No Free Lunch: Using Technology to Improve the Efficacy of School Feeding Programs

Brookings, Delhi

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Welfare Programs in Developing Countries

- Leakages and inefficiencies in social welfare programs.
- Benefits often do not reach the intended beneficiaries (World Bank, 2003).
- Institutional capacity to implement programs is thin enough to being labelled 'Failing' (Pritchett, 2009).
- This results in undermining of development outcomes.
- Revamping the entire system is costly and implausible.
- Are there scalable, low cost mechanisms to improve current institutional capacity?

Related Literature

- Incentive to teachers based on attendance (Duflo, Hanna, and Ryan 2012)
- Biometric attendance technology improved attendance of public health workers by 15 percent (Dhaliwal and Hanna, 2016)
- Biometrically-authenticated payments lead to a reduction in leakages in public programs (Muralidharan, Niehaus, Sukhtankar, 2016)
- Community monitoring versus audits (Olken, 2007)

Context and Study

- MDM, initiated in 1995 to combat malnutrition among school going children.
- Entitles each enrolled child to a meal on the school premises each day
  - $\rightarrow$ Currently benefits 120 million primary school going children.
- Anecdotal evidence that the program is fraught with leakages.
- Challenge: Information provided by middle level bureaucrats for performance assessment.
- Room for siphoning and over reporting beneficiary take up.
- How to improve information flow from grass root level to the top tier?

The Policy Reform

- In 2012, Bihar side stepped the beneficiary take-up information provided by the middle tier of the delivery machinery and introduced IVRS.
- IVRS is a fully automated platform that calls one school teacher in every school every day to record provision of meal.
- Reasons to expect Improvements.
  - → Information provided by the middle tier can be cross tallied.
  - → Non performing schools can be identified and middle tier bureaucrats held accountable for improving the cases.
  - → Beneficiary take up information is accessible to the public through a web-interface.

Main Empirical Challenges

- We can examine changes within districts of Bihar before and after the program.
- Eliminates concerns that time invariant districts characteristics (eg. distance from the capital) could be confounding the effects.
- But cannot rule out that unobserved secular trends are responsible for changes that we are falsely attributing to the policy.
- Use districts from the neighboring states with comparable profiles as controls.

Main Empirical Challenges

- Compare outcomes in Bihar districts before and after the policy change to the control districts (DiD)
- Control for a wide variety of time varying controls variables
- Further allay selection concerns by:
  - $\rightarrow$ Estimating a generalized DiD (matching on baseline characteristics and then carrying out DiD)
  - $\rightarrow$ Control for district-specific trends

Road Map

- Background about the MDM delivery system and the IVRS reform.
- Data and Contextual Information.
- Estimation Strategy.
- Results.
- Robustness Checks.
- Concluding remarks.

Mid Day Meals

- 1995: The National Program of Nutritional Support to Primary Education launched.
- 2004: Transition from raw grains to cooked meals.
- 2006: Major changes in the program introduced.
  - → Micronutrients added to the program
  - → Minimum calorie requirements increased.
  - → Coverage expanded to include upper primary grades in Government and Government aided schools.
- Central government provides free grains, while state governments share cooking costs (conversion costs)
- Grants to schools are either recurring and/or non-recurring.
- These grants vary by school.

Fund Flow

- Schools report their annual requirement to Block Resource Persons.
  - → Reports include the number of beneficiaries, details of meals served, and the status of funds and food grains supplied.
- Block officials submit these to district offices and ultimately to the state mid day meal director.
- These data are aggregated at the block, district, and state levels.
- Based on these aggregated reports, state governments prepare an Annual Work Plan and Budget (AWP&B) and submit them to the Project Approval Board for review and approval.
- Actual allocations and release of funds are based on the PAB approvals.
- Sanctioned funds flow back to the schools following the same channel.

IVRS

- Each school had to register cellular numbers of 5 teachers.
- The IVRS calls any one of the five teachers and collects data on the numbers of meals served in each school every day.
- If no meals were served the teacher is supposed to press 0 and provide reason for the same.
- In 2012, over 99 percent of a total of 70,000 head masters had a mobile phone. ▸ Headmasters with Mobile Phones
- After completing the calls a software summarizes the data at the district, block, village, and school level.
  - → District level reports are e-mailed and texted to District Magistrates.
  - → Block level reports are sent to the Block Education Officer.
  - → Uploaded on a publicly accessible web-site.

