Food Subsidies and Their Impacts on Child Nutrition

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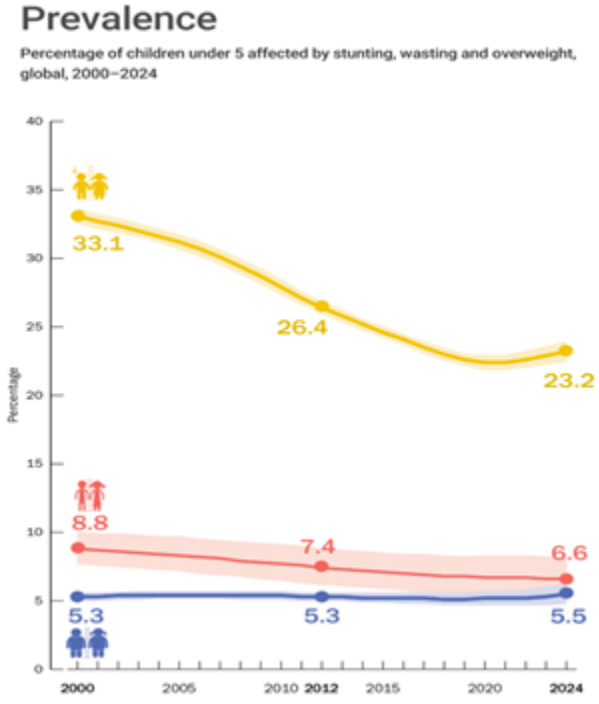
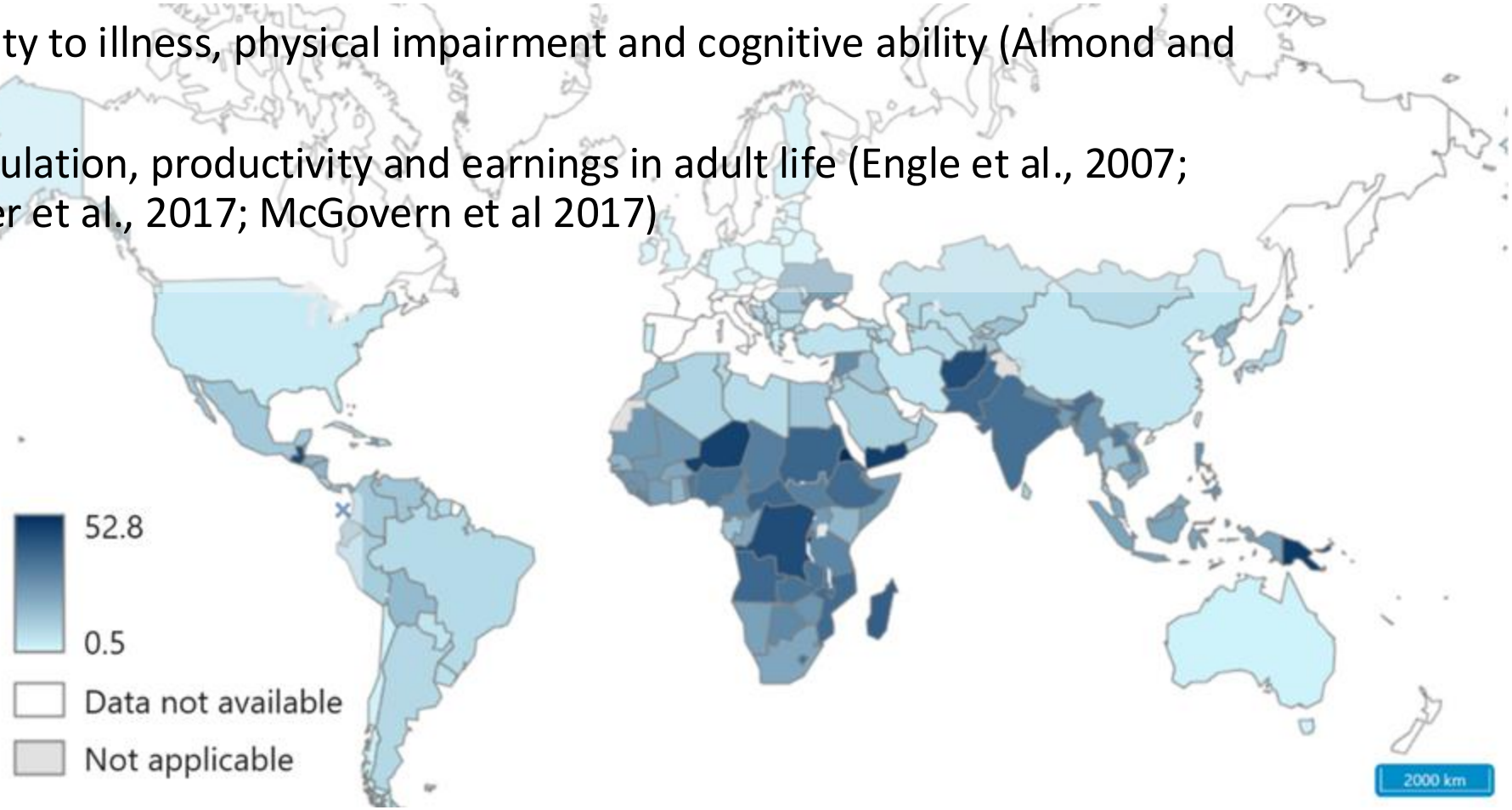
Child malnutrition is a global health concern

- 23% of children under 5 are stunted (< -2 SD median height for age z-score or HAZ)
- Almost 150 million kids (UNICEF/WHO 2020)
- Lasting effects on susceptibility to illness, physical impairment and cognitive ability (Almond and Currie, 2011b; Doyle, 2019)
- Lowers human capital accumulation, productivity and earnings in adult life (Engle et al., 2007; Hoddinott et al., 2013; Richter et al., 2017; McGovern et al 2017)





https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-jme-country-children-aged-5-years-stunted-(-height-for-age--2-sd)

What can be done?

