In-kind transfers, marketization costs and household specialization: Evidence from Indian farmers

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Abstract

I examine the effect of in-kind staple transfers on agricultural production in a setting where transactions with markets are costly for households and result in interlinked consumption and production decisions. The expansion of India's Public Distribution system between 1993-2009 led to large variation in the quantity and value of staple grain transfers across households, districts and states. I find that an increase in PDS quantity crowds out consumption from home production and decreases staple production, while increases in the PDS subsidy per unit have zero or opposite effects. PDS quantity expansion has larger effects for households and districts that initially have less market-oriented production.

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1. Introduction

Many households in developing countries produce staple crops for their own consumption. Output market frictions such as travel and search costs, retail markups over farm-gate prices, price volatility, and the absence of markets on both the buyer and seller side constitute "marketization costs" that could link consumption and production decisions at the household level and incentivize production for own consumption, potentially lowering specialization and productivity in agriculture. In these settings, policies that provide households with free or subsidized staples could potentially affect their agricultural production and specialization decisions.

I examine these issues in India, where consumption out of home production is quantitatively important for many households and the Public Distribution System (PDS) provides entitlements to subsidized staples (rice and wheat). India's National Sample Survey shows that over 12% of aggregate consumption in India was sourced out of home production in 1993, including over 46% of food consumption by the quarter of households classified as farmers. Consumption out of home production fell substantially between 1993 and 2009. During the same period, reforms to the PDS increased both the quantity and unit subsidy value (difference between market and PDS prices per KG) of entitlements, raising the total value of entitlements from 0.6% to 2.4% of aggregate expenditures (see Table 1).

Are marketization costs in India high enough that these trends are related? I document several facts consistent with marketization costs that are substantial and high enough to distort production decisions for some households. First, the gap between retail prices and farm-gate/harvest prices within Indian districts is as large as the price gap between district markets. Second, farmers in districts with a lower road density have a higher share of consumption out of home production. Third, crop specialization has increased slightly at both the district and farmer level during this period and is related to consumption needs – smaller farmers allocate a greater share of their land to staple crops with high consumption value than larger farmers in the same village. These findings motivate an analysis of the causal impacts of India's PDS expansion on household production decisions.

To guide the empirical analysis, I analyze a simple partial equilibrium model where household consumption and production are linked by marketization costs that drive a wedge between the buying and selling price of staples. In response to marketization costs, some households may re-allocate their inputs away from market production towards staple production intended for own consumption. While PDS-like entitlements have no effect on production in the absence of marketization costs, I show that with marketization costs they can lead some households to re-allocate their inputs away from staple production and back towards market production, raising the value of output and productivity (evaluated at market prices). The model highlights that increases in PDS quantity ("in-kind" transfers) have opposite effects of increases in PDS unit subsidy (equivalent to "cash" transfers when PDS entitlements are infra-marginal), with only the former lowering incentives for staple crop production. The model also provides guidance on potentially heterogeneous impacts of PDS quantity expansion at the household and aggregate level, and highlights that price changes provide an alternative general equilibrium mechanism through which PDS expansion could affect staple production.

The empirical analysis tests the model implications for staple production and staple consumption out of home production using NSS data (1993, 1999, 2004, 2009), ICRISAT district data, and ARIS/REDS data (1999 and 2006). Identification is based on the plausibly exogenous changes in PDS quantities and unit subsidy value that occurred over time across states as part of national PDS expansion, with entitlements measured using either consumption surveys or official BPL (below poverty line) entitlements. I first conduct a partial equilibrium analysis that compares PDS recipients to other households in the same village who have access to the same output/input markets. I then conduct a district-level analysis that covers a longer time-period and captures any additional general equilibrium effects such as spillovers through prices.

The results indicate that marketization costs in India are large enough to generate important effects of PDS expansion on production. For rural PDS recipients, an additional kilogram per month of entitlement reduces consumption of staples from home production by 0.3-0.4KG and reduces rice output along with land and labor allocated to rice. At the district-level, an extra kilogram per month of PDS entitlements per person lowers rice output per person by 0.1-0.27KG per month and lowers the share of food consumed from home production by 1.3-4.8 percentage points (enough to account for over half of the decline in this variable between 1993-2009). Increases in the subsidy value of PDS entitlements have zero or opposite effects on the same production and consumption outcomes, lending further support to marketization costs as the explanation for these results and implying that income effects are unlikely to be the main mechanism underlying the impact of PDS quantity expansion. For both partial and general equilibrium analysis, the effects of PDS expansion are larger for farmers and districts that initially consume a larger share of their output or that have less access to markets, leading to larger re-allocations of inputs away from staples. For farmers who consume a self-produced crops equivalent to 35% of their income, PDS expansion led to substantial increases in the value of agricultural output per day of farm labor (10-60%). I find no evidence that changes in staple prices are an important mechanism for district-level general equilibrium effects and find limited effects on other farm inputs and wages.

This paper contributes to the large literature on agricultural household models and production decisions that appear inefficient from a market perspective but can be welfare maximizing given market failures (see Singh et al. (1986), de Janvry et al. (1991), Taylor and Adelman (2003) and de Janvry and Sadoulet (2006) for reviews). Much of the empirical literature focuses on input markets frictions but several studies have analyzed output market frictions linking household consumption and production, particularly in relation to risk (Fafchamps (1992), Karlan et al. (2014)). The most closely related papers in this literature by Omamo (1998) and Morando (2020) argue that even without risk, high transaction costs in output markets can lead poor households to allocate more land to staple crops instead of market-oriented crops. I contribute to this literature by considering a novel implication of these non-separabilities related to output market transaction costs – in-kind staple transfers can displace staple production intended for own consumption – and demonstrate its quantitative importance at a national scale. This paper also relates to a trade literature that measures domestic trade frictions (Allen (2014), Atkin and Donaldson (2015), Chatterjee (2020), Bergquist and Dinerstein (2020)) and shows how they can lower agricultural specialization and efficiency (Allen and Atkin (2016), Donaldson (2018), Sotelo (2020), Adamopolous (2020), Rivera-Padilla (2020), Leemput (2021)), a macro literature highlighting the low productivity of small farms and the role of input market frictions (Adamopolous and Restuccia (2014), Adamopolous et al. (2019), Adamopolous and Restuccia (2020), Chen et al. (2021)), and a development literature linking transport costs to input misallocation (Morando (2021), Britos et al. (2022)). My findings highlight that output frictions between households and the market could be as important as trade costs between markets or input market frictions when it comes to the input and output decisions of small farmers, implying that policies affecting the consumption of small farmers could have sizable effects on their production decisions.

My analysis also contributes to the literature on India's Public Distribution System and the broader literature on the effects of cash and in-kind transfers for rural households. Most of the literature on India's PDS has focused on evaluating its effects on consumption, nutrition, and poverty (Tarozzi (2005), Kochar (2005), Dreze and Khera (2013), Krishnamurthy et al. (2014), Kaushal and Muchomba (2015), Basu and Das (2014), Shrinivas et al. (2018)). Recent papers by Gadenne (2020) and Gadenne et al. (2021) also focus on consumption but explore how the specific features of the PDS (i.e. quantity rationing combined with the subsidy and insurance value of PDS prices that are fixed below market prices) affect household welfare and how they compare to other potential mechanisms for helping poor households. Shrinivas et al. (2022) analyze labor supply and wage effects of PDS expansion under the National Food Security Act of 2013 without distinguishing the separate effects of cash and in-kind components. I am not aware of other studies that consider production-side effects of PDS in the context of the large quantity expansion that took place between 1993 and 2009, so this paper addresses an important gap in the literature on the world's largest in-kind transfer program and a pillar of India's welfare state. Currie and Gahvari (2008) note that paternalism may be a primary motivation for in-kind transfers but that pecuniary effects – e.g. general equilibrium effects on prices, supporting farmers – may play some role. The empirical evidence for effective paternalistic transfers in developing countries is mixed and several studies find zero or only small differences when comparing cash and in-kind or voucher transfers (Cunha (2014), Sivakul (2012), Aker (2017)). However, Cunha et al. (2019) show that pecuniary effects for developing countries could be important, demonstrating that cash and in-kind transfers have opposite effects on local prices for remote Mexican villages. Survey evidence suggests that poor households in developing countries often prefer in-kind to cash transfers, particularly when they have trouble accessing markets (Khera (2011a), Ghatak et al. (2016), Hirvonen and Hoddinott (2021)). I find limited general equilibrium effects on prices but show that even the partial equilibrium effects of in-kind (PDS quantity expansion) versus cash (changes in PDS unit subsidies) transfers can be distinct in settings where many households engage in agricultural production and the costs of exchanging own production for market consumption are high. My findings thereby complement the literature on welfare programs by providing more evidence on the circumstances under which we may expect similar or distinct effects from cash versus in-kind transfers, and imply that ongoing debates about reforming India's welfare schemes and increasing the role of cash transfers ought to consider the non-trivial effects that the current PDS scheme has on the production decisions of its users.

The paper is organized as follows. Section 2 describes the data and context of PDS expansion and interlinked household consumption and production of staples in India. Section 3 presents a simple model building on these features to derive testable implications for the effects of PDS expansion on agricultural outcomes. Section 4 presents empirical tests of these implications and provides some evidence on alternative mechanisms, while section 5 offers concluding comments.

2. Data and context

2.1. Consumption and PDS expansion

Data from India's National Sample Survey (NSS) provide the most comprehensive picture of sources of household consumption, including home production and the PDS. Repeated cross-section surveys of around 100,000 households from 1993-94, 1999-00, 2004-05, and 2009-10 use a 30 day recall of quantities and values of individual items such as rice, wheat, chick peas, etc.[1] Between 10-12 households are sampled per village or urban block but districts are the least aggregated units that can be used for panel analysis or matched to other data.

Table 1 documents the evolution of household consumption sourcing during the 1993-2010 period. Panel A shows that the share of aggregate consumption sourced from home production fell by almost half from 12.5% to 6.6% during this period. Most consumption from home production is food, and while the decline in the food share of consumption contributed to the overall decline in home consumption, the share of food from home production also fell from 20.7% to 13.9%. This in turn was driven by a simultaneous decline in the share of farmer households (i.e. classified as "self-employed in agriculture" according to the NSS major income criteria) and a decline in the share of food from home production for farmers from 47.4% to 38.6%. A

[1] Home produced goods are valued based on the "ex farm or ex factory gate" price which excludes "any element of distributive service charges." Note that only agricultural commodities are considered home-producible; derivatives of these (e.g. refined rice or wheat flour, bread, puffed rice, etc.) are not observed if produced at home but their market purchases are recorded. In the 1999-00 survey home and market consumption are not recorded separately – instead households were asked whether consumption was out of cash, home, or both. I treat "both" as home production given the lack of market purchases observed for households with home production in the other survey rounds.

major component of this consumption from home production is rice and wheat, the major staples in India, with the share of households consuming rice and/or wheat out of home production declining from 30.7% to 25.7% and the quantity of rice/wheat consumed out of home production falling from 3.53 to 2.28 KG per person per month during this period.

Panel B presents data on the sourcing of rice and wheat from the Public Distribution System. The quantity of rice and wheat consumed from the PDS almost doubled from 0.9 to 1.77 KG per month per person during the period. The implied subsidy value of this consumption (calculated using aggregate PDS quantities and the difference between mean national market and PDS prices) rose from 0.6% to 2.4%, implying that the increase in PDS quantity was accompanied by a proportionate increase in the subsidy value per KG. Looking only at households that purchased rice and/or wheat from the PDS, the quantity of PDS rice/wheat rose by more than 1 KG per month per person during this period and the subsidy value rose from 2.3% to 7.7% of expenditures.

The rising importance of rice and wheat consumption from the PDS coincided with an expansion of entitlements along multiple margins. Prior to 1997, India's PDS was a universal program providing a fixed quantity of rice and/or wheat to households (typically 10KG/month) at fixed prices.[2] The central government procures grains from farmers using minimum support price and sets "central issue prices" not exceeding these support prices, thereby absorbing the costs of procurement, storage, and distribution to the states. States are charged with distributing goods to households through a network of state-managed fair price/ration shops or licensed agents (over half a million by 2011) and oversee the distribution of ration cards. Due to prices that were usually below market, the PDS provided substantial value even in 1993, to an extent that varied across states owing to differences in the quality and de facto availability of PDS grains, limited variation in state prices permitted to cover distribution costs, and variation in the subsidy value due to different local market prices.

In 1997 the PDS transitioned to a targeted system aimed at directing more of the subsidy to below poverty line (BPL) households. State-level BPL allotments were based on estimated poverty rates in 1993, while allotments for above poverty line

[2]Note that throughout the period the PDS also subsidized other goods to an extent that varied across states (most notably kerosene and sugar) but rice and wheat are by far the most important in terms of consumption and potential home production.

(APL) households were based on historic PDS offtake. Initially only prices changed, with APL households charged prices to cover 100% of the central government's "economic cost" (related to support prices and operational costs) while BPL households were charged 50% of "economic cost." However BPL prices were fixed in nominal terms in 2000 and APL prices were fixed in 2002, leading to an increase in the subsidy value for all households as economic costs rose. In 2000 the Antyodaya Anna Yojana (AAY) program was introduced to target the poorest BPL households with a larger subsidy and a larger (25KG/month) entitlement, and BPL allotments available to states increased to 20KG/month per household. In 2002 the central allotments for AAY, BPL and APL households increased to 35 KG/month (Balani (2013), Planning Commission (2002), Government of India Department of Food and Public Distribution (2021)). The number of households entitled to lower BPL and AAY prices was also revised upwards over time based on population growth and expansion of the AAY program, particularly in the late 2000s.

The transition to Targeted PDS resulted in substantial variation across states that was largely eliminated (in theory) in 2013 with the National Food Security Act. While the central government set central issue prices and the maximum quantity allotments for AAY, BPL and APL households, states themselves managed the details of the system including how much to offtake from the central government, quantity entitlements and prices for each type of ration card, and the targeting of ration cards.[3] For some states offtake was well below the central allotment (see Appendix Figure A1). States chose different quantity entitlements, with some states opting for a fixed quantity per individual up to a maximum (e.g. Andhra Pradesh, Gujarat, Karnataka, Kerala, and West Bengal) and most opting for a fixed quantity per household. Figure 1 documents the variation across states in the official BPL quantity per household which I construct by combining NSS data on PDS usage with data on BPL card ownership (for 2004-2005) and official sources. Most states increase BPL quantities between 1999-2000 and 2004-2005 to take advantage of the increase in the central BPL allotment but did so by different amounts, and some changed quantities between 2004-2005 and 2009-2010 despite no change in central BPL allotments. States were also free to charge different prices from those set by the central government for BPL and APL households, either to cover additional distribution costs (this was initially limited to a small amount but relaxed after 2001) or by supplementing with their own

[3]AAY households were in principal guaranteed similar prices and quantities regardless of state.

funds. Figure 1 also reports the subsidy per KG implied by PDS prices given state-level variation in BPL PDS prices compared to the national median market prices of rice and wheat.[4] The BPL subsidy value per KG varies across states even without taking into account variation in state-level market prices, with most states experiencing large increases between 1993 and 2000 (reflecting the new lower BPL prices under the Targeted PDS) and 2004-2009 (reflecting rising national market prices relative to central issue prices).