Flow of Beneficiary Information

Who: School Head Master
What: Beneficiary take-up, funds and grain use data
How-Manually
To Who: a) BRP for the MDM system (every month) ,
b)Administration of the District System for Education (every year)

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How: Manually or in MIS
To Who: district in charge.
Other functions: BRP also periodically audit schools to verify school reports

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Directorate: then releases funds and food grains

Flow of Beneficiary Information

Who: School Head Master / Teachers
What: Delivered MDM? If not, why?
How: Automated IVRS
To Who: Cloud (every day)

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Data Sources - Independent Assessment

- Main data - Annual Status of Education Report (ASER).
- Period choice 2009-13 for five states in India: Bihar, Chhattisgarh, Jharkhand, Orissa, and Madhya Pradesh.
- Repeated cross section at school and household level.
- For each village surveyed under ASER, one government school (if any) is inspected randomly.
- For each of the inspected schools ASER collected:
  - → MDM was served in the school on the date of interview.
  - → If interviewer found any evidence of meals being served.
  - → If interviewer saw food being cooked.
  - → School infrastructure.
- The sample includes 5041 schools for Bihar and 19771 schools for the five states.

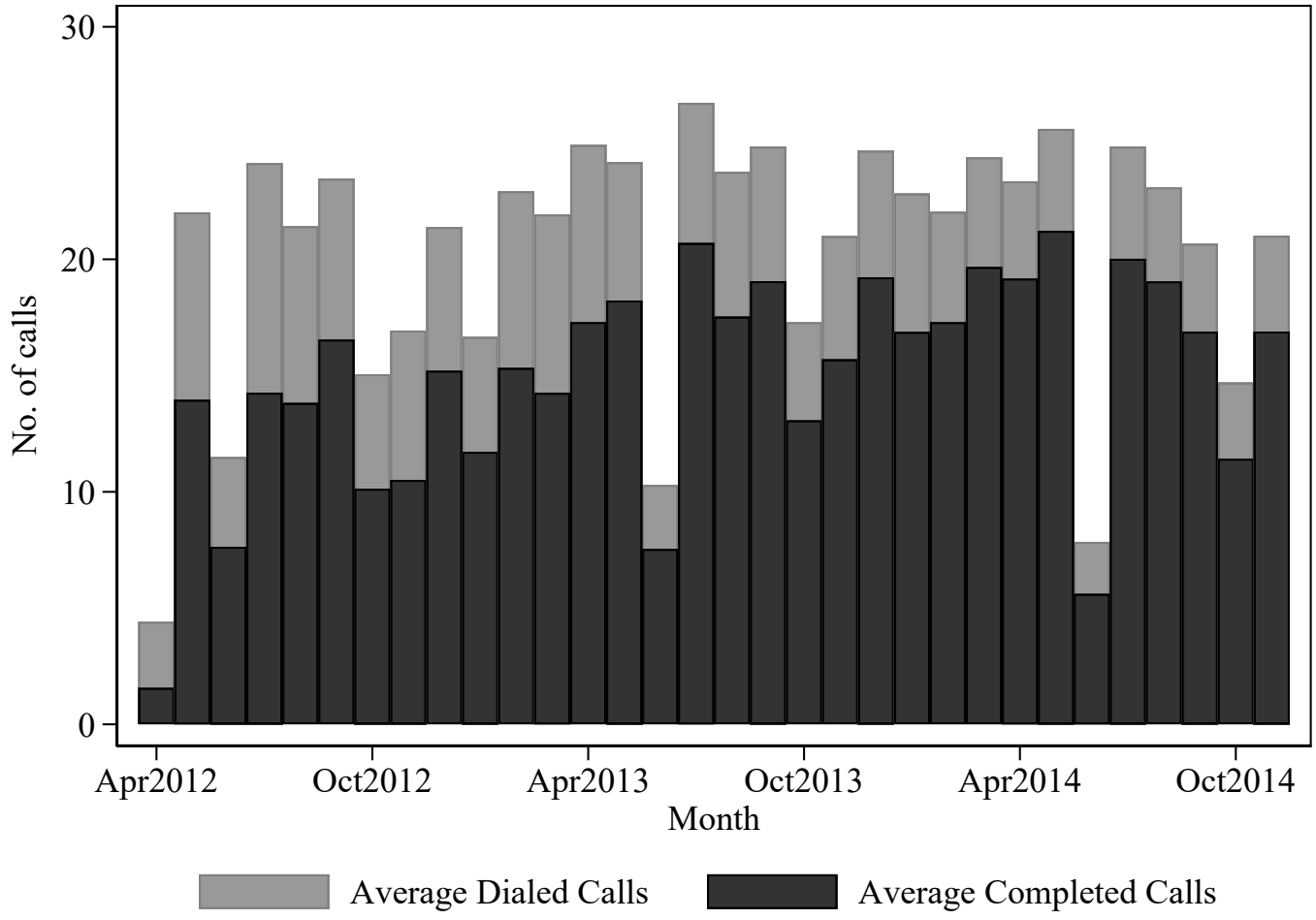
Data Sources - State Official Data

- District level *Annual Work Plan Budgets* (AWPB) submitted by the state midday meal authorities to the Government of India.
- Variables:
  - → Total number of schools serving midday meals
  - → Children availing meals
  - → Amount of rice consumed
  - → Cooking cost
  - → Expenditure on cook's wages
- Our Bihar data has 38 districts and 189 district-year observations. Our event study analysis is based on this sample.
- Overall, there are 157 districts and 785 district-year observations in our sample of five states.