- Social transfers (Carneiro et al. 2021; Field and Maffioli 2021; Ahmed, Hoddinott and Roy 2019)
- Prenatal and early child support (Hoddinott et al 2007; Kandpal 2013)
- Improved access to nutrient dense foods (long nutrition literature, e.g. Pimpin et al. 2019)
- Food transfers

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- Improved access to nutrient dense foods (long nutrition literature, e.g. Pimpin et al. 2019)
- **Food transfers**

  Widely used tool for improving food security and nutrition of the poor
  - 44% of individuals on social welfare programs around the world receive in-kind food (World Bank, 2015)
  - More than 3/4 of low and middle income countries use food transfer programs
  - Cover more than 1.5 billion people

Setting : India

India has one of the highest proportion undernourished children in the world

- India accounts for 30% of stunted children in the world
- Within India, 36% of children are stunted

India's Public Distribution System (PDS)

- World's largest food transfer program
- India's largest social welfare program, accounts for 60% of social assistance budget.
- Most important safety-net during the recent COVID crisis
- Ration of staple cereals (rice and wheat) sold below the market price to ration card holders (BPL, AAY) through a network of over 500,000 fair price shops.

Do PDS transfers reduce child stunting?

I’m going to try and convince you…

…that PDS had wide-ranging effects by

(1) Improving nutrition

(2) Increasing income

Evidence in the case of social transfers and CCT (Carneiro et. al 2021, Fink et. al. 2020, Bandiera et. al. 2017; Barham et al. 2018; Araujo and Macours 2021)

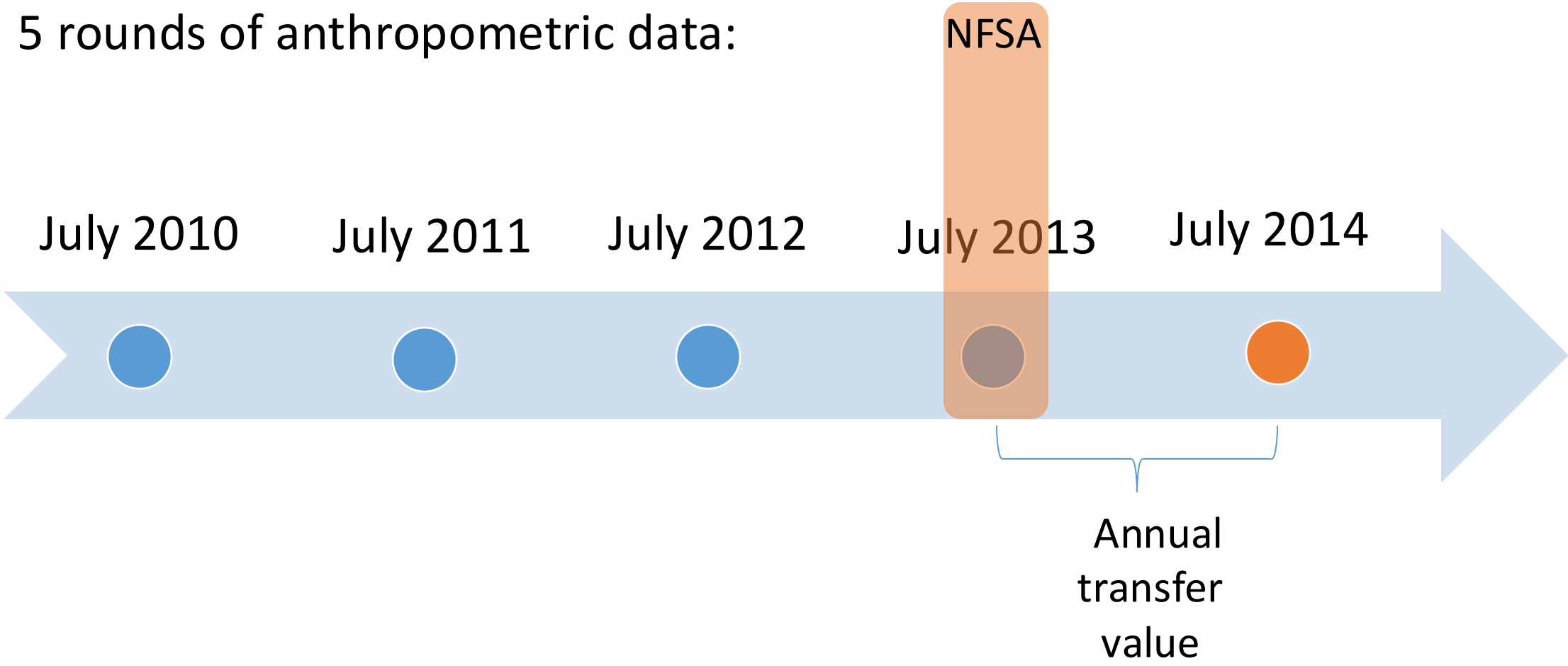
(3) Reducing risk: limiting harm from weather shocks

What do we do?