As states were responsible for targeting and managing the allocation of BPL cards and distribution of grain to village shops, there was also variation in how offtake from the central government translated into PDS consumption on the ground. One state, Tamil Nadu, collapsed APL and BPL entitlements into a single category (while maintaining the AAY category). There were large differences between official offtake and NSS measured consumption (see Appendix Figure A2), reflecting both "ghost" ration cards and leakage into the open market.[5] Combining the variation in offtake across states with differences in de facto targeting and distribution leads to large variation in PDS usage across states between 1993 and 2009 period, summarized in Appendix Figure A3.

Table 2 provides a closer look at actual PDS usage and grain consumption for rural households in the 2004-2005 NSS survey, the only one that records BPL card ownership. For rural households that consume PDS grains in 2004-2005, the quantity consumed is about 21 KG/month, which is close to the official limit in most states. PDS quantities account for less than half the rice/wheat consumption for these households and over three quarters of PDS using households consume rice and/or wheat from another source, implying that PDS entitlements are mostly infra-marginal. BPL card ownership is highly predictive of PDS usage, as these households are 10 times more likely to consume PDS grains, consume 10 times higher PDS quantities on average, and derive a 15 times higher subsidy value (at national market prices). Only

[4]I use state median PDS prices as BPL PDS prices. Given that most households purchase PDS grains at the BPL prices, and the smaller number of APL and AAY households partly offset, the state median PDS price closely corresponds to the official PDS prices that can be verified from available sources (see Commission (2005), Khera (2011a), Khera (2011b), Balani (2013) and Shrinivas et al. (2022)) for the states and time periods analyzed.

[5]Leakage was estimated to range from 36% to 50% in the 2000s with substantial variation across states (Khera (2011b), Balani (2013)). In 2002 the central government carried out a BPL census to improve classification and targeting. States were supposed to follow this classification for the central PDS entitlements starting in 2006, but in 2009 there was still evidence of substantial errors of inclusion and exclusion. See Commission (2005) and Balani (2013) for more discussion of targeting issues.

6% of households without a BPL card consume PDS grains, and these households consume a similar quantity to BPL card households but derive a 25% lower subsidy value due to higher PDS prices. About one third of households with BPL cards do not consume any PDS grains. Many of these households live in villages where no other household is observed to consume from the PDS, and they are much more likely to consume rice/wheat out of home production. This suggests that a combination of seasonality, supply-factors (e.g. unavailability at the local level or unattractive quality/price for PDS relative to market) and demand factors (e.g. households with BPL cards but higher incomes or home production capabilities) contributes to the lack of PDS usage by some rural households with BPL cards in an average month. Overall, Table 2 shows that most BPL card holding households consume their full entitlement when available and that these households consume over three quarters of PDS grains and an even larger share of the subsidy value. Changes in access to BPL cards and changes in BPL entitlements are thus an important factor behind changes in aggregate PDS quantities. While PDS quantities consumed depend on decisions by BPL and especially APL households to consume their full entitlement, the quantitative importance of this endogenous take-up appears limited relative to other sources of variation in PDS quantity.

2.2. Prices and Marketization costs

An important motivation for producing goods with high own consumption value is the presence of "marketization" costs between households and the markets where they sell their output and purchase goods. For rural households deciding whether to produce or buy their food, these factors include retail and distribution markups, travel costs, search costs, storage costs, and uncertainty about buying and selling prices.[6] But given that many of these costs are difficult to observe, is there evidence that they are large enough to plausibly lower specialization in production and increase production of staples intended primarily for own consumption?

[6] Li (2021) provides evidence on transaction costs for purchasing goods in India while Fafchamps and Hill (2005), Fafchamps et al. (2005) and Gollin and Rogerson (2010) provide evidence on transaction costs when selling goods in other contexts. See also Fafchamps (1992) and Kurosaki and Fafchamps (2002) for the linkage between price volatility and crop choice, Gadenne (2020) and Gadenne et al. (2021) for the welfare cost of price uncertainty when buying staples in India, and Casaburi et al. (2013) and Allen (2014) for the role of information frictions and search costs when selling agricultural goods.

A readily observable lower bound on marketization costs is the gap between the price at which a household can sell a crop to the market and the price at which it can purchase the same crop from the market, a gap that includes both distribution/storage costs and markups. The NSS data can be used to derive district-level median unit values (expenditure divided by quantity) for major crops purchased by households. These can be compared to two sources of data on selling prices – farm gate prices implied by dividing NSS values by quantities for home produced crops, and harvest prices collected by ICRISAT from agricultural wholesale markets (mandis). Table 3 reports the ratio of the NSS market purchase price over either the NSS farm-gate price or ICRISAT harvest price for 11 of the most important food items. The measured gaps provides some insight into the plausibility of large marketization costs. I report the average ratio for all districts where I observe both the buying and selling prices. ICRISAT harvest prices are lower than NSS farm-gate prices leading to larger ratios – respectively 1.39 and 1.14 on average in 1993, rising to 1.49 and 1.19 in 2009.[7] Rice is an important exception as the buying/selling price gap fell using either selling price measure. It seems unlikely that marketization costs have risen overall during this period, implying that other sources of marketization costs (beyond prices) may have contributed to the decline in consumption out of home production. These observable buying/selling price gaps are thus likely to represent a lower bound that may not be very informative about differences in marketization costs.

The magnitude of these within-district buying/selling price gaps can be contrasted with price dispersion across district markets that potentially lowers district specialization and domestic trade. Table 3 reports the ratio of the 75th to 25th percentile purchase prices or harvest prices across districts. The market purchase price gaps are larger than the harvest price gaps, which likely reflects that harvest prices are only observed for producing districts with correlated geography while market price gaps are observed for a larger number of consuming districts. The across district price gaps have a similar magnitude to the within-district buying/selling price gaps. There is no clear evidence of decreasing price dispersion during this period – while the 75th-25th harvest price ratio fell from 1.28 to 1.21 for the average listed

[7] Part of this difference appears to be related to seasonality. ICRISAT harvest prices are collected at the lowest point of the year. NSS ex-farm gate prices are collected year round as long as households are consuming their own output. While the importance of consumption out of home production does not appear to vary much across quarters, farm gate prices in the NSS are on average 20%-25% lower in the quarter with the lowest price compared to the quarter with the highest price for a given district, slightly larger than the seasonality in market purchase prices.

food, the equivalent market price ratio rose from 1.50 to 1.54. This is consistent with the persistence of high internal barriers to agricultural trade in India despite some liberalization and improvements in highways and transportation infrastructure during this period.[8]

Transportation infrastructure and distance to markets are important factors that influence marketization costs for rural households – roads affect the ability of food producers to access buying and selling markets directly and also affect the distribution costs of intermediaries that service the farm to retail supply-chain. Appendix Figure A4 shows that there is substantial variation in all-weather road length per square kilometer across Indian districts (from ICRISAT district data) whose variation is negatively correlated with the share of home-produced food consumed by farmers and the share of the rural population primarily engaged in farming. Interestingly, districts with better access to the national market display an opposite correlation, highlighting an important distinction between frictions that may affect transactions between households and markets *within* a district (such as roads and access to primary markets) and those that affect transactions across district-level markets.[9]

2.3. Production and specialization

District-level data from ICRISAT provides a macro-level picture of agricultural production for the 300 districts in the 16 largest states of India, covering land allocation and output for 16 major crops, along with the harvest price data discussed earlier and some measures of agricultural inputs. Table 1 Panel C uses these data to document that districts became slightly more specialized over the 1993-2009 period, as the Hirschman-Herfindahl index of concentration (based on land shares of 16 major crops) rose from 0.41 to 0.43. The share of land devoted to all cereal crops fell but the share of land devoted to rice and wheat (which makes up about 75% of all land devoted to cereals and about 40% of all land under cultivation in India) rose. At the aggregate district level these land shares may not be that informative about input al-

[8]See Atkin (2013) for a discussion of internal trade barriers and reforms and Ghosh (2011), Mallory and Baylis (2012), and Chatterjee (2020) for evidence of low spatial integration of prices across Indian agricultural markets during this period.

[9]National market access uses the measure of travel time across districts from Allen and Atkin (2016) based on changes in highways combined with the value of agricultural output from each district in the ICRISAT data, based on $Mktaccess_{dt} = \sum_{i\ neqd} \frac{val_{it}}{hours_{ijt}^{1.5}}$. The value of district agricultural output in each year is based on combining output and harvest prices for the major crops. The coefficient 1.5 is based on the estimate in Allen and Atkin (2016).

locations across crops given the importance of the intensive margin of yields during this period, but they highlight the growing demand for rice and wheat relative to other cereal crops ("coarse grains" such as maize, millet, sorghum and barley) and the potential for this demand to be met by land re-allocations associated with greater specialization across districts.

To measure household-level production, I turn to the ARIS/REDS data that were designed to constitute a nationally representative sample of *rural* Indian households. The survey records detailed production data for almost 5,000 households in over 240 villages across 15 states in each round, with a panel component that allows almost 2,000 households to be linked between the 1999 and 2006 rounds. These data also display some increase in crop concentration at the household-level, with the HHI rising from 0.736 to 0.755 for rural households. Household production data show that small farmers have a systematically different pattern of production than large farmers that is consistent with a consumption motive. Figure 2 Panel A shows that in 1999, in addition to consuming a higher share of their crop output, households that own less land devote a considerably higher share of their land to staple production (whether as defined as rice/wheat or all cereal crops). Consistent with other cereal crops having a lower income elasticity than rice/wheat, the decline in land share is steeper for cereals overall. This pattern holds when looking *within* village (Panel B), so it is not a feature of smaller farmers sorting into villages with land better suited for staple crops. I also construct a more systematic measure of own-consumption crops by constructing a farmer-level consumption crop index that weights the farmer's share of land allocated to each crop by the crops share of aggregate output consumed at home. This measure also decreases with land owned within village.

3. Model

To analyze the implications of in-kind transfers for production specialization in the presence of marketization costs, consider a Ricardian model in which rural households consume both a food staple s and a market good m and decide how to allocate their input L between two activities, staple farming (with productivity $A_{i,s}$) and market production (with productivity $A_{i,m}$). For simplicity, the single input L can be interpreted as a composite of labor and land that includes both household endowments and any labor or land exchanged in input markets (e.g. a landless laborer can produce staple crops by exchanging some labor for land on input markets and combining both). In the empirical analysis I will distinguish between different inputs but here I simplify the household's decision to the allocation of a single input between staple production and market production. Market production in this case includes non-staple crops, non-agricultural household enterprise, and selling inputs to the market (e.g. leasing land or wage labor), with the distinguishing characteristic being that market goods can only be exchanged for staples at the retail price.[10]

Consumers have Stone-Geary utility given by $U = (q_s)^{\alpha}(q_m + \gamma)^{1-\alpha}$ where $\gamma > 0$ implies that the market good is a luxury and the staple is a necessity. The staple good has price p_s and the price of the market good is normalized to one ($p_m = 1$). Households with income Y face standard demand functions given by $q_m = (1-\alpha)Y - \gamma\alpha$ and $q_s = \frac{\alpha Y}{p_s} + \frac{\gamma\alpha}{p_s}$. With linear production technology, households maximize their income by devoting all inputs to the activity that generates the highest income such that $Y_i = \max\{A_{i,m}, p_s A_{i,s}\}L_i$. The home-produced share of consumption is zero for households specializing in market production, while for staple farmers it is bounded above by the staple budget share but otherwise indeterminate due to indifference between selling all or part of the staple output.

With no frictions, consumption and production are separable in this environment and household input allocations and production are unaffected by cash or in-kind transfers. However, a maketization friction affecting the relative buying versus sell-

[10]In-kind wage and rent payments are common in India but their contribution to staple consumption is much smaller than consumption from home production for two reasons. First, factor markets play a limited role in many rural areas. NSS data for 1993 indicate that only 3.8% of owned land is leased out. Only 3.3% of rural households lease land out and only 8.6% lease land in. Agricultural labor is more common, with one third of rural households earning a majority of their income from casual agricultural labor, but most crop-producing households in India are small and only hire labor during the peak/harvest season if at all (about half never hire labor and only 16% hire labor outside of the peak/harvest season). Second, conditional on a given level of input market transactions, in-kind rent and wage payments are much less important than consumption from home production. In-kind rent makes up 14.6% of the value of land rent and is received by less than one in four landlords (1999 ARIS/REDS). NSS employment data shows that in-kind wage payments fell from 8.2% to 5% of rural wage income between 1993 and 2009 and are received by only one in four rural wage earners. In the 1993 NSS consumption data, in-kind wage payments are measured in a category that includes gifts, barter and inter-household transfers which together make up 6.6% of rural food consumption, compared to 28.4% of rural food consumption from home production (which includes in-kind rent payments). These figures can also be compared to the 16% share of all consumption from home production in rural areas (and 31% share for rural farmers). Marketization costs that incentivize staple production for own consumption may be partly mitigated by these in-kind input market transactions but given these magnitudes it is plausible that such incentives remain, which is what the model requires.

ing price of the staple crop leads to non-separability. Suppose farmers can sell their staple crop at a price p_s below the market purchase price given by $p_s(1+\tau)$, with τ representing a marketization wedge that can be interpreted narrowly as the ratio of market to farm-gate/harvest prices in Table 3 or broadly as capturing all welfare relevant factors that make producing a unit of staples more attractive than procuring it through the market, including travel/search costs and the (consumption-equivalent) cost of price uncertainty. With this additional assumption, household i sorts into one of three production patterns based on their relative productivity in staple production, the staple-selling price, and the marketization wedge:

- If $A_{i,m} > A_{i,s}p_s(1+\tau)$, the household specializes in market production. The household produces no staples and the share of consumption out of home production is zero. Utility is given by $V_i = \alpha^\alpha(1-\alpha)^{1-\alpha}\left(\frac{1}{p_s(1+\tau)}\right)^\alpha [A_{i,m}L_i + \gamma]$.
- If $A_{i,s}p_s > A_{i,m}$, the household specializes in staple production. All consumption of staples is sourced out of home production and the home produced share of consumption is strictly decreasing in staple output due to non-homotheticity. Utility is given by $V_i = \alpha^\alpha(1-\alpha)^{1-\alpha}\left(\frac{1}{p_s}\right)^\alpha [A_{i,s}L_i p_s + \gamma]$.
- If $A_{i,s}p_s(1+\tau) > A_{i,m} > A_{i,s}p_s$, the household is a mixed staple farmer. All consumption of staples is sourced out of home production and all staple output is consumed at home. The home produced share of consumption is decreasing in market productivity due to non-homotheticity. Utility is given by $V_i = (\lambda_{i,s}A_{i,s}L_i)^\alpha \left[(1-\lambda_s)A_{i,m}L_i + \gamma\right]^{1-\alpha}$ where $\lambda_{i,s} = \alpha\left[1 + \frac{\gamma}{A_{i,m}L_i}\right]$ is the share of inputs allocated to staple farming.