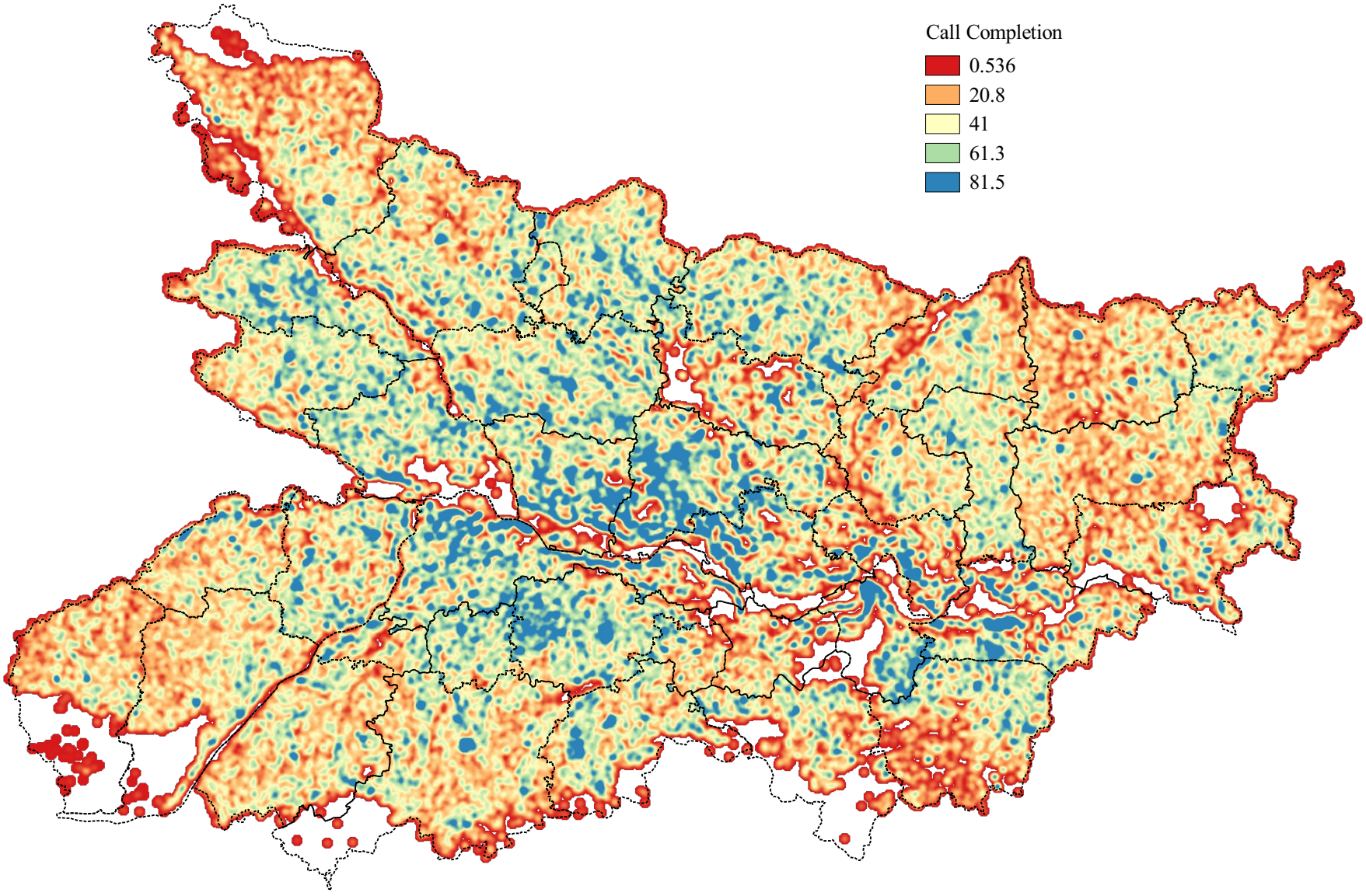
Summary Statistics

	Bihar			All states		
	Obs	Mean	S.D.	Obs	Mean	S.D.
Panel A: AWPB Data.						
Percent of schools serving MDM: Primary	228	99.01	2.39	948	99.58	1.62
Percent of schools serving MDM: Upper Primary	228	98.63	2.71	932	99.57	1.64
Percent of students availing MDM: Primary	228	91.01	12.79	948	88.31	37.74
Percent of students availing MDM: Upper Primary	228	88.62	15.42	948	86.02	26.47
Rice consumption (in M.T.): Primary	228	2892.95	1438.61	832	1791.64	1365.34
Rice consumption (in M.T.): Upper Primary	228	1438.96	889.73	832	1056.91	822.21
Cooking cost (in Million Rs.): Primary	228	89.58	49.23	948	63.15	38.48
Cooking cost (in Million Rs.): Upper Primary	224	46.17	30.69	944	58.73	95.10
Panel B: ASER School Level Data.						
School provides meals	6105	0.65	0.48	23980	0.84	0.37
Meals were cooked on the day of visit	6069	0.58	0.49	23781	0.73	0.44