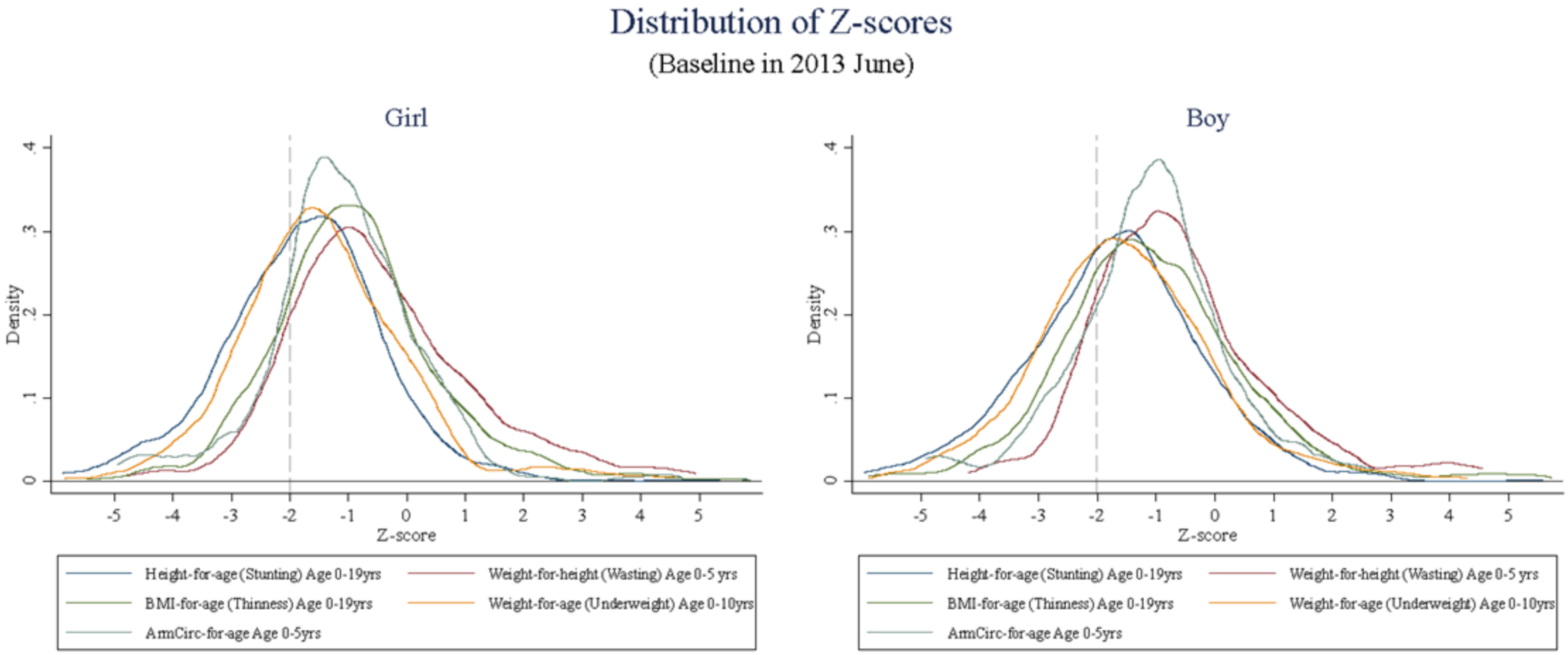
- Use the large expansion of food transfers in India as part of the National Food Security Act (NFSA) in 2013
    - Center introduced binding mandates to States
- Variation across state and time
    - Pre-NFSA, states had flexibility
    - Post-NFSA, Out-of-compliance states forced to expand to bring in line with the mandate
- Variation within state
    - NFSA changed quantity mandates from per HH to per individual
    - With and without ration cards
- Use ICRISAT's Village Dynamics in South Asia panel data
    - Rural sample of 1683 children and adolescents in 30 villages, 8 states
    - Annual data on anthropometrics for 5 years from 2010 to 2015
    - Monthly data on consumption
- Instrument for transfers using changes in rules to evaluate the effect on HAZ, stunting and food consumption

Timeline

5 rounds of anthropometric data:



Child malnutrition in VDSA villages

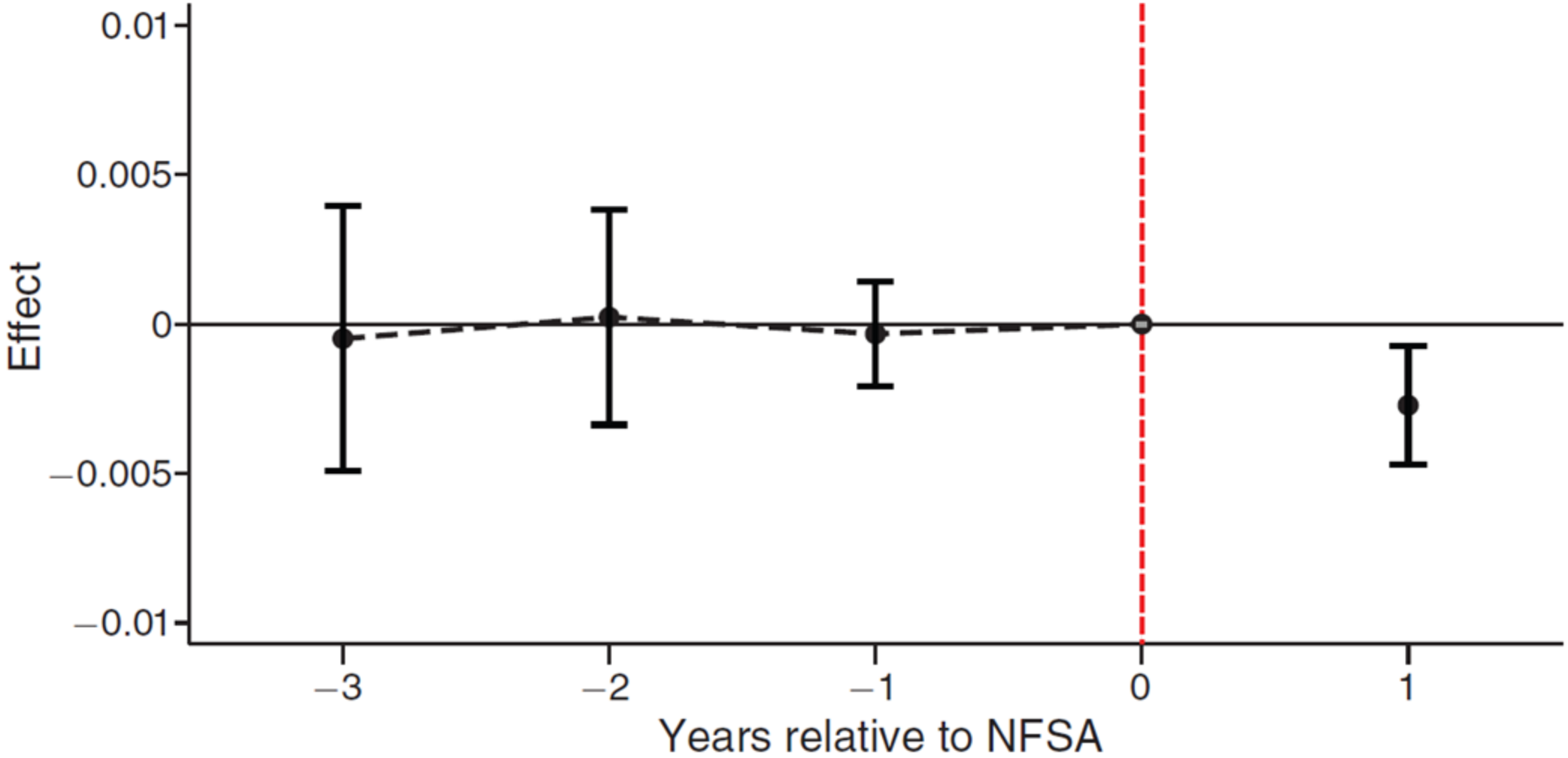


Note: WHO 2007 reference population

Results, for a 100 Rs increase in transfer

	Stunting	Stunting moderate	Stunting severe	HAZ
	(1)	(2)	(3)	(4)
PDS transfer value	−0.216	−0.183	−0.033	0.298
(IV : NFSA target value)	(0.087)	(0.073)	(0.045)	(0.153)
Age # year FE	X	X	X	X
State # year FE	X	X	X	X
HH-size group # year FE	X	X	X	X
BPL status # year FE	X	X	X	X
HH-char # year FE	X	X	X	X
State cluster bootstrap *p*-value	0.025	0.073	0.320	0.027
Observations	1,305	1,305	1,305	1,305
Baseline mean	0.387	0.199	0.187	−1.485
Change from PDS expansion (in level)	−0.071	−0.061		0.098
Change from PDS expansion (in %)	−18.5%	−30.3%		6.6%

Pre-trends on Stunting



The effect is concentrated in children 0-2 yrs of age

	Stunting	HAZ
	(1)	(2)
PDS transfer (IV: NFSA target value)		
X age 0 to 2	−0.279	0.422
	(0.104)	(0.187)
X age 3 to 5	−0.118	0.102
	(0.106)	(0.203)
Age # year FE	X	X
State # year FE	X	X
HH-size # year FE	X	X
BPL status # year FE	X	X
HH-char # year FE	X	X
Observations	1,305	1,305

Effects are concentrated on infants 0 to 2 years, consistent with importance of “first 1000 days of life” as a period of fast growth (Bundy et al. 2018; de Onis and Branca 2016)

Effects are broadly similar between boys and girls

Effects are large but are in line with other work

	This study	Ahmed et. al. 2019	Field et. al (2021)	Han et. al (2021)		Miguel and Kremer (2004)
Study population	1400 Children (0-5 yrs) Rural India	454 Children (0-4 yrs) Rural Bangladesh	2100 children (0-2 yrs) Myanmar	640 children (0-2 yrs) Ethiopia		30,000 pupils in Kenya
Modality	Food	Cash + BCC	Cash + BCC	Food voucher + BCC		Deworming
Transfer size (% of hh consumption)	4%	14%	5%			
Effect on HAZ (SD)	0.10 SD	0.25 SD	0.07 SD	0.21		0.09 SD

Additional results

- Limited impacts on weight-based indicators (underweight and wasting) and mid-upper arm circumference (MUAC)
- Limited impacts on stunting of older children. Except, MUAC improved for children aged 6 to 10
- Improved body mass index (BMI) status of adult women, especially women of child-bearing age.
- Null effects on obesity
- Null effects on men

Mechanisms: PDS "crowds-in" nutrient dense foods

Results for a 1 Re increase in PDS transfer (IV)

	Value (in 2010 Rs) (1)	Quantity (in grams) (2)	Energy (kcal) (3)	Protein (mg) (4)	Fat (mg) (5)
Staple cereals					
PDS grain	0.019	17.138	1.961	49.321	3.991
	(0.006)	(5.330)	(0.615)	(14.705)	(1.253)
Staples except PDS	0.096	6.341	0.728	21.241	2.110
	(0.076)	(4.554)	(0.522)	(13.706)	(1.497)
Animal proteins					
Milk and milk products	0.299	14.915	0.488	19.575	34.326
	(0.080)	(4.806)	(0.155)	(6.170)	(10.853)
Meat	0.084	0.502	0.019	4.174	0.538
	(0.029)	(0.232)	(0.009)	(1.614)	(0.182)
Eggs	0.012	0.003	0.011	0.925	0.925
	(0.005)	(0.002)	(0.006)	(0.445)	(0.445)
Vegan proteins					
Pulses	0.124	2.974	0.342	22.814	1.076
	(0.023)	(0.521)	(0.060)	(3.973)	(0.667)
Fruits and vegetables					
Fruits and vegetables	0.255		0.297	9.211	2.483
	(0.042)		(0.068)	(2.143)	(0.394)
Total food	1.449		5.564	144.778	138.596

Improves animal protein intake

- e.g. at baseline, daily intake of animal proteins was 7.5g.
- a 30 Rupees per capita PDS transfer increased intake of Animal protein by 0.72 g
- Equivalent to ~ 9.6% increase in Protein intake from Animal sources

In total PDS expansion increased consumption

- **167 kcal (1/3 from PDS grain),**
- **4.3 g of protein**
- **4.2 g of fat**

Mechanisms: PDS increases income

	Wage earnings	Wages	Labor supply
PDS transfer value	1.212	0.108	−0.051
(IV: NFSA target value)	(0.553)	(0.054)	(0.014)
Observations	54,479	42,054	57,322
Mean of outcome	910 Rs/month	183 Rs/day	36 days/month