This leads to the following implication:

Model implication 1: Ceteris paribus, marketization costs induce a higher share of consumption out of home production and induce some households to allocate a higher share of inputs to staple production, with larger effects for households with fewer inputs.

Figure 2 and Appendix Figure A4 present evidence consistent with this implication by documenting that farmers with less land devote a higher share of inputs to staple crops and that road density is negatively correlated with the share of consumption sourced out of home production.

Now consider a PDS entitlement that allows households to purchase a quantity of the staple good ($q_{s,PDS}$) at a price (p_{PDS}) below the market price. For most households, the PDS entitlement is infra-marginal (Table 2) and I maintain this assumption throughout the rest of the analysis for simplicity (e.g. the technology for selling PDS entitlements to other households is irrelevant). With no marketization costs, infra-marginal subsidized entitlements like the PDS have an income effect equivalent to a cash transfer valued at the difference between the market and PDS price multiplied by the quantity of the PDS transfer. The demand function for staples in this case is given by $q_{s,mkt} + q_{s,PDS} = \frac{\alpha}{p_s}[Y_i + \gamma] + \alpha q_{s,PDS}[1 - \frac{p_{PDS}}{p_s}]$. Since staples are a normal good in the model, increases in PDS quantity or unit subsidy ($p_s - p_{PDS}$) increase staple consumption through the same income effect. Increases in PDS quantity will lower staple purchases from the market (by less than the change in PDS quantity) for households that do not produce staples, while for households that do produce staples, there are no effects on production and ambiguous effects on consumption of home produced staples due to indifference to sourcing.

With marketization costs, the effects of PDS entitlements are distinct and go beyond the income effect. PDS prices before the transition to targeted PDS were likely below the cost of purchasing staples from the market inclusive of marketization costs ($p_s(1+\tau)$) but may have been higher than the staple selling price (p_s). The transition to targeted PDS led to PDS prices that were even lower than the staple selling price (p_s) for BPL households as well as larger quantity entitlements. Production by households fully specialized in market production or staple farming remains unaffected by PDS expansion. However, when marketization costs are high enough compared to a household's relative staple productivity that they become a mixed-staple farmer, the share of inputs devoted to staple production depends on the size and nature of the PDS entitlement and is given by the equation:

$$\lambda_{i,s} = \alpha \left[1 + \frac{\gamma}{A_{i,m} L_i}\right] - \frac{q_{s,PDS}}{L_i} \left[\frac{\alpha}{A_{i,m}} + \frac{(1-\alpha) p_{PDS}}{A_{i,s}}\right] \tag{1}$$

An increase in the quantity of the PDS transfer lowers the inputs devoted to staple production (and hence staple output) because $\frac{\partial \lambda_{i,s}}{\partial q_{PDS}} < 0$. Note that lowering the share of inputs devoted to staple production increases the market return to inputs because by definition, these mixed-staple households have a lower market return from staple production than the alternative. Increasing the unit subsidy of PDS staples by lowering p_{PDS} has the opposite effect of increasing PDS quantity on staple inputs and output because $\frac{\partial \lambda_{i,s}}{\partial p_{PDS}} < 0$. The intuition is that when home production is the cheapest

way to procure staples besides the PDS, providing a higher quantity of PDS staples crowds out home production but providing a higher subsidy (equivalent to a cash transfer) crowds in home production. Note that with marketization costs, the effect of in-kind transfers on consumption out of home production displays a similar pattern as staple production, but may be even larger, because both mixed staple farmers and specialized staple farmers (whose production remains unaffected) will consume less home-produced staples. These implications can be summarized as follows:
Model implication 2: Without marketization costs, increasing PDS transfers (by increasing PDS quantity and/or lowering PDS price) has no effect on production of recipients and ambiguous effects on consumption out of home production. With marketization costs, increasing PDS quantity (in-kind transfers) crowds out consumption of home produced staples and also lowers staple inputs and output for households that produce staples mainly for home consumption. Increasing the unit subsidy of the PDS by lowering the PDS price (equivalent to cash transfers) has the opposite effect on consumption of home produced staples, staple inputs, and staple output.

Note that while the existence of marketization costs and consumption out of home production are both necessary conditions for negative effects of in-kind transfers on production, neither is a sufficient condition. Conversely, observing effects of in-kind transfers on the production of recipients supports the existence of marketization costs high enough to induce some households to produce staples mainly for their own consumption, and observing opposing effects of in-kind versus cash equivalent transfers provides even stronger evidence by ruling out alternative mechanisms like income effects.

Combined, model implications 1 and 2 suggest that in-kind transfers will have larger effects on production in setting where more households behave like the mixed-staple farmers in the model, i.e. settings that are far from markets and have poor infrastructure. In the model, this is an extensive margin (share of households that are mixed-staple farmers) and not an intensive margin (within mixed-staple farmer) effect. In practice, identifying which households are specialized staple versus mixed-staple farmers ex ante may be difficult as both types of farmers have similar shares of home produced consumption under positive marketization costs, and the model assumptions that could distinguish them are stark and unlikely to hold exactly (e.g. mixed-staple farmers never sell staples to the market and neither specialized nor mixed-staple farmers ever buy staples from the market). However, the model suggests that when marketization costs are higher, the share of households that act like mixed-staple farmers will be higher. Thus we should expect proxies for marketization costs to be associated with larger effects on production both at the aggregate level and across households that are candidates for the mixed-staple farming regime (e.g. households that consume at least some self-produced staples). We should also expect that at the aggregate level, where higher marketization costs are associated with a higher average share of consumption out of own production (due to more mixed-staple farmers on the extensive margin), a higher share of consumption out of home production will also be associated with larger effects on production.

For the mixed-staple farmers whose staple production is crowded out by in-kind transfers, there may also be heterogeneous intensive margin effects of PDS transfers on production related to observable household characteristics. However, these may be quite sensitive to model assumptions about functional forms for demand (e.g. Stone-Geary preferences) and production (e.g. constant returns to scale and perfect substitution of inputs within the household) or details of input markets excluded from the model. With this caveat, equation 1 implies that households with a higher quantity of inputs (L_i) will see smaller declines in the *share* of inputs devoted to staples in response to a one unit increase in PDS quantity, with no heterogeneous effects on the quantity of inputs used for staple production ($\lambda_{i,s}L_i$) or staple output ($\lambda_{i,s}L_iA_{i,s}$). Households with higher market productivity ($A_{i,m}$) also see smaller declines in the share of inputs devoted to staples, but in contrast also see smaller declines in the quantity of staple inputs and output. Households with higher staple productivity ($A_{i,s}$) see similar effects for inputs but larger effects for staple output. Because both L_i and $A_{i,m}$ are negatively associated with the share of consumption out of own production for these farmers, mixed-staple farmers with a higher value of this variable should experience larger declines in the share of inputs devoted to staples with more ambiguous effects on input and output quantities depending on what drives the variation in home consumption shares. Note that all of these comparative statistics assume that other characteristics are held fixed, and strong enough correlations between $L_i, A_{i,m}, A_{i,s}$ could potentially reverse these patterns in an empirical application. Nevertheless, the analysis suggests that we might generally expect to see larger effects of PDS transfers on production (and input shares in particular) for households with fewer inputs or higher home consumption shares. Finally, note that the level of marketization costs has no effect on the intensive margin in equation 1, but may influence household level responses through the extensive margin effect mentioned previously.

These additional model implications related to heterogeneity can be summarized as follows: ***Model implication 3a (Intensive Margin): For households whose production is affected by transfers (i.e. households that produce staples primarily for own consumption), the effects of PDS transfers on the share of inputs devoted to staples may be larger for those that have fewer inputs or that have a higher share of home consumption, leading to larger (percent) increase in income and productivity measured at market prices. Heterogeneous effects on input and output quantities are more ambiguous.***
Model implication 3b (Extensive Margin): At the aggregate level, both higher marketization costs and a higher average share of consumption out of home production are associated with a higher share of households producing staples mainly for own consumption and hence a larger effect of PDS transfers on staple production. Among households whose production is potentially affected by PDS transfers (i.e. households that consume at least some self-produced staples), higher marketization costs raise are associated with a higher share that exhibit a production response.

The analysis so far is partial equilibrium, but expansion of PDS entitlements could affect production through general equilibrium mechanisms. Increasing PDS quantity in a location raises staple supply by more than demand, crowding out purchases from the market and putting downward pressure on staple prices; increases in PDS unit subsidies have the opposite effect. Lower staple prices could reduce staple production for PDS non-recipients and recipients alike, beyond any direct effect on recipients. Even without marketization costs, a decline in p_s could lead some specialized staple farmers to switch away from staple production. With marketization costs, it could lead some households to switch from specialized staple farming to mixed staple farming and others to switch from mixed staple farming to specialized market production. These general equilibrium price effects could be limited by three factors. First, markets in India may be relatively small and integrated such that they behave like small open economies – the local level of PDS entitlements then exerts a minimal effect on local prices even though PDS quantity still affects prices at a national scale. Second, the Indian government implements a minimum support price for rice

and wheat that in recent years has been binding in many parts of India; this puts a floor on any potential effects of PDS entitlements on prices that farmers receive for staple crops. Third, since PDS entitlements have an income effect and rice and wheat are normal goods with higher income elasticities than some other staple grains, the effect of PDS expansion on their prices may be attenuated by the rise in rice/wheat demand from income effects. These considerations yield a final model implication:
Model implication 4: If PDS expansion has large effects on local staple prices, this provides another channel through which PDS quantities could lower staple production.

The implications of openness and national market access are interesting to consider in this context. If openness leads to smaller price changes, this might lead to smaller GE effects for locations that are more open. On the other hand, if districts that are more open have more households close to the margin of switching from specialized to mixed staple farming, or mixed staple farming to market production, a given price change might induce a larger decline in staple output. Thus the effect of openness on the GE effects of PDS expansion is ultimately an empirical question that hinges on both the magnitude of the price response and the distribution of productivity and marketization costs across locations.

4. Empirical analysis of PDS expansion

To test model implications 2 through 4, I begin by analyzing partial equilibrium consumption and production effects – comparing PDS recipients to non-PDS recipients in the same village that face similar input and output prices – and then turn to district-level general equilibrium effects that compare districts with higher and lower aggregate PDS transfers.

4.1. Partial Equilibrium

To examine the within-village effect of PDS expansion on consumption outcomes, I pool the 1993, 1999, 2004, and 2009 NSS cross-sections to estimate a specification based on the following household-level equation:

$$Y_{ivst} = \beta PDSQuant_{ivst} + \eta PDSValueKG_{ivst} + \alpha_v + \gamma_s * PDS_{ivst} + \delta_t * PDS_{ivst} + C_{ivst}\lambda + \epsilon_{ivst} \quad (2)$$

where i indexes households, v indexes villages, s indexes states, and t indexes survey rounds. $PDSQuant$ and $PDSValueKG$ are the actual quantity (in KG per month) and subsidy value per KG (calculated using PDS unit values reported by the household and median village unit values for market purchases, imputed with state medians when missing). The village fixed effect α_v controls for any common output or input market prices (or marketization wedges) in the village that would affect consumption sourcing – villages cannot be matched across NSS years so in practice this controls for factors common to a village in a particular year. Households that use the PDS may be poorer (which may provide superior BPL or AAY entitlements) or have higher demand for (potentially inferior) grains. The regression equation partly accounts for this by including interactions of a PDS usage dummy with state and year dummies and including a large set of household control (C) that capture factors likely to affect demand and/or eligibility for PDS entitlements (see Table 4 for the full list). The conditional variation in quantities and values includes variation that is exogenous to households (de jure and de facto entitlement variation across locations and years) and orthogonal to average differences in unobservables between PDS users and non-users within states or over time, but could still reflect differences in entitlements related to type of ration card, household size/composition, and endogenous demand (e.g. households that do not consume their full entitlement). To address these issues I also estimate a specification where actual quantity and value are replaced by the interaction of the PDS dummy with the official state-level BPL quantities ($StBPLQ$) and subsidy values ($StValKG$) (see Figure 1). The estimating equation becomes:

$$Y_{ivst} = \beta PDS_{ivst} * StBPLQ_{st} + \eta PDS_{ivst} * StValKG_{st} + \alpha_v + \gamma_s * PDS_{ivst} + \delta_t * PDS_{ivst} + C_{ivst}\lambda + \epsilon_{ivst} \quad (3)$$

Selection into PDS usage that is correlated with changes in State BPL entitlements is less of a concern, particularly for changes in quantity entitlements, and identification of the coefficients β and η in this specification relies on variation in state PDS entitlement policy that is plausibly exogenous from a household perspective.

Table 4 presents the results for total rice/wheat consumption, consumption of rice/wheat out of home production, and the share of food consumption from home production for all rural households (columns 1-3) and farmers only (columns 4-6). Panel A uses actual PDS quantities and unit subsidies for the household and provides evidence consistent with model implication 2. Both quantity and subsidy margins of PDS expansion raise total rice/wheat consumption through standard income effects, but they have opposite effects on consumption of home produced rice/wheat and the home-produced share of food, consistent with the marketization cost mechanism in Model Implication 2. With marketization costs, these effects are driven by both staple specialized and mixed-staple farmers. Panel B uses the official state BPL quantity and unit subsidy and yields broadly similar quantitative and qualitative findings, but standard errors are much larger and only the effect of PDS quantity on consumption out of home production is significant at conventional levels. To help interpret magnitudes, note that for this sample and period, household BPL quantity entitlements rose from 10 to 26 KG/month on average while average PDS quantities consumed rose from about 4 to 9 KG. The point estimates imply that increases in PDS quantity in rural areas can explain between 20% (Panel A) and 25% (Panel B) of the decrease in rice/wheat quantity consumed out of home production and about 14% of the decrease in the share of food sourced from own production between 1993 and 2009.