Tap or hand-pump for drinking water	6153	0.93	0.25	24236	0.88	0.32
No. of teachers appointed	4815	2.76	2.85	18178	2.64	2.52
No. of teachers present	4815	2.23	2.29	18178	2.18	2.08
Common toilet in the school	4937	0.53	0.50	19576	0.48	0.50
Separate boys toilet in the school	5175	0.62	0.48	20335	0.60	0.49
Separate girls toilet in the school	5306	0.66	0.47	20740	0.65	0.48
School has boundary wall	6098	0.49	0.50	23977	0.42	0.49

Monthly Average Dialed and Completed Calls



Call Completion Rates



Estimation

Event study framework (within Bihar)

$$y_{dt} = \alpha_0 + \sum_{-3 \leq k \leq 1} \alpha_k \times \text{IVRS operational for } k \text{ periods} + \alpha_X X_{dt} + \delta_d + \epsilon_{dt}$$

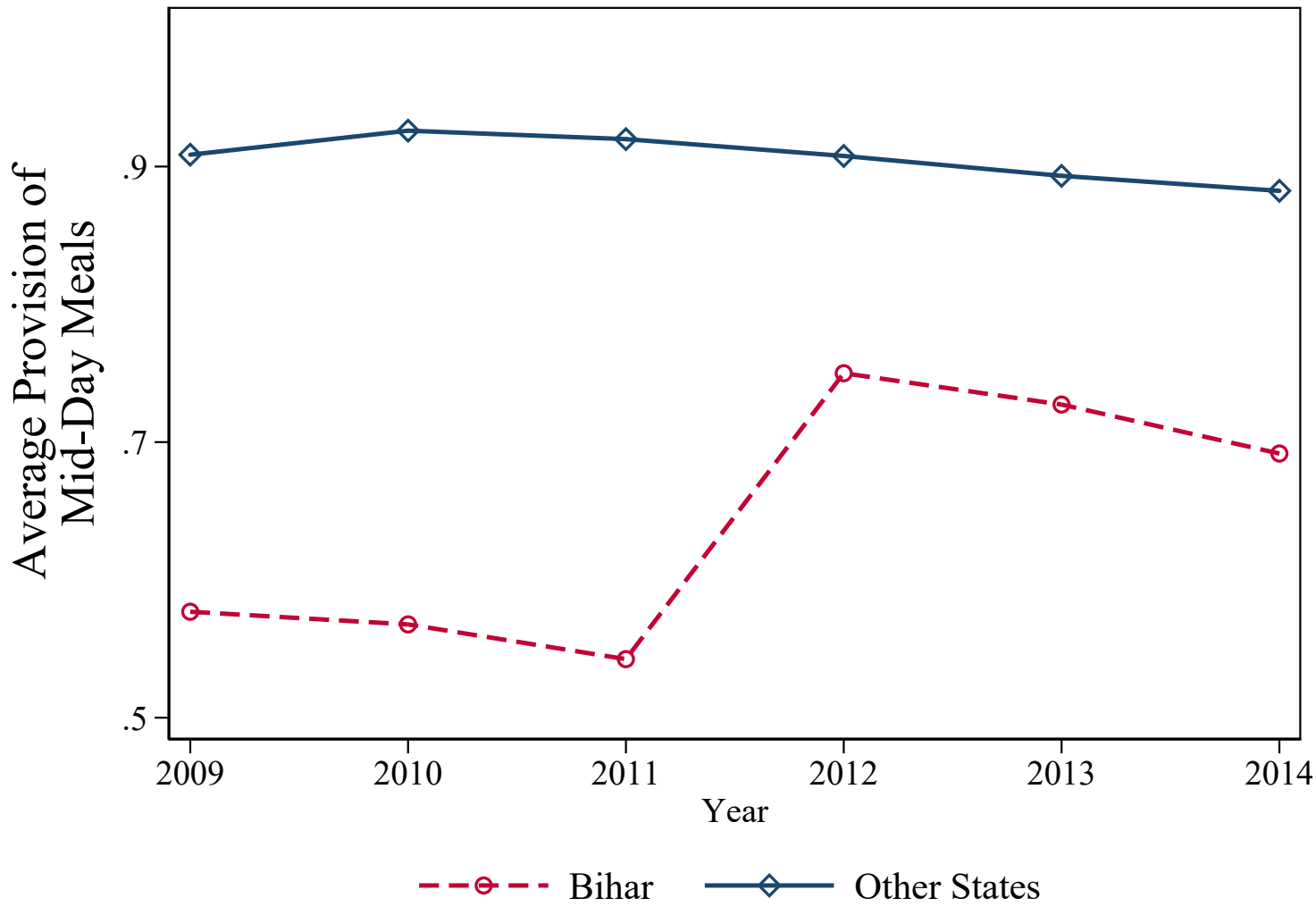
- y_{dt}: Outcome variable for district d in year t
- X_{dt}: Average school characteristics for district d in year t
- δ_d: District fixed effects