PDS transfer increased wages by 1.7% (3.2 rupees/day) that benefit labor suppliers

Magnitude of increase in labor income is more than the transfer itself

PDS expansion decreases effect of weather shock

	Stunting		HAZ	
	(1)	(2)	(3)	(4)
PDS transfer (IV–NFSA value)	−0.211 (0.090)	−0.167 (0.088)	0.269 (0.161)	0.167 (0.161)
Rainfall quantity (*z*-score)	−0.034 (0.036)	−0.081 (0.040)	0.189 (0.110)	0.296 (0.134)
PDS transfer × RF quantity		0.099 (0.029)		−0.228 (0.093)
Observations	1,305	1,305	1,305	1,305

A bad rainfall year increases stunting. PDS transfers attenuate the negative impact of rainfall on stunting: During a drought (- 2 SD), a 100 rupee transfer decreases stunting by 36pp but during plentiful rainfall (+ 1 SD), it only decreases 2.3 pp

Conclusions: Impacts of PDS expansion are striking

Results

1. Significantly reduced stunting in children
2. Largest effect on infants 0 to 2 years
3. Improvements in dietary diversity, particularly animal proteins
4. Important “second round” impacts on wages and labor incomes.
5. Larger reductions in stunting in years with a bad rainfall

Implications on PDS

- PDS can substantially improve children’s nutrition
- PDS still remains an effective tool – crowding out concerns are not generally valid
- Back of the envelop calculations, suggest NFSA prevented approximately 1.8 million children from being stunted

Discussion

- Stunting can have long-run health and economic costs, perpetuating intergenerational poverty (Sudfeld et al. 2015; Victora et al. 2008; Currie and Almond 2011; McGovern et al. 2017)
- …and stunting is expected to increase with climate change (Grace et al. 2012, Davenport et al. 2017, Randell et al. 2020, Theide & Gray 2020, Dimitrova 2021, Hoddinott & Kinsey 2001, Aldermann et. al 2006, Akresh et.al. 2011, del Ninno & Lundberg 2005, Thiede & Gray 2020; McMahon & Gray 2021; McMahon et al 2025)
- Possible interventions are wide-ranging, from improving public health, sanitation, women's empowerment, access to nutrient dense foods…
- …and social safety nets in the form of cash and food transfers
- …which can improve labour market outcomes
- …and the returns to intervention are potentially large: McGovern et al 2017 find almost 18:1 returns on interventions to reduce stunting

Thank you

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Extra slides

Literature

1. Effect of food transfers on child nutrition in developing countries
   - Recent studies show limited effects of food alone in Bangladesh (Ahmed et. al. 2019) and Ethiopia (Han et. al. 2021)
   - Cash transfers - extensive literature in Latin America – find mixed or null impacts (Walque et. al 2017; LeRoy et. al. 2009)
   - No consensus on the effect of social transfers on child nutrition
   - Stronger effects if transfers are combined with Behavioral change communication (Field et. al. 2021; Han et. al. 2021)

2. Labor market effects of transfers can reinforce effects on nutrition
   - Social transfers increased labor incomes of beneficiaries, in addition to the transfer itself (Carneiro et. al 2021, Fink et. al. 2020, Bandiera et. al. 2017; Barham, Macours and Maluccio 2018; Araujo and Macours 2021)

Literature

3. Child nutrition and climate shocks

- Impacts of climate change on undernutrition (Phalkey .et. al. 2015)
- Extreme weather events (droughts/floods, extreme heat) increase under-five stunting (Grace et al. 2012; Davenport et al. 2017; Hoddinott & Kinsey 2001; Aldermann et. al 2006; Akresh et.al. 2011; McMahon and Grey 2021; McMahon et al. 2025)
- Improved nutritional diversity through food transfer can potentially mitigate the effect of climate shocks on child nutrition

4. PDS and nutrition

- Broad skepticism - concern over “empty” calorie consumption and “crowding-out” of more nutritious food
- Previous work was constrained by dearth of plausibly exogenous variation in PDS transfers at the household level
- Small or no effect of PDS (Kochar 2005, Kaul 2018, Kaushal and Machomba 2015, Tarozzi 2005)
- First study to examine NFSA

Background

Center-State relationship

- **Center** procures and allocates a fixed quantity of grains (*central quota*) to states at *central issue price*
- **State** distributes and determines the quantity and price to distribute to beneficiaries