To examine the within-village effect of PDS expansion on production outcomes, I use the ARIS/REDS data for the 1999 and 2006 agricultural years. From the perspective of identifying causal effects of PDS expansion, the ARIS/REDS data have one major advantage over the NSS – households can be linked in a panel – and one major disadvantage, which is that PDS usage, quantity and unit subsidy are not recorded in the 1999 survey. The 2006 survey contains more detailed PDS data, including a module asking households to report the value of PDS entitlements received currently and under the two previous village governments. I use this recall information to impute the value of PDS entitlements in 1999 under the assumption that it was two elections ago (village elections are held every 5 years), which should reflect the PDS entitlement after transition to targeted PDS in 1997 but before the large quantity expansion that took place after 1999 (Figure 1).[11] This variable rises from about 0.9 to 1.3 (in

[11]Specifically, household module 30 asks about various household-level programs including the PDS and households are asked to report "Amount received against the program in rupees [in case of kind payment write the equivalent monetary market value]' ' for the current, previous, and previous to previous Panchayat periods. It is unclear from the documentation whether this was interpreted as

thousands of rupees) for the full sample between 1999 and 2006 assuming values are reported in constant rupees. I first consider a specification based on using these values directly:

$$Y_{ivt} = \beta PDSValue_{ivt} + \alpha_i + \gamma_{vt} + X_{ivt}\lambda + \epsilon_{ivt} \quad (4)$$

where α_i is a household fixed effect and γ_{vt} is a village-year fixed effect. The fixed effects account for time-invariant household characteristics correlated with PDS eligibility and usage, and common village-year factors like weather, input and output prices that may affect production. Controls include a quadratic in household size, land owned, and the value of all other government benefits (based on the same recall module that measures the value of PDS benefits).

Relative to the specification in Table 4 Panel A, the PDS value measure in ARIS/REDS is likely to be noisy due to both the nature of the recall and the imputation of timing. Predicted effects in this specification are also unclear since increases in the value of PDS entitlements reflect both changes in quantity and unit subsidy and these have opposite effects on production (model implication 2). Thus I also consider an alternative specification analogous to the one in Table 4 Panel B that interacts a dummy for PDS usage with state-level official BPL quantities and unit subsidy, estimating:

$$Y_{ivt} = \gamma PDS_{ivst} + \beta PDS_{ivt} * StBPLQ_{st} + \eta PDS_{ivt} * StValKG_{st} + \alpha_i + \gamma_{vt} + X_{ivt}\lambda + \epsilon_{ivt} \quad (5)$$

This specification helps distinguish quantity and subsidy margins of PDS expansion and is not affected by omitted variables correlated with household ration card status or endogenous quantity (provided quantity is non-zero). To interpret magnitudes, note that average official state BPL quantities rose by about 16 KG/month for this ARIS/REDS sample but the median unit subsidy was unchanged and the average fell slightly (by 0.24 1993 rupees/KG).

Table 5 presents the results for the sample of rural households that consume at least some of their own agricultural output in 1999. Columns 1 and 2 look at effects on overall inputs devoted to agriculture – total hectares of land under cultivation in the Kharif/monsoon season and total days of labor input. Effects of PDS value are negative in Panel A but with large standard errors, while in Panel B the effect of PDS quantity on total labor inputs is negative and significant at the 1% level. The model is ambiguous about the effects of PDS quantity on total agricultural inputs as inputs

current or constant rupees.

could be re-allocated from staples to other crops, so columns 3 and 4 look directly at land and labor inputs devoted to rice cultivation. There are significant negative effects on labor used for rice in both Panel A and B and for land in Panel B, consistent with a 0.025 hectare and 1.5 day decrease in land and labor devoted to rice cultivation for a 1KG increase in BPL entitlements. Column 5 looks at rice output (in KG, converted to a monthly basis), which decreases in Panel B – the point estimate is large but so are standard errors (not surprising for a household level crop output regression) and the 95% confidence interval is consistent with a crowding out equal to or below one. Columns 6 and 7 show that the share of land under cultivation devoted to all grain crops or crops with high consumption value (measured using the standardized consumption crop index discussed earlier) decreases significantly in response to PDS expansion in both Panel A and B specifications. Column 8 assesses whether agricultural value added per day of work was affected by looking at the net value of annual agricultural output (total value of all crops at market prices, including those consumed, net of spending on seeds, fertilizers, pesticides, hired machinery and irrigation) divided by total days of farm labor. The average effect is small (about 1% increase per 1KG of BPL entitlements) and imprecisely estimated but consistent with the model prediction that re-allocating inputs away from staples increases efficiency at market prices for some households, e.g. those that produce staples only due to high marketization costs.

These results, particularly the Panel B specification, provide additional support for model implication 2. A negative effect of PDS quantity on staple production suggests that marketization costs in India are high enough to do more than divert rice output from home consumption to the market – they are high enough to induce some households to produce staples mainly for their own consumption. The effects of changes in PDS unit subsidies are estimated less precisely and are less supportive of the model, with marginally significant effects in the opposite direction of model implication 2 in columns 6 and 7. This may reflect the minimal variation in unit subsidy relative to quantity during this period, and it is important to note that the average change in PDS unit subsidy during this period (-0.24) is much smaller than the change in PDS quantities (16) such that the net contribution of changes in PDS unit subsidy implied by these results is much smaller.

To examine heterogeneous impacts along the lines of model implications 3a and 3b, I estimate similar regressions that interact the BPL quantity and BPL unit subsidy variables from Table 5 Panel B with initial (1999) values of the following variables in the ARIS/REDS data: the value of own crops consumed out of total income (Panel A), land owned (Panel B), and village distance to a weekly market (Panel C). The variables are standardized to ease interpretation – the uninteracted coefficient on PDS quantity and value represent the effect for households with the sample mean values of the interaction variable. The results are presented in Table 6.

Panel A of Table 6 shows that households with a higher share of home consumption have a somewhat more negative effect of BPL PDS quantity on staple input shares (columns 6 and 7) and farm labor (columns 2 and 4), consistent with the model. At the 90th percentile (equivalent to 35%), a 1KG increase in BPL entitlements reduces days of farm labor by (-9.472,-4.130) days, rice labor by (-3.566,-0.913) days, share of land under grain cultivation by (-0.0123,-0.003), and standardized consumption crop share index by (-0.0269,-0.006) standard deviations. Most interestingly, the greater decrease in labor inputs and shift towards more market oriented crops is reflected in a larger and statistically significant increase in the net value of agricultural output per day of farm labor, with a 95% confidence interval of (0.006, 0.0372) for these households. This corresponds to a large increase in own farm agricultural labor productivity of between 10% and 59% for these households given the average increase in BPL PDS entitlements during the period. The interaction effects are positive for total land and land under rice cultivation (columns 1 and 3) and rice output (column 5) which is less supportive of the model, but these interactions are not precisely estimated and the direction of the model predicted effect depends on whether market productivity or inputs drive the variation in home consumption shares.

Panels B and C look more directly at interaction effects in variables with a more straightforward interpretation in terms of the model – initial land owned, and initial distance to a weekly market. Panel B shows that households with more land experience larger reductions in total and staple land inputs but smaller reductions in total and staple labor inputs; both effects on staple inputs are at odds with the model, which predicts zero heterogeneity with respect to input quantities. Although the average response of both types of inputs is consistent with the model in Table 5, these results suggest that for households with particularly large or small land endowments there may be some substitution effects not captured by the model and its simplified treatment of input markets, or that that the model may miss an additional mechanism (e.g. different land/labor intensities for staple vs. non-staple cultivation). The other land owned interaction coefficients are not significantly different than zero.

Panel C provides stronger additional support for the marketization cost mechanism in the model. Recall that in the model marketization costs have no intensive margin effect on the response to in-kind transfers, but that model implication 3b highlights that on the extensive margin, the share of households in the mixed-staple farmer regime (whose production is linked to their consumption needs) increases with marketization costs. The uninteracted coefficient on PDS quantity shows that households with the mean distance to a weekly market (7.2km) experience effects on staple input shares, staple input quantities, staple output, and own farm labor productivity consistent with the model. Households with an even greater distance to a weekly market have larger reductions in labor inputs and total land input, significantly larger reductions in input shares for staples, and significantly larger increases in own farm labor productivity. Interaction effects on rice output and land allocated to rice go in the wrong direction but are not significantly different than zero. For households at the 90th percentile distance from a weekly market (16km), the 95% confidence interval for the impact of a 1KG increase in BPL quantity is (-0.030,-0.005) for the share of land allocated to grains, (-0.067,-0.010) for the consumption crop share index, and (0.006,0.068) for the increase in own farm labor productivity. For the one third of sample households with a weekly market in their village (distance 0km), these effects are notably smaller and not significantly different than zero, with 95% confidence intervals of (-0.010, 0.002), (-0.022, 0.000) and (-0.014, 0.016) respectively.

Altogether, the results of the heterogeneity analysis in Table 6 provide some support for specific intensive margin responses outlined in model implication 3a, and stronger support for the association between marketization costs and the likelihood that farmers are producing mainly for own consumption (model implication 3b), but they also suggest that the simple model presented above may be missing some important nuances by abstracting from different inputs and input markets.

In Appendix Table A1 I report several additional outcomes of interest using the specification with state BPL entitlements, with and without the initial share of output consumed interaction. I find similar but weaker effects on wheat inputs and output (marginally significant and negative for wheat labor inputs but half the magnitude), and negative but small and insignificant effects on overall income (summing net agricultural income with employment income and other household enterprise income) or the value of inputs used in agriculture. The decrease in labor inputs occurs both within family labor and hired labor but is larger for the latter. In Appendix Table A2 I look at several other potential mechanisms for the main effects in Table 5. I interact the value of other government programs with the initial share of crops consumed to see whether the effects of PDS expansion might be picking up general income/security effects of safety net expansion (particularly since expansion of PDS subsidy value has weak/noisy effects in the estimation). I also interact PDS expansion with a measure of household risk (based on the value of crop losses during the sample period) to see whether risk mitigation might be an important mechanism for the PDS effects. Neither income/security effects based on the value of all other government transfers nor mitigation of risk from crop losses appear to be important mechanisms based on these estimates.

4.2. General Equilibrium

To estimate general equilibrium effects of PDS expansion, I combine district-level data from the 1993, 1999, 2004, and 2009 NSS rounds (rural areas only) with ICRISAT district data for about 300 districts (based on 1966 boundaries) in the 16 largest states. I first consider a panel specification using quantity per capita and subsidy value per KG from the PDS as the independent variable of interests:

$$Y_{dt} = \beta PDSQuantpc_{dt} + \alpha_d + \gamma_t + X_{dt}\lambda + \epsilon_{dt} \tag{6}$$

where α_d and γ_t are district and year fixed effects. To test model implication 3b, I also consider a specification that allows for heterogeneous effects in terms of initial (1993) marketization costs, using (one minus) the initial share of farmer food consumption that is home produced and district road density as proxies for low marketization costs:

$$Y_{dt} = \beta PDSQuantpc_{dt} + \eta PDSQuantpc_{dt} * LowMktCostVar_{d,1993} + \alpha_d + \gamma_t + X_{dt}\lambda + \epsilon_{dt} \tag{7}$$

I also consider heterogeneous impacts with respect to initial national market access (described earlier), which captures openness to trade with other districts and could have effects that are quite different from district road density (e.g. see Appendix Figure A4). I standardize these measures to assist interpretation so the uninteracted coefficient β is for a district with the mean value of the interaction variable.

Changes in PDS quantities reflect expansion of official entitlements as well as improvements in the targeting and administration of the system (e.g. reductions in leakages and improvements in the quality and de facto availability of statutory entitlements at the village level). However, they may also reflect endogenous usage of PDS entitlements and/or endogenous changes in BPL or AAY card ownership over time that are correlated with other determinants of staple production (e.g. weather shocks or district trends that result in lower staple output and simultaneously increases eligibility and/or usage of the PDS). To address this, I consider an IV specification of the equation above where PDS quantity per capita in a district is instrumented by the interaction of State-level BPL entitlement quantity with the share of households owning BPL cards in the district in 2004 (in heterogeneity specifications the instrument is interacted with the heterogeneity variable). State BPL quantities are plausibly exogenous and will translate into larger effects in districts with a higher share of BPL households, providing a "predicted" level of PDS consumption that should not be affected by local trends or shocks. In both OLS and IV specifications I include the interaction of the BPL card share with the official State BPL subsidy per KG (using national median market prices and state-level median PDS prices) to see whether this has similar (or opposite) effects as quantity, again providing a test of model implication 2 and the plausibility of income effects as an alternative mechanism for effects on production. I also include BPL card share interacted with year dummies to capture any common trends correlated with 2004 BPL card ownership. I control for state-level PDS procurement which is the most disaggregated level available for each year and is highly concentrated in a few states (see Appendix Figure (A5). This could be expected to have the opposite effect of in-kind PDS transfers, e.g. raising harvest and/or market prices and incentivizing staple production for market and/or home production. Additional controls in both the OLS and IV specification capture some of the time-varying endogenous determinants of PDS demand including the fraction of households below the poverty line, real per capita monthly expenditures for rural households, rural population, road density, national market access, and the fraction of households using NREGA (zero for all but the last sample period).

Table 7 presents the results for two main production and consumption outcomes – output of rice per capita and the share of food consumed from home production (which at the district level reflects both exit from farming and reductions in self-produced food consumed by farmers). Note that the quantity effects are expected to be smaller than in the partial equilibrium analysis (absent GE effects) because the partial equilibrium sample only includes households with consumption from home production in 1999, but many rural households receive PDS but do not produce any crops or consume out of home production. The OLS results in Panel A show that these outcomes exhibit significant and quantitatively meaningful responses to PDS quantity expansion – one extra KG/month/capita of PDS rice in a district reduces rice output by 0.1 KG/month/capita and reduces the share of food from home production by 1.3 percentage points. Increases in the BPL unit subsidy have an opposite effect and increase rice output. These results contrast with the lack of consistent opposite and significant effects of BPL unit subsidy in the farmer-level ARIS/REDS results and may reflect the timing of large changes in BPL quantities (mostly between 1999 and 2006) and BPL unit subsidies (mainly before and after that period). State PDS procurement is positively associated with rice output as expected.