Diff-in-Diff framework

$$y_{dt} = \beta_0 + \sum_{-3 \leq k \leq 1} \beta_k \times \text{Bihar} \times \text{IVRS operational for } k \text{ periods} + \beta_X X_{dt} + \delta_d + \eta_{dt}$$

Mid-Day Meals in Primary Schools

Figure: Percentage of Schools Providing Meals in Bihar and Other States Over Time (ASER Data)



Event Study: MDM in Schools, ASER Data

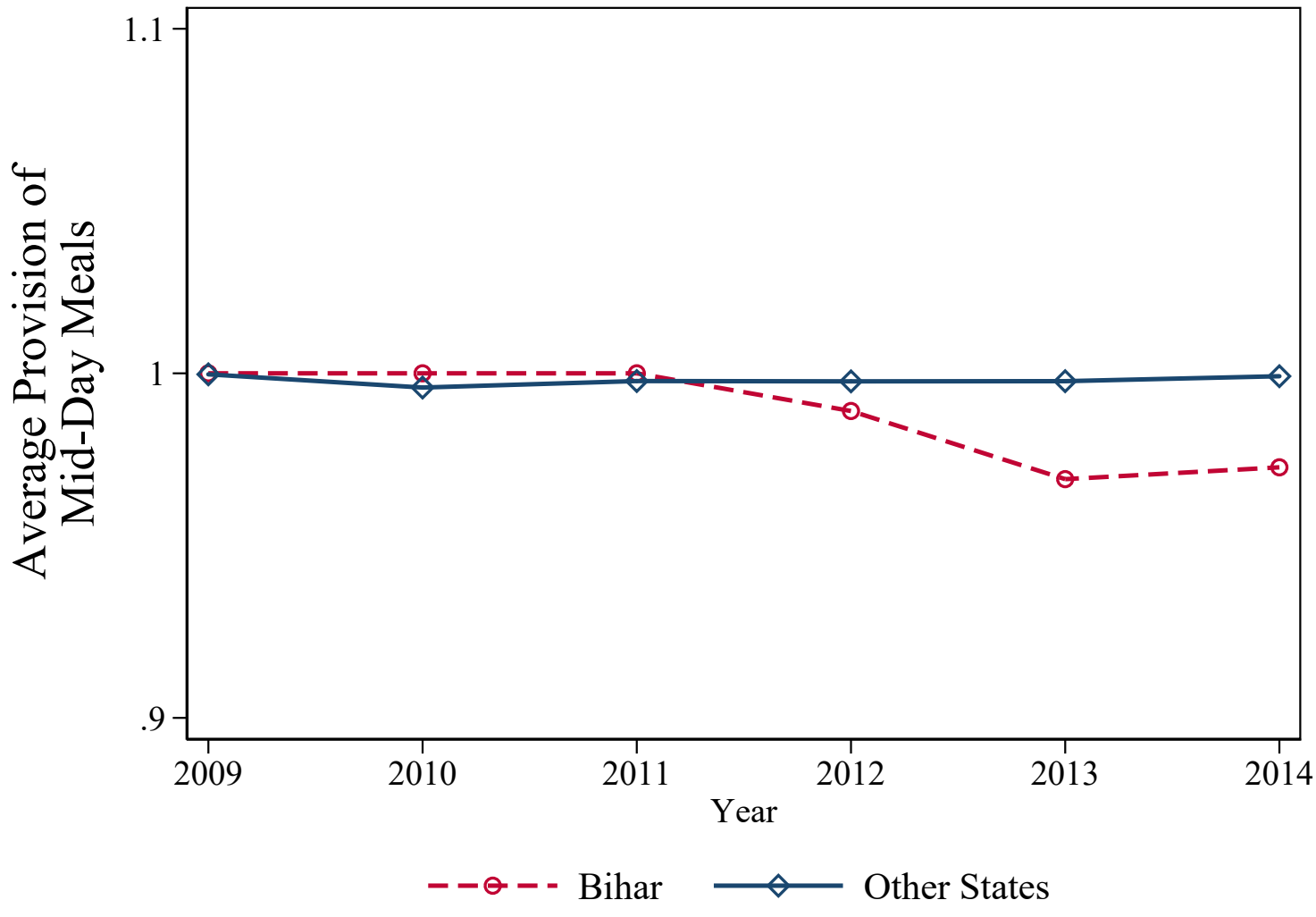
Dependent Var.	School Provides Meal		MDM Cooked	
Baseline average	56.203	56.203	50.309	50.309
	(1)	(2)	(3)	(4)
Two years before IVRS	-0.63	-0.88	3.64	4.63
	(3.52)	(3.63)	(3.54)	(3.83)
One year before IVRS	-3.47	-5.94	2.40	0.48
	(3.97)	(3.89)	(4.17)	(3.95)
IVRS year	17.4***	13.8***	18.5***	15.3***
	(3.47)	(3.52)	(4.11)	(4.07)
One year after IVRS	15.0***	10.5**	14.4***	10.6**
	(4.21)	(4.33)	(4.62)	(4.51)
Two years after IVRS	11.4**	7.38*	15.0***	11.8***
	(4.37)	(4.14)	(4.70)	(4.32)
Post IVRS - Pre IVRS	18.47***	16.4***	12.01**	10.12**
School Characteristics	No	Yes	No	Yes
R Squared	0.067	0.069	0.074	0.081
No. of Observations	6105	4854	6069	4828