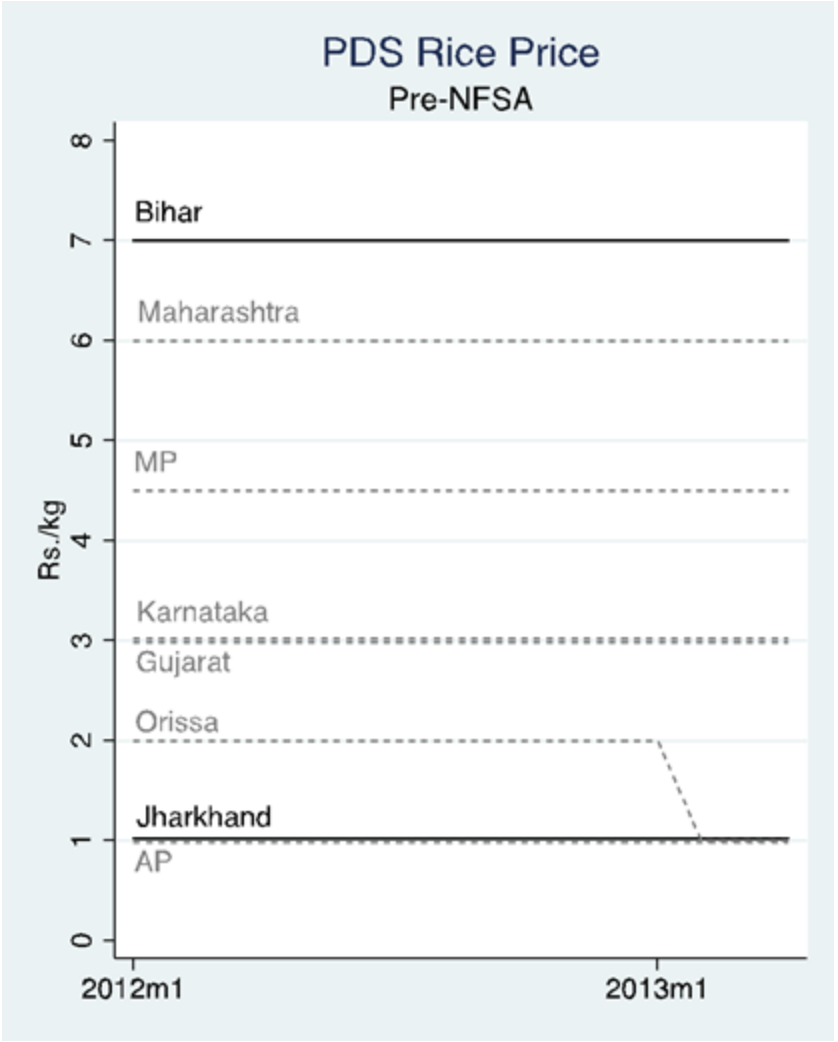
NFSA reforms in 2013

1. Center increased outlays, reduced central issue price
2. Center mandated States these minimum price/quantity targets
   - Every poor person in India to receive a minimum legal entitlement of food
   - 5 kg of staple food per individual : 2 kg of rice at Rs 3/kg; 3 kg of wheat at Rs 2/kg

Identification Strategy

Pre-NFSA (Targeted PDS)

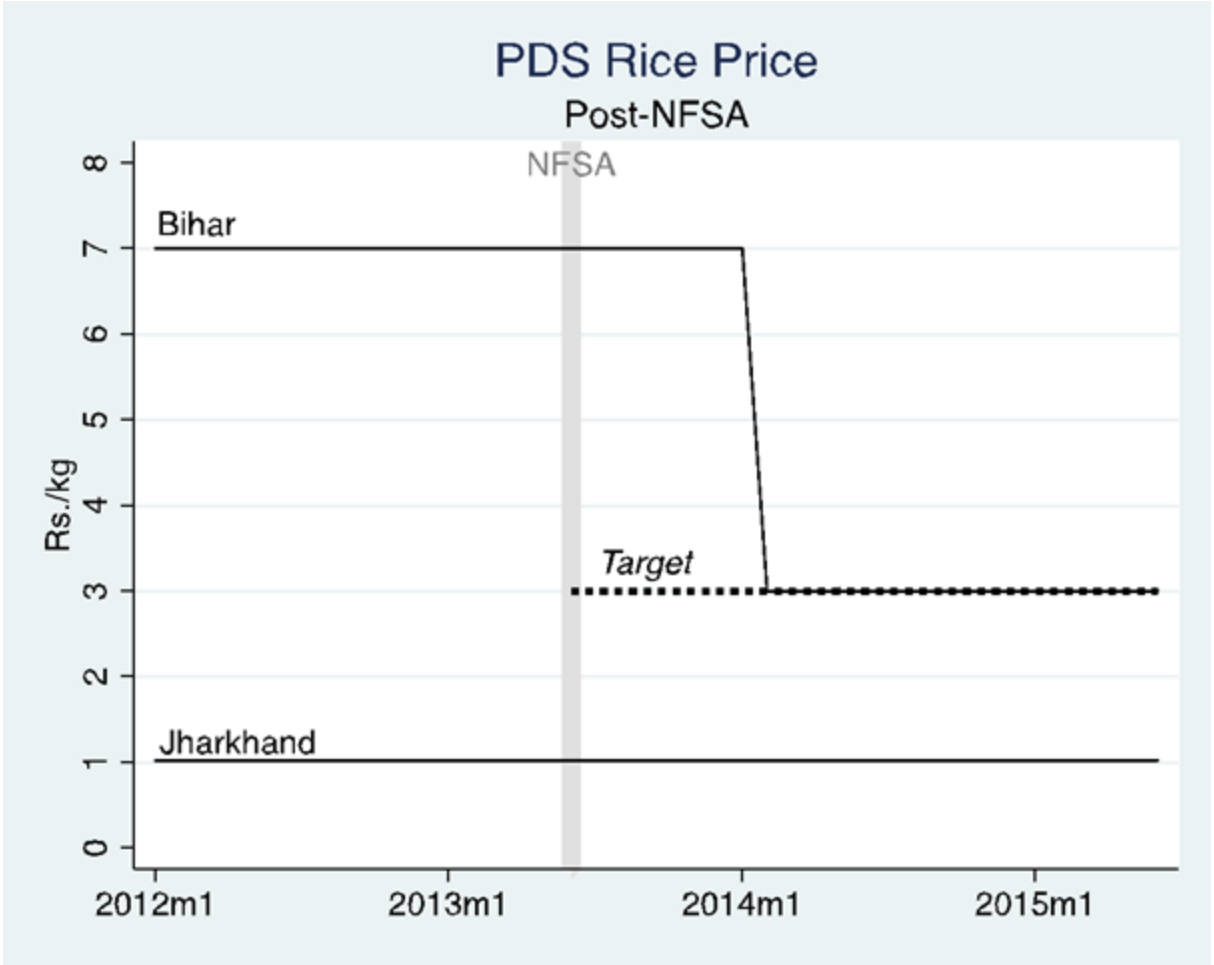
- PDS Rice price for 8 states in our data
- States had discretion in setting the price
- Bihar offered at 7 Rs/kg
- Jharkhand offered at 1 Rs/kg



Identification Strategy

Post-NFSA

- Mandated target = Rs 3/kg
- Out-of-compliance states brought down prices
- In-compliance states continued
- Bihar reduced to Rs 3/kg
- Jharkhand continued at 1 Rs/kg