Model implication 3b notes that all else equal, higher marketization costs induce more households to become mixed-staple farmers, leading to larger production side responses through the extensive margin. Because this also increases the share of food consumed out of home production in a district, home consumption shares can also serve as proxies for high marketization costs. Table 7 presents results for interactions of PDS quantities with two indicators of low marketization costs – one minus the district share of food consumed out of home production (columns 2 and 6) and district road density (columns 3 and 7). The theory predicts that both interactions should be positive, implying that production effects of in-kind transfers are smaller (less negative) for districts with lower marketization costs. The estimates provide support for the theory. For example, a district with a farmer home share of food two standard deviations below the mean has an output effect with confidence interval of (-0.10, 0.02) compared to (-0.23,-0.10) for a district two standard deviations above the mean. The interactions with road density have a similar magnitude but are less precisely estimated. Interestingly the interaction with national market access implies a larger effect on output for districts with higher access. This confirms that that local roads supporting trade with local markets have distinct effects from highways supporting trade across district markets. Turning to the Panel B IV specification, the mean effects of PDS quantity are more than twice as large and highly significant and the subsidy value effects are similar. The interaction effects are similar or larger in some cases (roads) but the set of interacted instruments is weak (e.g. the first-stage F-stat is halved to about 6 or 7 for the interacted specifications).

Overall these district-level results provide support for model implications 2, implying that the average district in India faces marketization costs high enough to induce some households to produce mainly for own consumption such that in-kind and cash (equivalent) transfers have large and opposite effects on output and consumption out of home production. These effects are larger in districts with proxies for higher marketization costs, confirming model implication 3b. Quantitatively, the IV estimates imply that the PDS expansion can account for an output decline equivalent to 20% of the total decline in rice and wheat consumption from home production, and 61% of the decline in the the share of food from home production between 1993 and 2009. Appendix Table A3 shows that these results are robust to dropping states with high levels of PDS procurement (Punjab, Haryana and Andhra Pradesh), dropping the 2009 period (eliminating any possible confounding effect of NREGA), and are not driven by district pre-trends in rice output or home food share that are correlated with PDS quantity expansion (i.e. future changes in PDS quantities do not predict current changes in these variables).

Table 8 looks at additional outcomes and provides more insight into potential mechanisms underlying these district-level general equilibrium effects. Model implication 4 suggests that partial equilibrium effects could be amplified by general equilibrium price changes that affect farmers regardless of whether they use the PDS or face marketization costs. I find effects that are close to zero on rice prices using NSS or ICRISAT measures (similar to Gadenne et al. (2021)). Effects on wheat output are negative but smaller and less robust (significantly different from zero only for the OLS specification), while district-level effects on consumption of rice/wheat and consumption of home-produced rice/wheat follow a similar pattern to the partial-equilibrium effects in Table 4 (the point estimates are larger for home consumption but well within the 95% confidence interval). In terms of inputs and input markets, there are few significant effects of PDS quantity expansion beyond some mixed effects on individual inputs related to changes in unit subsidy. PDS quantity has a negative effect on male wages (significantly different than zero for the IV specification) but both OLS and IV estimates are consistent with small effects. The PDS unit subsidy has a positive (but insignificant) effect on wages. The negative IV wage effect of PDS quantity is consistent with earlier results showing that PDS quantity reduces labor inputs (especially hired labor) for farmers and with the model (since an increase in inputs allocated to market production should lower the real return to these inputs in general equilibrium). However it is at odds with the positive general equilibrium wage effects in Shrinivas et al. (2022), who study a subsequent PDS expansion (transition to National Food Security Act of 2013). The difference may be due to their focus on PDS transfer value, as they do not distinguish between the quantity and unit subsidy margins and the latter was much more important during the expansion they analyze.

Appendix Table A4 revisits the main results at the state level (including urban areas previously excluded) and considers three distinct measures of PDS quantity that reflect different sources of potential endogeneity and PDS leakage – the state PDS allotment from the center (based only on the number of BPL and AAY households determined by the census and the historic APL offtake), the state PDS offtake from the center (the amount actually transferred to states, which depends on the endogeneity of state-level policy), and the PDS consumption measured in the NSS (which also depends on endogenous consumption decisions and leakage). After controlling for state and year fixed effects as well as state population and per capita expenditure, OLS estimates using all three PDS measures confirm the absence of large price effects and the robust negative effect of PDS quantities on home consumption and staple output at the state level. Effects are larger for the measures that are more endogenous but better reflect de facto availability of PDS grains due to targeting and distribution at the state-level. In some specifications I cannot reject one for one crowd out of output or home consumption while in others the effects are more consistent with the partial crowd-out predicted by the model given some positive income effects. Overall the results support the idea that the main mechanism through which PDS quantity expansion reduces output and consumption from home production is through direct receipt rather than general equilibrium effects on output prices.

5. Conclusion

My analysis of India's PDS expansion provides a test of consumption/production separability through agricultural output market frictions I call marketization costs and shows that they are pervasive at a national scale. The importance of these frictions varies within India and may be greater in other settings where farmers are poorer and/or the costs of buying and selling staple goods to the market are larger (due to lower population densities, worse infrastructure, etc.). My findings suggest that under these conditions, in-kind and cash transfers are not equivalent and have opposite effects on staple production and specialization incentives of recipients, beyond any general equilibrium effects that may operate through local prices.

A limitation of this study is that it focuses on the effects of PDS entitlements but not procurement. A full evaluation of the PDS or any transfer scheme with in-kind elements from the perspective of social welfare and agricultural productivity needs to account for administrative costs, distortionary effects of procurement, and other consumption benefits to recipients (e.g. convenience or insurance). Given ongoing policy debates about reforming the PDS and liberalizing agriculture in India, and more general development policy debates about transitioning to cash-transfers, these are promising areas for further research. My findings caution that while the costs and inefficiencies of in-kind transfers are often apparent, there are potential benefits of in-kind transfers for poor households that are not well served by markets, advantages that go beyond the general convenience and security of food entitlements provided at fixed, subsidized prices. In-kind food transfers could be a second best policy in contexts where high marketization costs and poverty distort production towards staples, leading to a re-allocation of inputs towards production that is more efficient from a market perspective. While the analysis provides some evidence that households that produce crops mainly for own consumption or that are distant from markets increase their agricultural labor productivity in response to in-kind transfers, extending this by improving measurement of marketization costs and their distortionary effects on agricultural efficiency, perhaps by combining widely available data on home-produced shares of consumption in developing countries with quantitative theoretical frameworks that use similar data to measure welfare gains from trade in comparative advantage frameworks (e.g. Arkolakis et al. (2012)) or richer frameworks where data permits (e.g. Bergquist et al. (2020)), is a promising direction for future research.

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6. Tables and Figures

Table 1: Aggregate changes in consumption sourcing and agricultural specialization

	1993-94	1999-00	2004-05	2009-10
Panel A: Consumption from home production				
Consumption share from home production	0.125	0.098	0.077	0.066
Food consumption share from home production	0.207	0.177	0.160	0.139
Food consumption share from home production for farmers	0.474	0.434	0.401	0.386
Share of households primarily engaged in farming	0.272	0.243	0.260	0.226
Share of households with home rice/wheat	0.307	0.285	0.278	0.257
Rice+wheat consumption (KG/person/month)	10.73	10.68	10.18	9.78
Rice+wheat consumption from home (KG/person/month)	3.53	3.19	2.86	2.28
Panel B: Consumption from Public Distribution System				
Rice+wheat consumption from PDS (KG/person/month)	0.90	0.97	1.01	1.77
Value of PDS subsidy as share of expenditure	0.006	0.010	0.009	0.024
Rice+wheat consumption from PDS for PDS users (KG/person/month)	3.37	3.13	4.50	4.53
Value of PDS subsidy as share of expenditure for PDS users	0.023	0.035	0.053	0.077
Panel C: District specialization				
Mean district crop concentration (HHI)	0.413	0.420	0.429	0.431
Mean district crop share of rice/wheat	0.391	0.394	0.386	0.411
Mean district crop share of cereals	0.531	0.519	0.507	0.518

Data for Panels A and B are national aggregates from NSS and use survey weights. Value of PDS subsidy is calculated based on the difference between national mean market and PDS prices multiplied by aggregate PDS quantity. Data for Panel C are the unweighted mean across districts from the ICRISAT district data set.

Table 2: Household-level summary statistics on PDS rice/wheat usage and quantities, 2004-2005 rural areas in NSS.

	Share of households			PDS		Home and/or market rice/wheat?		Home rice/wheat?		MPCE
Households	Category	Use PDS?	Has BPL card?	Quant.	Value?	Any?	Quant.	Any?	Quant.	MPCE
All hh	1.00	0.23	0.30	4.8	23.4	0.92	47.6	0.32	18.9	626
PDS hh	0.21	1.00	0.82	20.8	101.0	0.77	24.0	0.11	3.9	532
Non-PDS hh	0.79	0.00	0.15	0.0	0.0	0.97	54.6	0.39	23.4	654
BPL card hh	0.26	0.63	1.00	13.0	66.8	0.85	36.2	0.18	8.8	505
No BPL card hh	0.74	0.06	0.00	1.3	4.6	0.96	52.5	0.38	23.0	678
BPL card and PDS hh	0.16	1.00	1.00	20.7	106.7	0.77	24.0	0.10	3.7	501
No-BPL card and PDS hh	0.05	1.00	0.00	21.3	77.1	0.76	24.1	0.13	5.0	669
BPL card hh/Village PDS	0.20	0.81	1.00	16.7	86.0	0.81	29.3	0.14	6.2	511

All reported statistics are at the household level and use survey sampling weights. Tamil Nadu is excluded due to universal PDS. 'Village PDS' denotes villages where at least one household consumes PDS grains. Mean quantities are measured in KG/month, mean values are based on household quantities of rice and wheat multiplied by the difference between the price paid and the median state market price. MPCE is monthly per capita expenditures.

Table 3: Buying and selling price gaps within and across districts

	1993-94				2009-10			
	Mean within district		75th/25th pctile districts		Mean within district		75th/25th pctile districts	
	Buy/sell	Buy/sell	Buy	Sell	Buy/sell	Buy/sell	Buy	Sell
Selling price source	NSS	ICRISAT		ICRISAT	NSS	ICRISAT		ICRISAT
Rice	1.15	1.33	1.33	1.29	1.11	1.21	1.38	1.26
Wheat	1.15	1.14	1.50	1.19	1.25	1.14	1.50	1.17
Sorghum	1.10	1.03	1.33	1.38	1.15	1.21	1.40	1.23
Pearl millet	1.11	1.11	1.33	1.35	1.12	1.22	1.36	1.24
Maize	1.09	1.20	1.33	1.34	1.13	1.43	1.60	1.20
Finger millet	1.06	1.14	1.40	1.24	1.20	1.34	1.64	1.12
Barley	1.01	1.61	3.44	1.27	1.24	1.55	3.30	1.20
Gram	1.22		1.14		1.19		1.11	
Chickpea	1.13	1.62	1.13	1.23	1.18	1.67	1.14	1.31
Pigeon Pea	1.20	1.70	1.25	1.26	1.19	1.97	1.27	1.14
Groundnut	1.34	1.99	1.33	1.23	1.36	2.14	1.20	1.25
Average	1.14	1.39	1.50	1.28	1.19	1.49	1.54	1.21

Buying prices are median rural district unit values for market purchases derived from NSS. NSS selling prices are median rural district unit values for imputed value of consumption out of home production (based on ex-farm gate prices). ICRISAT prices are the wholesale/mandi harvest prices reported in the district data set (not reported for Gram).

Table 4: Household consumption effects of PDS expansion (within-village).

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	Rice/wheat (KG)	Home rice/wheat (KG)	Home share	Rice/wheat (KG)	Home rice/wheat (KG)	Home share
Mean Dep. Var.	55.77	22.16	0.217	66.85	47.19	0.419
	All rural households			Farmers only		
	Panel A: Observed PDS quantity and value					
PDS quantity (KG)	0.200***	-0.410***	-0.002***	0.200***	-0.578***	-0.002***
	(0.021)	(0.027)	(0.000)	(0.024)	(0.027)	(0.000)
PDS value/KG	0.517**	0.603**	0.002*	1.076***	0.969***	0.003**
	(0.213)	(0.267)	(0.001)	(0.212)	(0.294)	(0.001)
	Panel B: PDS usage * official state BPL quantity and subsidy/KG					
PDS*State BPL quant.	-0.006	-0.300***	-0.001	-0.071	-0.423**	-0.002
	(0.046)	(0.109)	(0.001)	(0.086)	(0.170)	(0.001)
PDS*State BPL value/KG	0.516*	0.168	-0.003	0.250	-0.279	-0.004
	(0.306)	(0.573)	(0.005)	(0.462)	(0.833)	(0.005)
Observations	239,540	239,540	239,540	81,564	81,564	81,564

Standard errors clustered by state-round in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Value of PDS transfer in Panel A is measured as the difference between what the household paid for its PDS consumption and the cost of acquiring the same quantity at market prices (median village where available, median state where this is missing), deflated to 1993 rupees using all-India CPI. All regressions include village fixed effects, state * PDS usage dummies, round * PDS usage dummies, and dummies for household size, household head education and gender, religion, scheduled caste and scheduled tribe status, as well as demographic ratios (fraction of adult and senior males and females), quadratic in log real per capita expenditure (1993 rupees), and rural district NREGA employment interacted with PDS usage indicator. Regressions for farmers (columns 4 to 6) also include a quadratic in log land possessed. The regressions in Panel B use official state-year quantities and subsidies interacted with an indicator for PDS usage (see Figure 1). All data from rural areas in 50th, 55th, 61st and 66th NSS rounds.

Table 5: Household production effects of PDS expansion (within-village and household).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.	Area cultivated	Days labor	Area rice	Rice labor	Rice output	Area share grains	Cons. crop index	Ln(ag. value/day)
Mean dep. var.	4.126	205.1	1.684	64.97	206.4	0.698	0.504	5.270
	Panel A: Value of PDS entitlement							
PDS value	-0.014	-4.715	-0.003	-3.040*	2.819	-0.011**	-0.020*	0.034
	(0.051)	(3.436)	(0.039)	(1.682)	(5.931)	(0.005)	(0.012)	(0.022)
	Panel B: PDS usage * official state BPL quantity and subsidy/KG							
PDS*State BPL quant.	-0.008	-4.512***	-0.026**	-1.457***	-4.075**	-0.005***	-0.013***	0.009
	(0.015)	(1.148)	(0.011)	(0.541)	(1.644)	(0.002)	(0.005)	(0.006)
PDS*State BPL value/KG	-0.162	-30.368	-0.220	-1.869	-30.517	-0.052*	-0.121*	0.009
	(0.284)	(19.363)	(0.159)	(6.583)	(25.868)	(0.029)	(0.062)	(0.075)
Observations	3,956	3,956	3,956	3,956	3,956	3,956	3,956	3,382

Standard errors clustered by village-year and household in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Sample is all households with positive consumption out of agricultural output in 1999. Value of PDS is self-reported in 1000s of 2006 rupees (imputed from recall for 1999). All regressions include household fixed effects and village-year dummies. Additional controls include household size and household size squared, land owned, the value of all other government programs received by the household (imputed from recall for 1999), and in panel B a dummy for PDS usage. The consumption crop index (cons. crop) weights each household crop area share by the crop's aggregate share of output consumed (across all households) and is standardized. Net agricultural income per day is the total annual value of crops produced at market prices (including those consumed by the household) minus variable inputs (seeds, fertilizers, pesticides, hired machinery, and irrigation) and divided by total days of labor input. Area and rice output (in KG, converted to monthly basis) are for the Kharif season but labor is reported annually. All data from the 1999 and 2006 ARIS/REDS survey (except official state BPL quantities and subsidy values).