DiD: MDM in Schools, ASER Data

Dependent Var.	School Provides Meal		MDM Cooked	
Baseline average	56.203	56.203	50.309	50.309
	(1)	(2)	(3)	(4)
Bihar × 2010	-2.38	-2.98	-5.81	-6.13
	(3.62)	(3.69)	(3.87)	(4.16)
Bihar × 2011	-4.82	-6.44	-6.17	-8.27*
	(4.07)	(3.96)	(4.50)	(4.24)
Bihar × 2012	17.5***	15.9***	19.3***	16.8***
	(3.63)	(3.66)	(4.50)	(4.50)
Bihar × 2013	16.3***	13.8***	17.4***	14.1***
	(4.37)	(4.47)	(4.95)	(4.94)
Bihar × 2014	13.8***	11.6***	18.2***	15.5***
	(4.59)	(4.44)	(5.13)	(4.92)
Post IVRS - Pre IVRS	21.14***	20.28***	23.61***	22.41**
School Characteristics	No	Yes	No	Yes
R Squared	0.149	0.147	0.110	0.114
No. of Observations	23980	18798	23781	18667

Mid-Day Meals in Primary Schools

Figure: Percentage of Schools Providing Meals in Bihar and Other States Over Time (AWPB Data)



Event Study: MDM in Schools, AWPB Data

Dependent Variable	Percentage of Schools Serving MDM		Percentage of Enrolled Children Availing MDM	
	Primary	Upper Primary	Primary	Upper Primary
Baseline average	100	100	100	100
	(1)	(2)	(3)	(4)
Two years before IVRS	-0.00	-0.00	-0.00	-0.00
	(0.25)	(0.23)	(0.31)	(0.57)
One year before IVRS	-0.00	-0.00	-0.00	0.00
	(0.25)	(0.23)	(0.31)	(0.57)
IVRS year	-1.01**	-1.24**	-4.91***	-6.74***
	(0.50)	(0.59)	(0.31)	(1.83)
One year after IVRS	-1.37***	-5.33***	-34.08***	-36.73***
	(0.43)	(0.34)	(1.01)	(1.19)
Two years after IVRS	-3.55***	-1.64***	-14.97***	-24.81***
	(0.42)	(0.32)	(0.55)	(0.57)
Post IVRS - Pre IVRS	-1.37***	-5.33***	-34.08***	-36.73***
R Squared	0.451	0.600	0.956	0.890
No. of Observations	228	228	228	228

DiD: MDM in Schools, AWPB Data

Dependent Variable	Percentage of Schools Serving MDM		Percentage of Enrolled Children Availing MDM	
	Primary	Upper Primary	Primary	Upper Primary
Baseline average	100	100	100	100
	(1)	(2)	(3)	(4)
Bihar × 2010	0.49**	0.16*	2.77	4.56
	(0.21)	(0.09)	(7.39)	(4.83)
Bihar × 2011	0.18*	0.15*	-3.15	5.37
	(0.09)	(0.09)	(5.30)	(3.70)
Bihar × 2012	-0.67	-1.03	-9.50	-20.4***
	(0.54)	(0.71)	(6.56)	(4.88)
Bihar × 2013	-1.07**	-5.08***	-41.6***	-47.6***
	(0.52)	(0.40)	(4.26)	(3.34)
Bihar × 2014	-3.43***	-1.60***	-29.2***	-37.6***
	(0.51)	(0.33)	(1.92)	(2.48)
Post IVRS - Pre IVRS	-1.25**	-5.22***	-38.41***	-52.94***
R Squared	0.399	0.560	0.407	0.402
No. of Observations	947	931	947	947

