories consumed per person*	
	(1)	(2)	(3)	(4)
Chhattisgarh* post	.009 (.055)	-.006 (.042)	-.010 (.048)	.013 (.040)
District fixed effects and control variables	N	Y	N	Y
Observations	87,739	87,739	87,739	87,739

Notes: This table reports estimates of the difference-in-difference estimator for the share of households that consume less than 2100 calories per person per day and the natural logarithm of total calories consumed per person per day. The table presents estimates of the differences between 1999/2000 and 2009/10, and include households surveyed in the 1999/2000 round and households surveyed in the 2009/10 round of the National Sample Survey Organization (NSSO) consumer expenditure surveys. In order to construct estimates of overall calorie consumption, it is necessary to restrict households to only those that consume positive amounts of non-processed calories at home. Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had below-poverty-line card in the 2004/05 round, for whether the household is self-employed, two indicators for whether the household belongs to a Scheduled Caste or a Scheduled Tribe, and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist). Standard errors clustered by district are reported in parentheses; * denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; *** denotes significance at the 1-percent level.

Source: USDA, Economic Research Service analysis.

[27]There continues to be no improvement in food security when separating the effect by overall household expenditure. It is important to emphasize that measurement error biases the estimates to finding no effect. However, this is true of the prior period as well.

These results, along with Krishnamurthy et al. (2013b), contrast with previous studies that cannot reject the hypothesis that food price subsidies had no effect on consumption and nutritional outcomes in India (e.g., Kochar, 2005; Tarozzi, 2005). Tarozzi (2005) is the most closely related and finds no effect of a reform to the PDS in the State of Andhra Pradesh on anthropometric measurements of children under four. Most importantly, this setting provides a much larger change in the availability of PDS food grains than the reform in Andhra Pradesh. Additionally, this analysis focuses on a State where the PDS initially functioned poorly, whereas the PDS functioned much better in Andhra Pradesh than in Chhattisgarh prior to the reform utilized by Tarozzi (2005).

Conclusion

We investigate how food security and PDS consumption responded to the post-2004 PDS reforms in Chhattisgarh. There were two significant changes in PDS consumption between 1999/2000 and 2009/10. First, the average number of calories consumed from PDS grains significantly increased. Second, the number of calories obtained per rupee spent on PDS grains also significantly increased, which suggests that there was an increase in the consumption of PDS grains for the poorest households. However, we also demonstrate that the increase in PDS consumption started to happen before the post-2004 reforms were implemented.

Taken together, these results suggest that the post-2004 reforms did help improve the PDS in Chhattisgarh. However, reforms made prior to 2004 and unobservable factors throughout both time periods also significantly contributed to Chhattisgarh's success. Furthermore, we cannot be sure whether the post-2004 PDS reforms would have been as successful without the prior reforms and the unobservable factors that driving PDS improvements prior to the reform.

Following the reforms to the PDS in Chhattisgarh and the increase in PDS consumption, we find that there was an improvement in food security in Chhattisgarh between 1999/2000 and 2004/05, and then no difference in food security between 2004/05 and 2009/10 as all regions across India had a marked increase in food insecurity in response to the financial crisis and rising food prices. Thus, the PDS expansion coincided with an initial improvement in access to food. However, given the dramatic shocks experienced later in the decade, there was not a similar increase in access to food over the later time period as the PDS continued to improve in Chhattisgarh.

Interestingly, the rising food prices and increased availability of food grains in Chhattisgarh actually increased the effective subsidy for PDS grains for Indian households in the State (Khera, 2011b). But the overall effect seems to have overwhelmed households, and even an increase in PDS consumption could not successfully mitigate the effects of these negative income shocks. Thus, targeting households undergoing sudden economic distress could be improved.

The results discussed in this report have a number of implications for the NFSA. First, the provisions designed to improve transparency of the PDS included in the NFSA mirror many of the post-2004 reforms made in Chhattisgarh. However, these results demonstrate that given a prior upward trend, it is difficult to predict how these provisions will impact States where the distribution of PDS food grains is still poor. Secondly, given the potential role that expanding the PDS in Chhattisgarh had on reducing food insecurity prior to the global food and financial crises, the expansion of subsidized food grains proposed in the NFSA has the potential to improve food security in States where the PDS operates well.

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Appendix 1—Estimating Calories Contained in Meals Consumed Outside the Household

Estimates of the amount of calories consumed in each meal outside the household are obtained by estimating the following specification:

$$\text{Calories}_{irt} = \tau_r + \beta\ \text{MealsReceived}_{irt} + \gamma\ \text{ControlVars} + \varepsilon_{irt}$$

Calories_{irt} denotes the total amount of processed and non-processed calories consumed over the past 30 days by household *i*, in district *r,* at time *t;* τ_r denotes a district fixed effect to help absorb unobserved characteristics shared by all households within a district; MealsReceived denotes the total number of meals eaten by household members outside the household over the past 30 days; and ControlVars denotes control variables, which include time dummies and a number of household characteristics that help absorb unobserved variation in calories purchased.[28, 29] Estimates of β will describe the decrease in calories purchased for every meal consumed outside the household and, under very restrictive assumptions, provide an estimate of how many calories are consumed in such meals on average.

The results of the above specification are reported below. The estimate suggests that households consume 475 fewer calories for each additional meal consumed outside the household. Thus, estimates of calorie consumption add 475 calories to household consumption for every meal consumed outside the household.

Calories purchased per meal consumed

	Total household calories consumed (3)
Meals received	-475.0*** (22.6)
Observations	343,843

Note: *** Denotes significance at the 1-percent level. Standard errors clustered by district are reported in parentheses. All specifications include district fixed effects, time dummies, and control variables. Control variables include the natural logarithm of monthly per capita expenditure as calculated by the NSSO, household size, and indicators for whether the household resides in a rural area, for whether the household purchased any type of commodity from the PDS, for whether the household had a below-poverty-line card in the 2004/05 round, for whether the household is self-employed, two indicators for whether the household belongs to a "Scheduled Caste or a Scheduled Tribe," and six indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist).

Source: USDA, Economic Research Service.

[28]Control variables include the natural logarithm of monthly per capita expenditure and indicators for whether a household resides in a rural area, for whether a household is self-employed, for whether a household has consumed any PDS commodity over the past 30 days, for whether the household has a below-poverty-line ration card in the 2004/05 round, six separate indicators for household religion (Hindu, Muslim, Christian, Sikh, Jain, and Buddhist), and two separate indicators for whether a household belongs to a "Scheduled Caste" or a "Scheduled Tribe."

[29]This approach differs from the methodology reported by NSSO (2007). It provides the number of calories used to estimate the number of calories contained in meals eaten outside of the household, meals given to non-household members, and calories contained in processed foods. However, NSSO does not provide an explanation of the source of these values. Furthermore, NSSO's methodology differs in that it assumes that processed foods purchased by rich households cost the same as processed foods purchased by poor households.

Appendix 2—Map of Chhattisgarh and Bordering States

Appendix 2
Map of Chhattisgarh and bordering States

Source: GADM database of Global Administrative Areas, 2013.