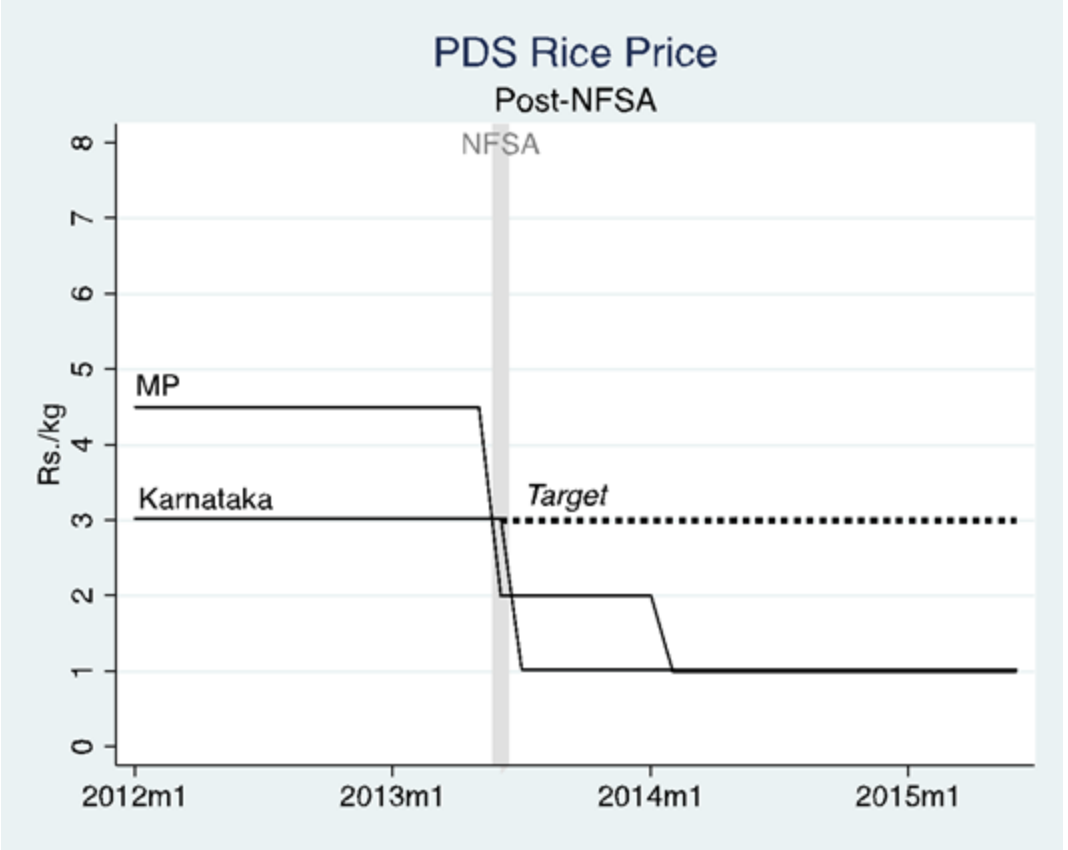


Identification Strategy

Concerns to identification

1. Voluntary overshooting
   - Mandate = 3 Rs/kg
   - MP reduced to 1 Re/kg
   - KN reduced to 1 Re/kg

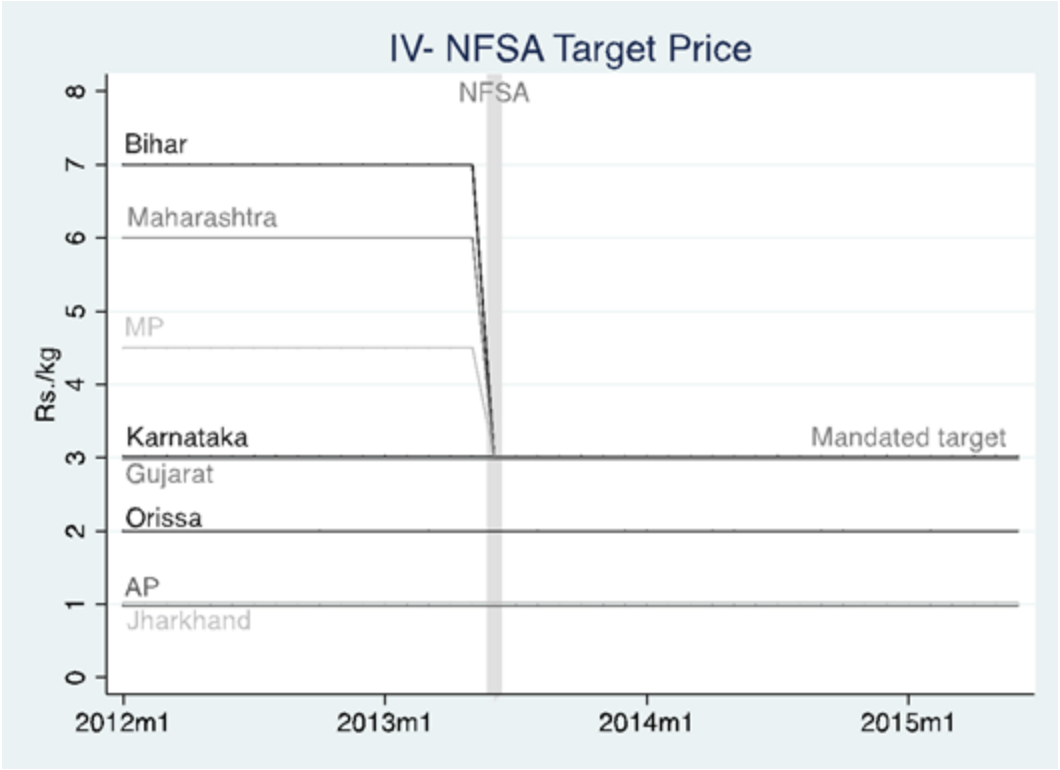
2 Timing of roll-out



Identification Strategy

Construct an IV

- Assign counterfactuals
- Out-of-compliance states did bare minimum to reach compliance (Pretend that MP reduced to 3Rs/kg)
- In-compliance states made no changes (Pretend that KN continued with 3 Rs/kg)
- All states enacted at the same time
- Excludes voluntary overshooting and timing of roll-out