DiD: All Districts

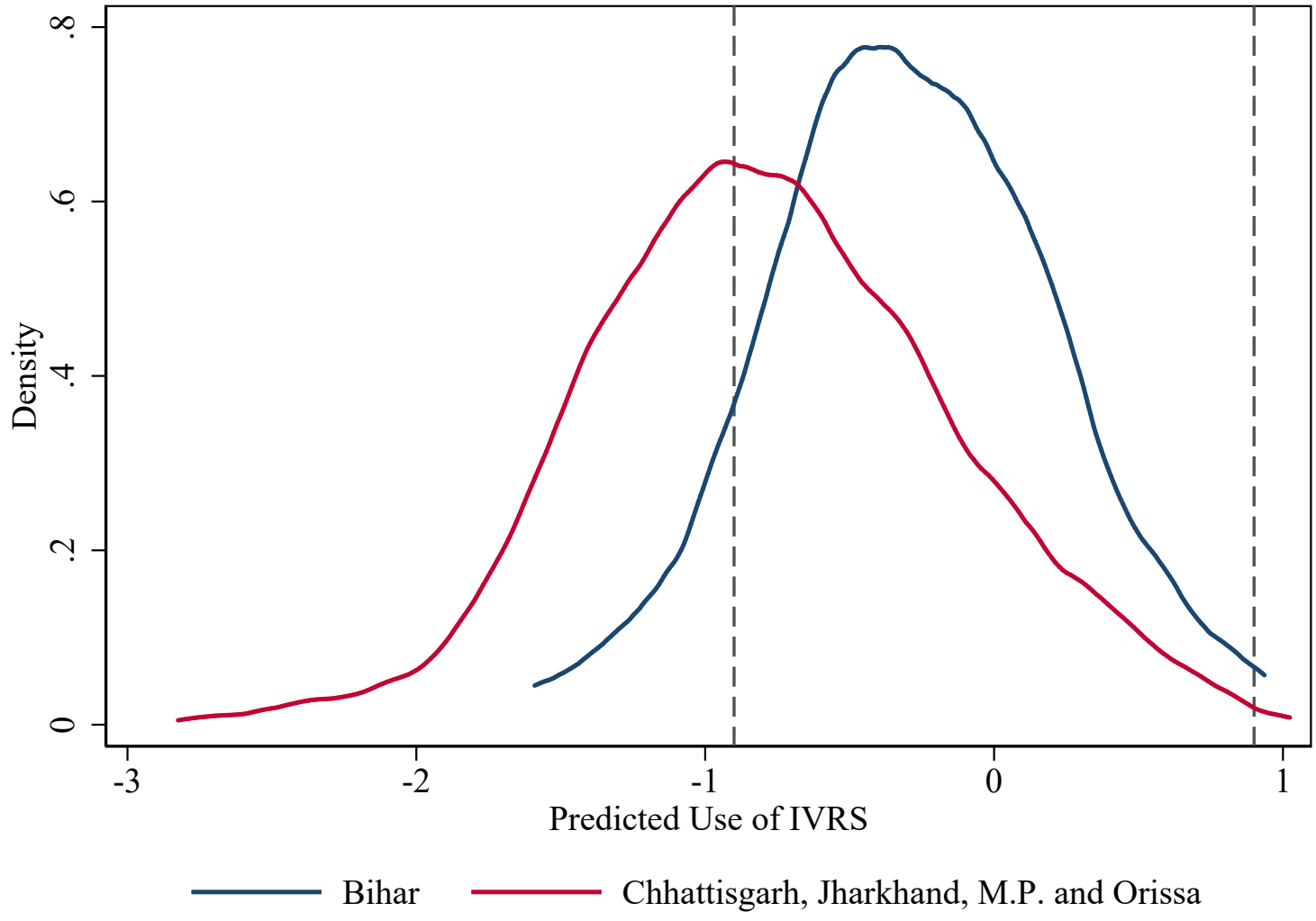
Dependent Var.	School Provides Meal	MDM Cooked
Bihar × Post	0.23***	0.27***
	(0.05)	(0.05)
R Squared	0.651	0.570
No. of Observations	891	891