Table 6: Heterogeneous household production effects of PDS expansion (within-village and household).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.	Area cultivated	Days labor	Area rice	Rice labor	Rice output	Area share grains	Cons. crop index	Ln(ag. value/day)
Mean dep. var.	4.126	205.1	1.684	64.97	206.4	0.698	0.504	10.21
Panel A: Interactions with initial share of crop output consumed								
PDS*State BPL quant.	-0.014	-3.977***	-0.030***	-1.215**	-4.426***	-0.005**	-0.012***	0.005
	(0.016)	(1.157)	(0.012)	(0.524)	(1.681)	(0.002)	(0.005)	(0.006)
PDS*State BPL quant.*Share	0.015	-2.203***	0.008	-0.799**	0.146	-0.002*	-0.003	0.013***
	(0.010)	(0.787)	(0.008)	(0.394)	(1.071)	(0.001)	(0.003)	(0.004)
PDS*State BPL value/KG	-0.164	-29.233	-0.217	-1.813	-28.650	-0.053*	-0.123**	0.002
	(0.282)	(19.241)	(0.156)	(6.664)	(25.735)	(0.029)	(0.062)	(0.075)
PDS*State BPL value/KG *Share	-0.151	-3.039	-0.169*	-0.044	-11.992	-0.036***	-0.089***	-0.009
	(0.107)	(6.660)	(0.090)	(4.736)	(12.510)	(0.010)	(0.024)	(0.030)
Panel B: Interactions with initial land owned								
PDS*State BPL quant.	-0.033	-1.034	-0.060***	-0.769	-5.304***	-0.005**	-0.012***	0.009
	(0.020)	(1.340)	(0.020)	(0.552)	(1.928)	(0.002)	(0.005)	(0.006)
PDS*State BPL quant.*Land	-0.089**	12.479***	-0.127**	1.951*	-3.127	-0.000	0.000	0.003
	(0.037)	(1.921)	(0.051)	(1.080)	(3.301)	(0.001)	(0.002)	(0.005)
PDS*State BPL value/KG	-0.132	-32.066	-0.189	-6.169	-22.514	-0.058**	-0.131**	0.019
	(0.287)	(22.485)	(0.179)	(7.312)	(27.410)	(0.029)	(0.061)	(0.075)
PDS*State BPL value/KG*Land	0.218	7.179	0.318	-14.326	11.530	-0.006	-0.004	-0.032
	(0.372)	(20.114)	(0.537)	(15.054)	(39.157)	(0.010)	(0.027)	(0.064)
Panel C: Interactions with initial distance to weekly market								
PDS*State BPL quant.	-0.014	-5.205***	-0.024**	-1.497**	-3.423**	-0.007***	-0.016***	0.012*
	(0.016)	(1.278)	(0.011)	(0.658)	(1.565)	(0.002)	(0.005)	(0.006)
PDS*State BPL quant.*Dist.Mkt.	-0.029	-4.247	0.015	-0.450	3.829	-0.008*	-0.018*	0.019*
	(0.030)	(2.587)	(0.020)	(1.088)	(2.575)	(0.004)	(0.009)	(0.010)
PDS*State BPL value/KG	-0.244	-46.200**	-0.209	-3.673	-24.545	-0.076**	-0.173***	0.071
	(0.277)	(20.506)	(0.147)	(6.448)	(22.637)	(0.031)	(0.066)	(0.084)
PDS*State BPL value/KG *Dist.Mkt.	-0.173	-94.061**	-0.160	-16.178	-8.158	-0.051	-0.133	0.304*
	(0.582)	(46.377)	(0.273)	(12.708)	(41.386)	(0.058)	(0.123)	(0.171)
Observations	3,956	3,956	3,956	3,956	3,956	3,956	3,956	3,382

Standard errors clustered by village-year and household in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Sample is all households with positive consumption out of agricultural output in 1999. All interaction variables use the standardized initial (1999) values of each variable. All regressions include household fixed effects and village-year dummies. Additional controls include household size and household size squared, land owned, the value of all other government programs received by the household (imputed from recall for 1999), PDS usage dummies, and interactions of PDS usage dummies with interaction variables. The consumption crop index (cons. crop) weights each household crop area share by the crop's aggregate share of output consumed and is standardized. Net agricultural income per day is the total annual value of crops produced at market prices (including those consumed by the household) minus variable inputs (seeds, fertilizers, pesticides, hired machinery, and irrigation) and divided by total days of labor input. Area and rice output (in KG, converted to monthly basis) are for the Kharif season but labor is reported annually. All data from the 1999 and 2006 ARIS/REDS survey (except state BPL quantities and subsidy).

Table 7: District-level general equilibrium effects of PDS expansion and district heterogeneity. All quantities in KG/month/capita.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.	Rice output (mean=0.954)				Share of food from home production (mean=0.251)			
Interaction		1-home share	Roads	Natl. Mkt.		1-home share	Roads	Natl. Mkt.
Panel A: OLS								
PDS quantity	-0.103***	-0.104***	-0.113***	-0.126***	-0.013***	-0.013***	-0.012***	-0.013***
	(0.026)	(0.019)	(0.021)	(0.023)	(0.004)	(0.003)	(0.004)	(0.004)
PDS quantity*Interaction		0.032**	0.023	-0.042**		0.010***	0.005*	-0.001
		(0.013)	(0.015)	(0.017)		(0.003)	(0.002)	(0.003)
BPLshare2004 *State BPL value/KG	0.146**	0.141***	0.155***	0.169***	0.002	0.002	0.002	0.003
	(0.056)	(0.052)	(0.052)	(0.052)	(0.015)	(0.014)	(0.014)	(0.015)
State PDS Procurement	0.041*	0.044***	0.041***	0.043***	-0.010	-0.004	-0.014	-0.009
	(0.022)	(0.014)	(0.014)	(0.014)	(0.025)	(0.025)	(0.026)	(0.025)
Panel B: IV using district BPL share * State BPL quantity as instrument								
PDS quantity	-0.269***	-0.133*	-0.250***	-0.165***	-0.048**	-0.039**	-0.048**	-0.034**
	(0.094)	(0.069)	(0.085)	(0.062)	(0.021)	(0.015)	(0.022)	(0.013)
PDS quantity*Interaction		0.033**	0.058*	-0.054***		0.010**	0.002	-0.006
		(0.016)	(0.033)	(0.019)		(0.004)	(0.005)	(0.004)
BPLshare2004*State BPL value/KG	0.221**	0.154***	0.223***	0.190***	0.019	0.014	0.019	0.014
	(0.087)	(0.055)	(0.075)	(0.061)	(0.023)	(0.019)	(0.023)	(0.018)
State PDS Procurement	0.058**	0.047*	0.054**	0.046**	0.002	0.005	0.000	0.004
	(0.027)	(0.024)	(0.025)	(0.023)	(0.037)	(0.034)	(0.038)	(0.032)
First-stage F	13.93	7.044	6.171	7.487	12.09	6.229	6.137	7.470
Observations	1,161	1,161	1,161	1,161	1,161	1,161	1,161	1,161

Standard errors clustered by district and state-year in parentheses. *** p<0.01, ** p<0.05, * p<0.10. Regressions include district and year fixed effects, and time-varying district level measures of population, fraction of households below the poverty line, real per capita monthly expenditure, national market access (distance to agricultural output weighted by highway travel times), road density, use of NREGA, and district BPL card share * year dummies. PDS quantities in column 1 through 4 are for rice only. Interactions use standardized 1993 district values of 1 - farmer share of food from home production (columns 2 and 6), log road density (columns 3 and 7), and log national market access (columns 4 and 8). Panel B interactions are instrumented by interaction variable*instrument. BPL subsidy value/KG is the value per KG of official BPL PDS entitlements valued using national median prices. BPL share is the share of households with a BPL card in rural areas of the district measured in 2004-2005. Data from rural sector of NSS 1993, 1999, 2004, and 2009 data, ICRISAT district data set, and Allen and Atkin (2016).

Table 8: Mechanisms for district-level general equilibrium effects of PDS expansion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
		Rice price				NSS consumption					Inputs		
Dep.var.	NSS home	NSS mkt	Harvest	Wheat output	Cons. rice/wh.	Cons. home rice/wh.	Share home cons.	Ln(wage)	Ln(fert.)	Share irr.	Ln(wells)	Ln(livest.)	Ln(tract.)
Mean dep. var.	2.328	2.413	1.723	1.052	10.27	3.708	0.146	4.041	10.64	0.441	4.337	7.180	1.179
						Panel A: OLS							
PDS quantity	-0.000	0.010	0.023**	-0.031**	0.113*	-0.498***	-0.010***	-0.012	0.001	-0.001	-0.029	0.006	0.072
	(0.010)	(0.007)	(0.011)	(0.012)	(0.066)	(0.093)	(0.003)	(0.014)	(0.018)	(0.002)	(0.037)	(0.024)	(0.057)
BPLshare2004*State BPL value/KG	-0.011	-0.017	-0.024	0.001	-0.202	-0.017	-0.004	0.036	0.099	0.027**	0.155**	-0.166***	0.392**
	(0.031)	(0.029)	(0.032)	(0.055)	(0.257)	(0.318)	(0.010)	(0.056)	(0.066)	(0.011)	(0.077)	(0.061)	(0.194)
State PDS Procurement	0.010	-0.004	0.015*	-0.074	-0.776	0.225	-0.010	-0.049	0.070	0.030	-0.057	-0.071	-0.380
	(0.007)	(0.006)	(0.007)	(0.189)	(0.663)	(0.549)	(0.015)	(0.094)	(0.114)	(0.019)	(0.118)	(0.086)	(0.309)
						Panel B: IV using district BPL share * State BPL quantity as instrument							
PDS quantity	-0.039	-0.016	0.015	-0.074	-0.076	-0.993**	-0.034**	-0.158**	-0.023	-0.020	-0.020	-0.054	-0.025
	(0.043)	(0.032)	(0.081)	(0.073)	(0.513)	(0.469)	(0.013)	(0.078)	(0.076)	(0.015)	(0.105)	(0.060)	(0.236)
BPLshare2004*State BPL value/KG	0.006	-0.006	-0.021	0.020	-0.111	0.221	0.008	0.101	0.111	0.036***	0.151*	-0.144**	0.410*
	(0.041)	(0.037)	(0.044)	(0.056)	(0.392)	(0.448)	(0.016)	(0.079)	(0.075)	(0.013)	(0.083)	(0.061)	(0.214)
State PDS Procurement	0.014*	-0.002	0.016	-0.057	-0.710	0.397	-0.002	-0.033	0.080	0.034	-0.059	-0.128	-0.510
	(0.008)	(0.006)	(0.010)	(0.183)	(0.715)	(0.628)	(0.023)	(0.133)	(0.116)	(0.021)	(0.120)	(0.078)	(0.448)
First-stage F	13.93	13.93	11.14	13.04	12.09	12.09	12.09	9.739	12.03	8.337	8.252	7.609	10.12
Observations	1,161	1,161	881	1,148	1,161	1,161	1,161	913	1,160	1,000	994	870	756

Standard errors clustered by district and state-year in parentheses. *** p<0.01, ** p<0.05, * p<0.10. Regressions include district and year fixed effects, and time-varying district level measures of population, fraction of households below the poverty line, real per capita monthly expenditure, national market access (distance to agricultural output weighted by highway travel times), road density, use of NREGA, and district BPL card share * year dummies. PDS quantities in columns 1 through 3 are for rice only. NSS home (farm-gate) and market prices are median unit values for rural households in the district based on consumption of out of home production and market purchases. BPL subsidy value/KG is the value per KG of official BPL PDS entitlements valued using national median prices. BPL share is the share of households with a BPL card in rural areas of the district measured in 2004-2005. Data from rural sector of NSS 1993, 1999, 2004, and 2009 data, ICRISAT district data set, and Allen and Atkin (2016).

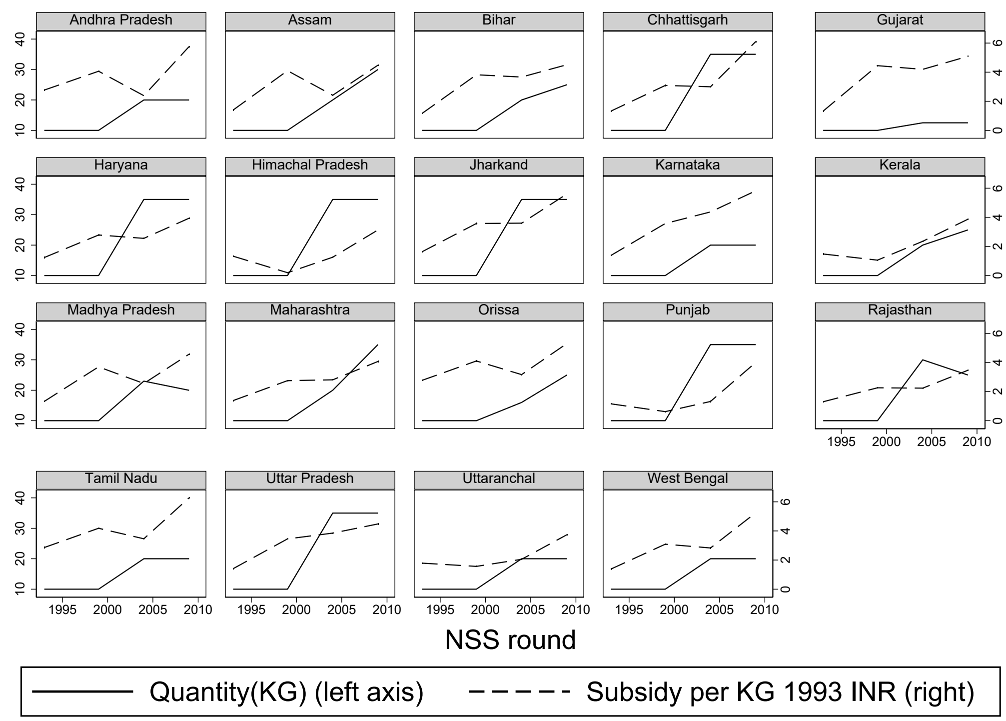

Figure 1: Solid line (left axis) measures official BPL PDS quantity (KG/month per household) by state in NSS data. Note that some states have official quantities that vary with household size; for these states I assume a five person household which is the median and modal household size during the period). Dashed line (right axis) measures the value of BPL PDS subsidies per KG (in 1993 rupees), based on median state PDS prices, official BPL quantities (to weight rice and wheat in some cases), and national market prices.