Leads test

	Baseline		Leads test	
	Stunting	HAZ	Stunting	HAZ
PDS Transfer value	−0.216	0.298	−0.213	0.275
(IV: NFSA target value)	(0.087)	(0.153)	(0.083)	(0.140)
Lead of PDS transfer value			0.013	0.122
(IV: Lead of NFSA target value)			(0.169)	(0.339)
Age # year FE	X	X	X	X
State # year FE	X	X	X	X
HH-size # year FE	X	X	X	X
BPL status # year FE	X	X	X	X
HH-char # year FE	X	X	X	X
Observations	1,305	1,305	1,303	1,303

Evidence of PDS takeup

	Entitlement		
	Quantity (kg)	Price (Rs/kg)	Transfer value (in 2010 Rs)
Panel A. Effect of NFSA target on entitlement			
NFSA target	0.776	0.578	0.849
	(0.076)	(0.039)	(0.054)
F-stat			245.4
Observations	72,290	69,451	72,290
	Actual consumption		
	Quantity (kg)	Price (Rs/kg)	Transfer value (in 2010 Rs)
Panel B. Effect of entitlement on consumption			
PDS entitlement	0.485	0.444	0.684
	(0.093)	(0.116)	(0.107)
Observations	72,290	64,716	72,290

Effect on other outcomes

	log of weight	WAZ	Underweight	WHZ	Wasting	log of MUAC	MUAC-for-age z-score
PDS transfer value	0.043	0.241	−0.237	−0.023	0.016	0.038	0.274
(IV : NFSA target value)	(0.030)	(0.209)	(0.071)	(0.186)	(0.062)	(0.035)	(0.383)
Age # year FE	X	X	X	X	X	X	X
State # year FE	X	X	X	X	X	X	X
HH-size group # year FE	X	X	X	X	X	X	X
BPL status # year FE	X	X	X	X	X	X	X
HH-char # year FE	X	X	X	X	X	X	X
Observations	1,570	1,517	1,517	1,314	1,314	1,546	1,360

Effect on adults

	BMI	Underweight	Overweight	Obese
Panel A. Adult women (18 to 30)				
PDS transfer value	0.326	−0.113	0.004	0.001
(IV: NFSA target value)	(0.135)	(0.051)	(0.016)	(0.006)
Observations	1,518	1,576	1,576	1,576
Baseline mean of outcome	19.87	0.37	0.06	0.01
Panel B. Adult women (18 to 49 yrs)				
PDS transfer value	0.226	−0.029	0.023	0.009
(IV: NFSA target value)	(0.160)	(0.025)	(0.028)	(0.015)
Observations	4,241	4,482	4,482	4,482
Baseline mean of outcome	20.38	0.32	0.12	0.02
Panel C. Adult men (18 to 49 yrs)				
PDS transfer value	−0.017	−0.016	−0.019	0.001
(IV: NFSA target value)	(0.139)	(0.038)	(0.009)	(0.003)
Observations	4,225	4,361	4,361	4,361
Baseline mean of outcome	20.42	0.28	0.09	0.01

First stage

	Transfer entitlement value				
	(1)	(2)	(3)	(4)	(5)
Panel A. Individual level					
NFSA target value (IV)	0.844	0.846	0.869	0.858	0.865
	(0.045)	(0.048)	(0.045)	(0.036)	(0.034)
Individual and year FE	X	X	X	X	X
State by year FE		X	X	X	X
Hhsize-year FE			X	X	X
Rationcard-year FE				X	X
Hhchar-year FE					X
F-stat	350.2	306.7	365.3	583.1	635.1
Observations	2,118	2,118	2,118	2,106	2,103
Panel B. Household level					
NFSA target value (IV)	0.860	0.863	0.896	0.894	0.898
	(0.043)	(0.046)	(0.046)	(0.037)	(0.045)
Household and month FE	X	X	X	X	X
State by month FE		X	X	X	X
Hhsize-month FE			X	X	X
Rationcard-month FE				X	X
Hhchar-month FE					X
F-stat	400.2	357.6	375.0	570.3	389.6
Observations	72,290	72,290	72,170	72,170	71,031

Mechanisms: Food expenditure

PDS transfer improves diet quality

Table A9: Effect of PDS transfer on food budget shares

	Animal Proteins	Cereals	Fruits and Veg.	Oils
PDS Transfer value	0.012**	-0.034***	0.000	0.003
(IV : NFSA value)	(0.006)	(0.005)	(0.006)	(0.003)
Observations	31859	31726	31859	31389
Baseline mean (in %)	10.0	27.0	14.7	8.7
Change from PDS expansion (in levels)	0.36	-1.02		
Change from PDS expansion (in %)	3.6%	-3.8%		

Large nutrition literature shows proteins from animal sources such as milk, meat, and eggs are associated with improved linear growth (Murphy and Allen 2003)

Price effects

Table A11: Effect of PDS transfer on local prices

	Market prices in first difference log * 100			
	Rice and wheat		Rice	Wheat
	(1)	(2)	(4)	(5)
Average effects				
Village avg transfer value	-0.056		-0.055	-0.041
(IV : Village avg target value)	(0.052)		(0.053)	(0.044)
Heterogeneity by Price Integration				
Below Median X PDS Transfer		-0.083*		
		(0.047)		
Above Median X PDS Transfer		-0.045		
		(0.054)		
Observations	1731	1731	1587	1486
Effect size : Below Median - Above median		-0.039		
		(0.037)		
H_0 : Below median = Above median (p-value)		0.296		

Null effects on local prices, but we are underpowered to detect effects of small to moderate size due to the limited amount of cross-village variation in average PDS transfers