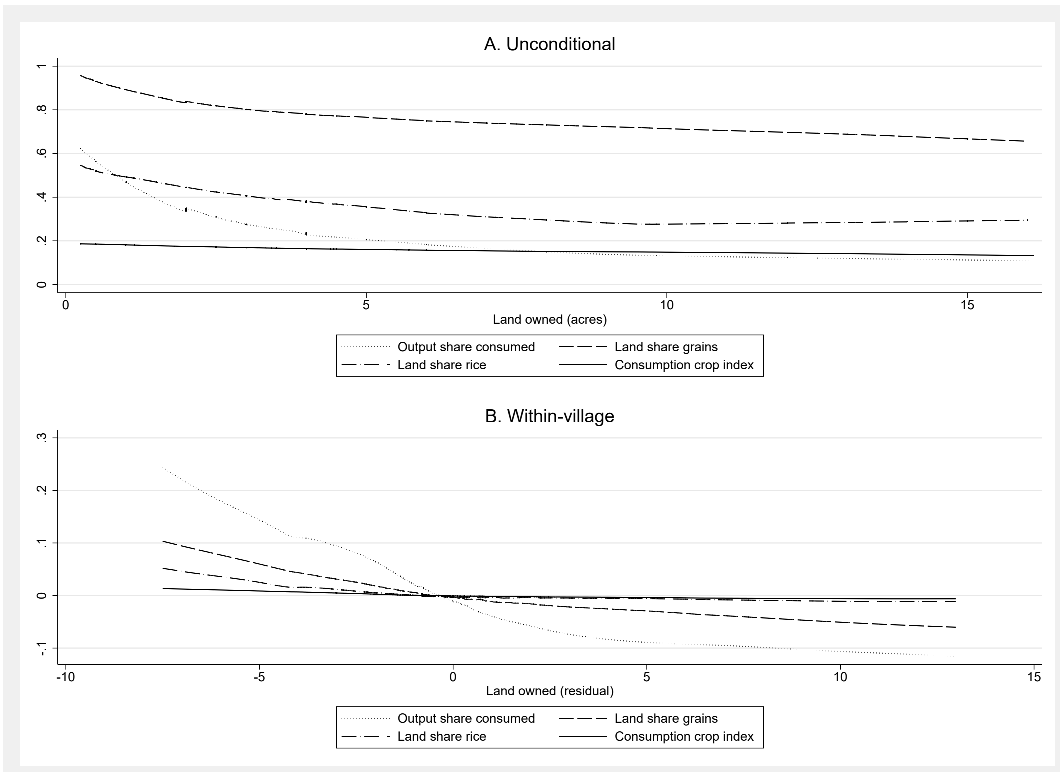

Figure 2: Staples, land allocation and land owned in ARIS/REDS 1999 data. Panel A presents locally weighted regression of the share of output consumed and share of land allocated to rice/wheat or all grains. Panel B is similar but partials out village fixed effects from the Y and X variables. Consumption crop index is the land share weighted sum of each crops aggregate share consumed at home.

A Additional Figures and Tables (For Online Publication)

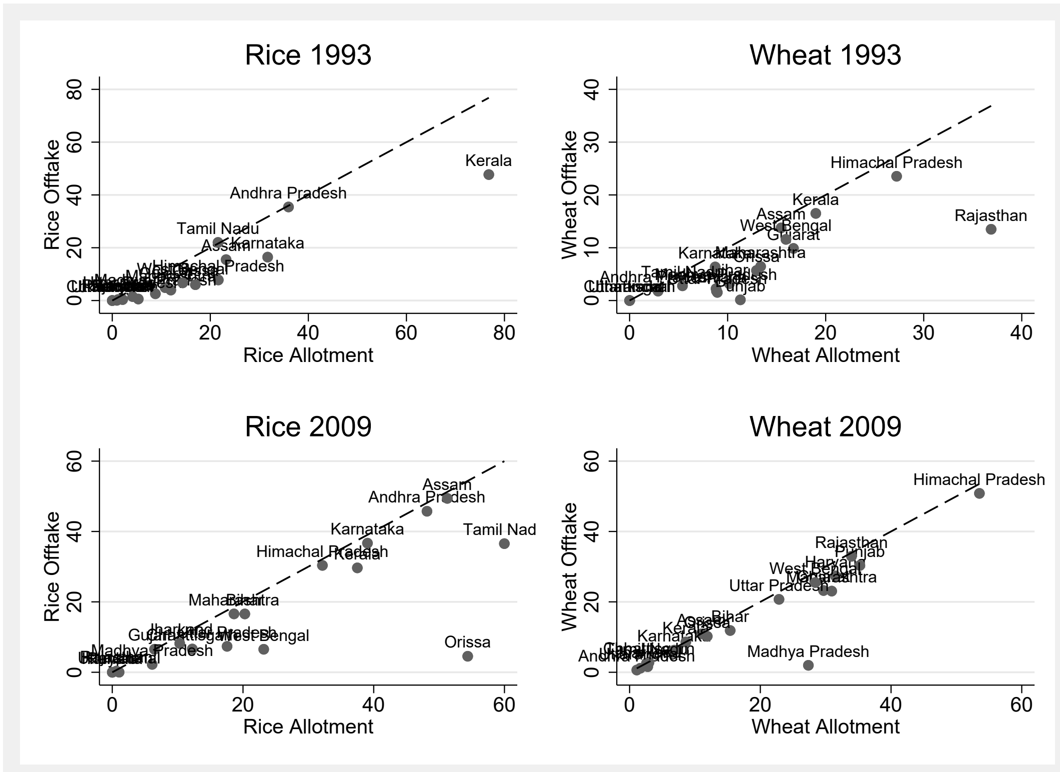

Figure A1: PDS allotment and offtake by state, 1993 and 2009 (all quantities in annual KG per capita).

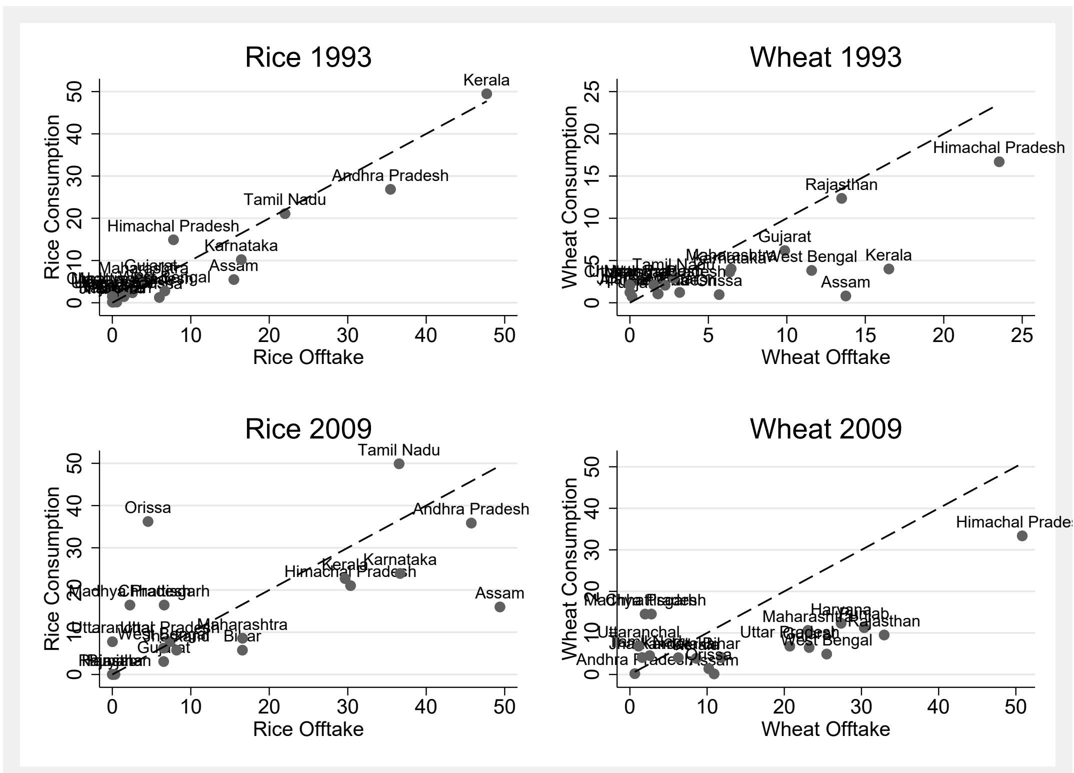

Figure A2: PDS offtake and consumption (NSS) by state, 1993 and 2009 (all quantities in annual KG per capita)

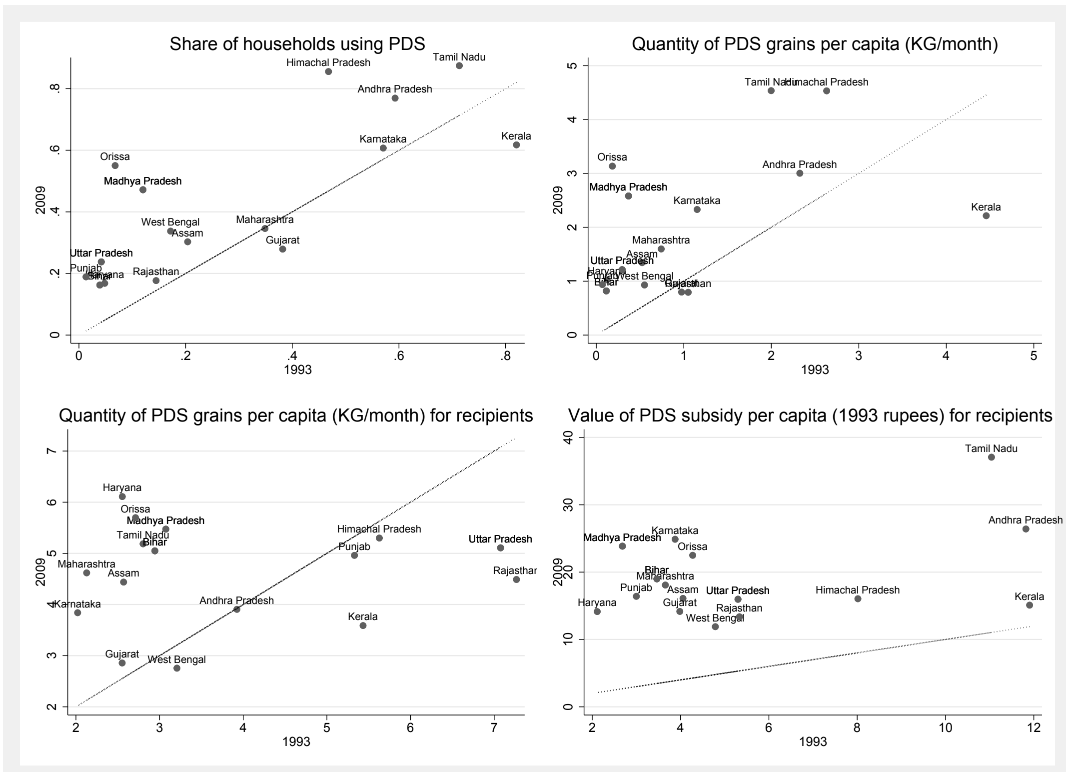

Figure A3: PDS variation across states. 45 degree line plotted. All data come from NSS rounds 50 (1993) and 66 (2009). Value of PDS subsidy is calculated based on state-level total PDS quantity and state-level gap between average market and PDS price (divided by number of state PDS recipients).

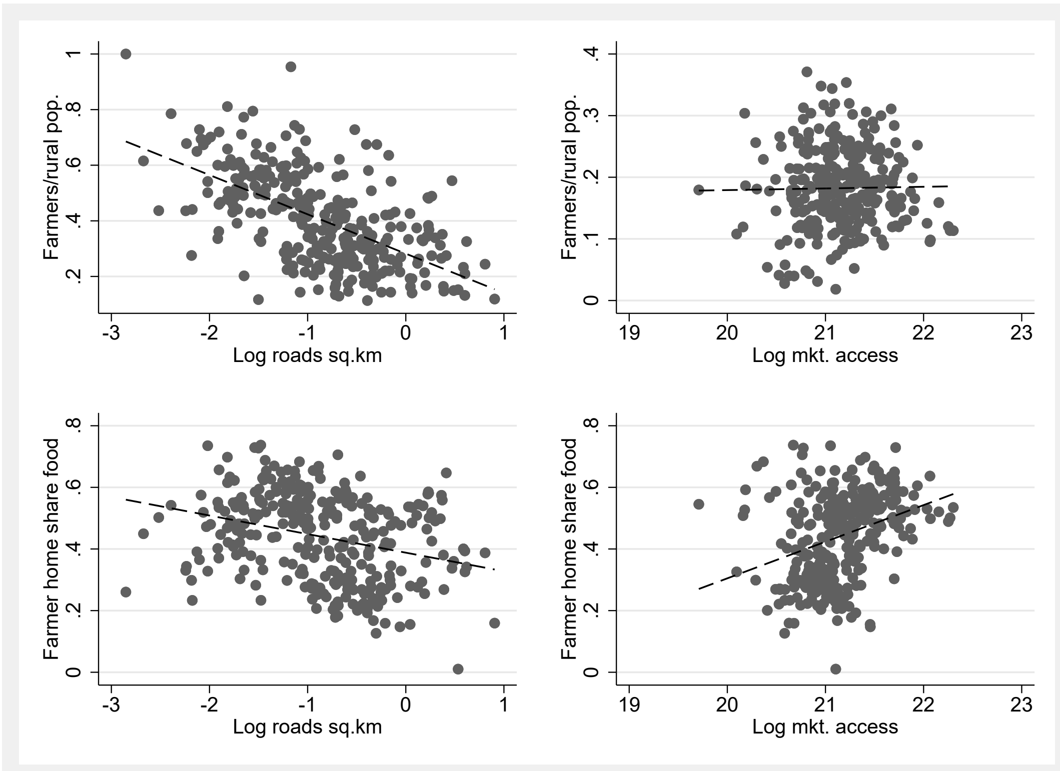

Figure A4: Relationship between district road density, national market access and marketization outcomes. Farmers/rural population calculated based on census data and interpolations. Average farmer home share of food from NSS. Road density is from ICRISAT district data while national market access is measured using highway driving times from Allen and Atkin (2016) combined with measures of district agricultural output from ICRISAT. Dashed line is regression line fit (all correlations have $p < 0.1$).

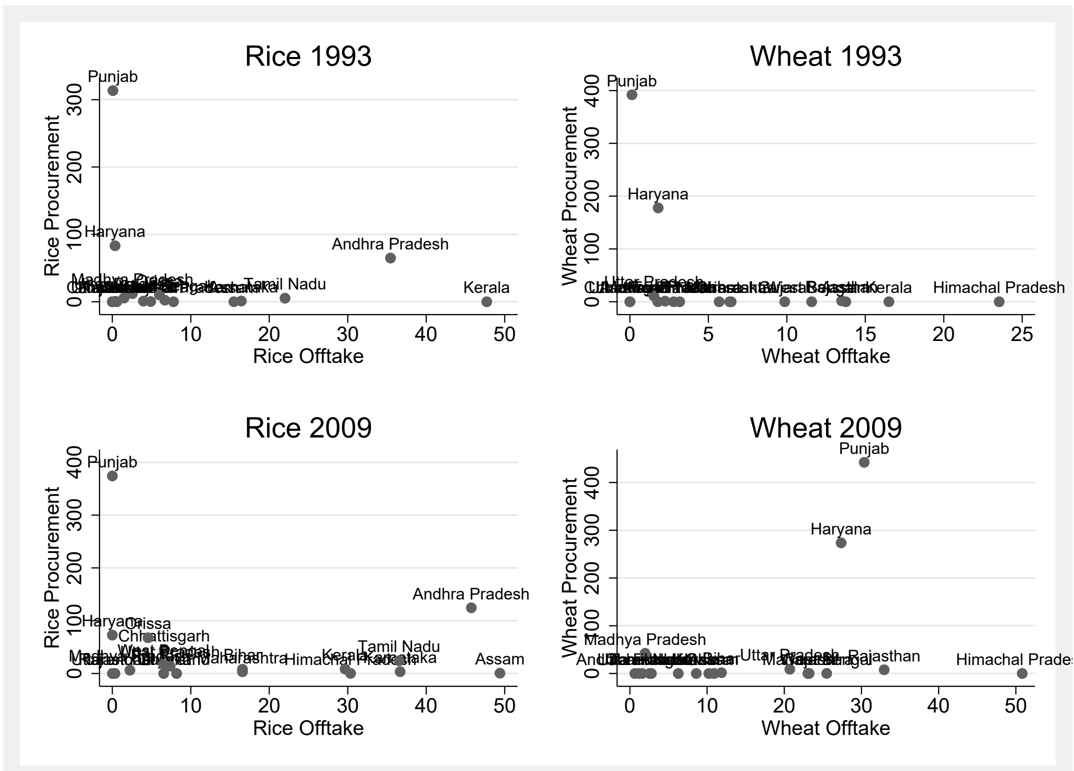

Figure A5: PDS offtake and procurement by state, 1993 and 2009 (all quantities in annual KG per capita)

Table A1: Additional household production effects of PDS expansion (within-village and household).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. var.	Area wheat	Days wheat	Wheat output	Ln(Income)	Ln(inputs)	Family work days	Casual work days
Mean dep. var.	1.559	34.56	164.6	10.71	8.748	125.7	73.63
			Panel A: Average effects				
PDS*State BPL quant.	-0.003	-0.526*	-0.874	-0.004	-0.007	-1.226*	-3.267***
	(0.019)	(0.298)	(1.180)	(0.006)	(0.005)	(0.643)	(0.782)
PDS*State BPL value/KG	-0.130	-1.987	-2.478	0.021	-0.068	-8.189	-20.978*
	(0.244)	(4.502)	(15.586)	(0.075)	(0.076)	(10.789)	(12.188)
			Panel B: Interactions with 1999 home consumption share				
PDS*State BPL quant.	-0.005	-0.516*	-1.028	-0.012**	-0.007	-0.940	-2.982***
	(0.020)	(0.311)	(1.233)	(0.006)	(0.005)	(0.676)	(0.770)
PDS*State BPL quant.*Share	0.011	-0.057	0.358	0.029***	-0.004	-1.182***	-1.018**
	(0.009)	(0.169)	(0.479)	(0.006)	(0.003)	(0.423)	(0.506)
PDS*State BPL value/KG	-0.139	-1.947	-2.356	0.030	-0.057	-7.784	-20.532*
	(0.243)	(4.478)	(15.524)	(0.074)	(0.074)	(10.712)	(12.154)
PDS*State BPL value/KG *Share	0.064	-0.336	-3.550	0.081**	-0.008	-4.335	2.006
	(0.055)	(1.140)	(3.360)	(0.036)	(0.028)	(3.134)	(4.881)
Observations	3,956	3,956	3,956	3,752	3,452	3,956	3,956

Standard errors clustered by village-year and household in parentheses. *** p<0.01, ** p<0.05, * p<0.10. Sample is all households with positive consumption out of agricultural output in 1999. Value of PDS is self-reported in 1000s of 2006 rupees (imputed from recall for 1999). All regressions include household fixed effects and village-year dummies. Additional controls include household size and household size squared, land owned, the value of all other government programs received by the household (imputed from recall for 1999), and interactions of PDS dummies with initial share consumed. The consumption crop index (cons. crop) weights each household crop area share by the crop's aggregate share of output consumed and is standardized. Areas and rice output (in KG, converted to monthly basis) are for the Kharif season but labor is reported annually. Wheat area and output (converted to monthly basis) are for Rabi season but all days are measured at the annual level. Income refers to net income from cultivation, non-agriculture household enterprise, and employment. Inputs refers to spending on seeds, fertilizers, pesticides, hired machinery, and irrigation. All data from the 1999 and 2006 ARIS/REDS survey (except state BPL quantities and subsidy).

Table A2: Alternative mechanisms for PDS effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var.	Area cultivated	Days labor	Area rice	Rice labor	Rice output	Area share grains	Consumption crop index	Ln(net ag. value)
Mean dep. var.	4.126	205.1	1.684	64.97	206.4	0.698	0.504	10.21
Panel A: Heterogeneous effects of other government program (interaction with 1999 home consumption share)								
Value other programs	-0.027	0.121	-0.012	-1.160*	-14.398	-0.000	-0.002	-0.016***
	(0.023)	(1.327)	(0.012)	(0.649)	(21.998)	(0.002)	(0.005)	(0.005)
Val. other programs*Share	0.074**	-0.756	0.079***	1.528	38.673	0.005	0.020	0.034***
	(0.036)	(2.351)	(0.027)	(1.425)	(47.668)	(0.006)	(0.014)	(0.011)
PDS*State BPL quant	-0.015	-3.971***	-0.031***	-1.229**	-44.315**	-0.005**	-0.012***	-0.003
	(0.016)	(1.155)	(0.012)	(0.520)	(20.249)	(0.002)	(0.005)	(0.006)
PDS*State BPL quant.*Share	0.013	-2.188***	0.007	-0.829**	-16.787	-0.002*	-0.004	0.004
	(0.010)	(0.787)	(0.008)	(0.396)	(16.368)	(0.001)	(0.003)	(0.004)
PDS*State BPL value/KG	-0.154	-29.333	-0.207	-1.609	-200.914	-0.052*	-0.121*	0.006
	(0.282)	(19.259)	(0.157)	(6.665)	(340.267)	(0.029)	(0.062)	(0.072)
PDS*State BPL value/KG *Share	-0.157	-2.981	-0.175*	-0.160	-64.554	-0.036***	-0.091***	0.023
	(0.107)	(6.713)	(0.090)	(4.772)	(176.471)	(0.010)	(0.024)	(0.035)
Observations	3,956	3,956	3,956	3,956	3,478	3,956	3,956	3,408
Panel B: Heterogeneous effects of PDS expansion w.r.t. household risk (value of crop losses 1999-2006)								
PDS*State BPL quant	-0.012	-4.574***	-0.030**	-1.497***	-51.669**	-0.006***	-0.014***	-0.002
	(0.014)	(1.175)	(0.012)	(0.567)	(20.398)	(0.002)	(0.005)	(0.006)
PDS*State BPL value/KG	-0.237	-32.680*	-0.184	-1.813	-195.755	-0.053*	-0.128**	-0.029
	(0.288)	(19.200)	(0.174)	(6.742)	(349.148)	(0.030)	(0.064)	(0.073)
PDS*State BPL quant*Crop losses	0.004***	0.795	0.004**	0.297	4.428	0.000	0.001	0.001
	(0.002)	(0.654)	(0.002)	(0.310)	(3.683)	(0.000)	(0.001)	(0.001)
Observations	3,866	3,866	3,866	3,866	3,418	3,866	3,866	3,348

Standard errors clustered by village-year and household in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Sample is all households with positive consumption out of agricultural output in 1999. Value of PDS is self-reported in 1000s of 2006 rupees (imputed from recall for 1999). All regressions include household fixed effects and village-year dummies. Additional controls include household size and household size squared, land owned, the value of all other government programs received by the household (imputed from recall for 1999), and interactions of PDS dummies with initial share consumed or crop losses. The consumption crop index (cons. crop) weights each household crop area share by the crop's aggregate share of output consumed and is standardized. Net agricultural income is the total value of crops produced (including those consumed) minus inputs (seeds, fertilizers, pesticides, hired machinery, and irrigation). Areas and rice output (in KG, converted to monthly basis) are for the Kharif season but labor is reported annually. Other government programs include: housing support scheme, sanitation support scheme, IAY, ARWSP, Total Sanitation Campaign, Swajaldhara, Samagra Yawaas Yojana, SGRY, SGSY, ICDS, Social Security Pension, Mid-day meal program, Business Support Program, Food for work program, PMGY, Employment Guarantee Scheme, Credit cum subsidy scheme, women centric programs and scholarships. "Risk" is measured using the total expenditures and losses (in 2006 rupees) incurred by the household between 1999 and 2006 from crop loss, pests, wells drying up, drought at the village level and crop loss, price increases, irrigation well drying up at the household level. All data from the 1999 and 2006 ARIS/REDS survey (except state BPL quantities and subsidy).

Table A3: Robustness for main district-level general equilibrium effects of PDS expansion. All quantities in KG/month/capita.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.		Rice output			Share of food from home production	
		Panel A: OLS				
PDS quantity	-0.071***	-0.105**		-0.014***	-0.015***	
	(0.021)	(0.043)		(0.004)	(0.005)	
PDS quantity (t+1)			-0.046			-0.004
			(0.032)			(0.004)
BPLshare2004*State BPL value/KG	0.072	0.184***	0.132***	-0.007	0.026***	0.024***
	(0.062)	(0.054)	(0.049)	(0.022)	(0.009)	(0.009)
State PDS Procurement	-0.016	0.042	0.043	-0.027	-0.054**	-0.032
	(0.011)	(0.027)	(0.027)	(0.037)	(0.025)	(0.027)
Panel B: IV using district BPL share * State BPL quantity as instrument						
PDS quantity	-0.124*	-0.492**		-0.057***	-0.068**	
	(0.074)	(0.228)		(0.022)	(0.026)	
PDS quantity (t+1)			-0.185*			-0.017
			(0.109)			(0.023)
BPLshare2004*State BPL value/KG	0.106	0.299*	0.148**	0.006	0.046	0.027***
	(0.072)	(0.153)	(0.073)	(0.034)	(0.029)	(0.010)
State PDS Procurement	-0.005	0.053*	0.059*	0.003	-0.105**	-0.005
	(0.018)	(0.031)	(0.031)	(0.065)	(0.046)	(0.056)
First-stage F	10.85	5.591	6.255	10.29	7.609	5.553
Observations	1,009	870	864	1,009	870	864

Standard errors clustered by district and state-round in parentheses. *** p<0.01, ** p<0.05, * p<0.10. Columns 1 and 4 drop the major procurement states (Punjab, Haryana, Andhra Pradesh). Columns 2, 3, 5 and 6 drop the year 2009 (and the NREGA variable). Columns 3 and 6 use the forwarded value of PDS quantity per capita (e.g. the value from 2009 for 2004, the value from 2004 for 1999) and the forwarded value of the instrument. Regressions include district and year fixed effects, and time-varying district level measures of population, fraction of households below the poverty line, real per capita monthly expenditure, openness (distance to agricultural output weighted by highway travel times), road density, use of NREGA, PDS procurement per capita (reported at the state level) in monthly KGs, and the interaction of district BPL card share with year. BPL subsidy value/KG is measured using the difference between state-level PDS prices and the national median market price (weighted by official state BPL quantities), with the value deflated to 1993 rupees using all-India CPI. The BPL share is the fraction of households in rural areas of the district observed with BPL cards in the 2004-2005 NSS round.

Table A4: State-level regressions using different measures of PDS quantity (India 1993-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Home consumption per capita			Output per capita			Market Price		
				Panel A: Rice					
PDS allotment per capita	-0.110**			-0.528***			-0.016		
	(0.048)			(0.157)			(0.047)		
PDS offtake per capita		-0.063			-0.617**			-0.033	
		(0.124)			(0.268)			(0.108)	
PDS consumption per capita			-0.496**			-0.750*			0.036
			(0.202)			(0.358)			(0.114)
Procurement per capita	-0.050	-0.067	0.014	0.351	0.255	0.395	0.020	0.017	0.012
	(0.049)	(0.051)	(0.039)	(0.260)	(0.259)	(0.282)	(0.052)	(0.050)	(0.055)
Observations	76	76	76	76	76	76	76	76	76
Mean dep. var.	1.648			8.854			6.667		
				Panel B: Wheat					
PDS allotment per capita	-0.176***			-1.479***			-0.029		
	(0.051)			(0.409)			(0.050)		
PDS offtake per capita		-0.230**			-1.432**			-0.050	
		(0.095)			(0.649)			(0.069)	
PDS consumption per capita			-0.506*			-4.615***			0.029
			(0.272)			(1.004)			(0.094)
Procurement per capita	-0.041	-0.009	0.011	0.517**	0.715**	0.993***	-0.031*	-0.024	-0.035*
	(0.036)	(0.058)	(0.061)	(0.233)	(0.280)	(0.122)	(0.018)	(0.017)	(0.020)
Observations	76	76	76	76	76	76	76	76	76
Mean dep. var.	1.206			8.185			5.427		

Standard errors clustered by state. *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Regressions include state and year fixed effects. All quantities are measured in monthly KG per capita. Additional controls include state population and state mean real per capita monthly expenditure per person. PDS allotment refers to the amount allocated to each state from the center based on the the number of BPL and AAY classified households and historic offtake by APL households. PDS offtake refers to the amount actually received by each state. PDS consumption per capita is from the NSS and measures actual reported PDS consumption.