DiD: All Districts with Dist. Specific Trend

Dependent Var.	School Provides Meal	MDM Cooked
Bihar × Post	0.23***	0.26***
	(0.06)	(0.06)
R Squared	0.760	0.691
No. of Observations	891	891

Generalized DiD

Figure: Common Support in Predicted Probability of Use of IVRS



Covariate Balance: On Common Support

	Control		Bihar				
	Obs. (1)	Avg. (2)	Obs. (3)	Avg. (4)	Diff. (5)	t-stat (6)	p-values (7)
Panel A: Districts on the Common Support							
Tap or hand-pump for drinking water	122	0.904	80	0.912	0.008	0.86	0.3883
No. of Teachers appointed	122	2.863	80	3.092	0.229	1.6	0.1105
No. of Teachers present	122	2.39	80	2.523	0.133	1.06	0.2887
Common toilet in the school	122	0.596	80	0.633	0.037	1.38	0.1681
Separate boys toilet in the school	122	0.512	80	0.508	-0.004	0.14	0.8883
Separate girls toilet in the school	122	0.531	80	0.521	-0.011	0.38	0.7053
School has boundary wall	122	0.461	80	0.489	0.028	1.38	0.1689

DiD: Districts on Common Support

Dependent Var.	School Provides Meal	MDM Cooked
Bihar × Post	0.26***	0.28***
	(0.05)	(0.06)
R Squared	0.691	0.616
No. of Observations	583	583

Covariate Balance: Propensity Score Weighted

	Control		Bihar				
	Obs. (1)	Avg. (2)	Obs. (3)	Avg. (4)	Diff. (5)	t-stat (6)	p-values (7)
Panel B: Propensity Score Weighted Covariate Balance							
Tap or hand-pump for drinking water	331	0.907	111	0.902	-0.004	0.6	0.5517
No. of Teachers appointed	331	3	111	3.105	0.105	0.94	0.3489
No. of Teachers present	331	2.471	111	2.511	0.04	0.43	0.6697
Common toilet in the school	331	0.613	111	0.618	0.005	0.28	0.7763
Separate boys toilet in the school	331	0.521	111	0.518	-0.003	0.15	0.8839
Separate girls toilet in the school	331	0.544	111	0.53	-0.014	0.66	0.5096
School has boundary wall	331	0.47	111	0.467	-0.003	0.18	0.8554

DiD: Propensity Score Weighted Results

Dependent Var.	School Provides Meal	MDM Cooked
Bihar × Post	0.18***	0.24***
	(0.03)	(0.03)
R Squared	0.508	0.322
No. of Observations	888	888

Event Study: Rice Consumed & Lifted

Dependent Variable	Rice Consumed (in M.T.)		Rice Lifted (in M.T.)	
	Primary	Upper Primary	Primary	Upper Primary
Baseline average				
	(1)	(2)	(3)	(4)
Two years before IVRS	344.1	83.0	-179.3	-221.8*
	(220.29)	(86.22)	(174.05)	(127.05)
One year before IVRS	31.2	114.9	-868.2***	-317.9***
	(185.60)	(119.76)	(169.21)	(114.95)
IVRS year	550.9***	429.6***	398.1**	264.8**
	(172.84)	(96.69)	(177.97)	(120.51)
One year after IVRS	1437.0***	1244.9***	1294.1***	908.1***
	(254.63)	(169.73)	(258.25)	(174.33)
Two years after IVRS	1326.9***	1172.2***	1733.0***	1339.1***
	(259.03)	(169.99)	(305.43)	(204.74)
Post IVRS - Pre IVRS	2162.29	1226.04	2162.3***	1226***
R Squared	0.721	0.746	0.801	0.754
No. of Observations	228	228	228	228

DiD: Rice Consumed & Lifted

Dependent Variable	Rice Consumed (in M.T.)		Rice Lifted (in M.T.))	
	Primary	Upper Primary	Primary	Upper Primary
Baseline average				
	(1)	(2)	(3)	(4)
Bihar × 2010	311.5	-33.6	-130.2	-304.0**
	(287.17)	(105.87)	(316.27)	(137.37)
Bihar × 2011	129.0	110.0	-789.9**	-343.8**
	(284.66)	(163.02)	(338.60)	(139.61)
Bihar × 2012	461.5*	111.0	407.0	75.5
	(250.08)	(121.51)	(290.61)	(139.08)
Bihar × 2013	1367.0***	961.1***	1332.4***	686.5***
	(320.31)	(191.33)	(348.31)	(192.11)
Bihar × 2014	1516.1***	1090.4***	1935.2***	1280.8***
	(337.18)	(185.50)	(402.54)	(219.17)
Post IVRS - Pre IVRS	2122.36***	1030.31***	2122.3***	1030.3***
R Squared	0.876	0.863	0.887	0.852
No. of Observations	797	797	831	830

Effects on Enrollment

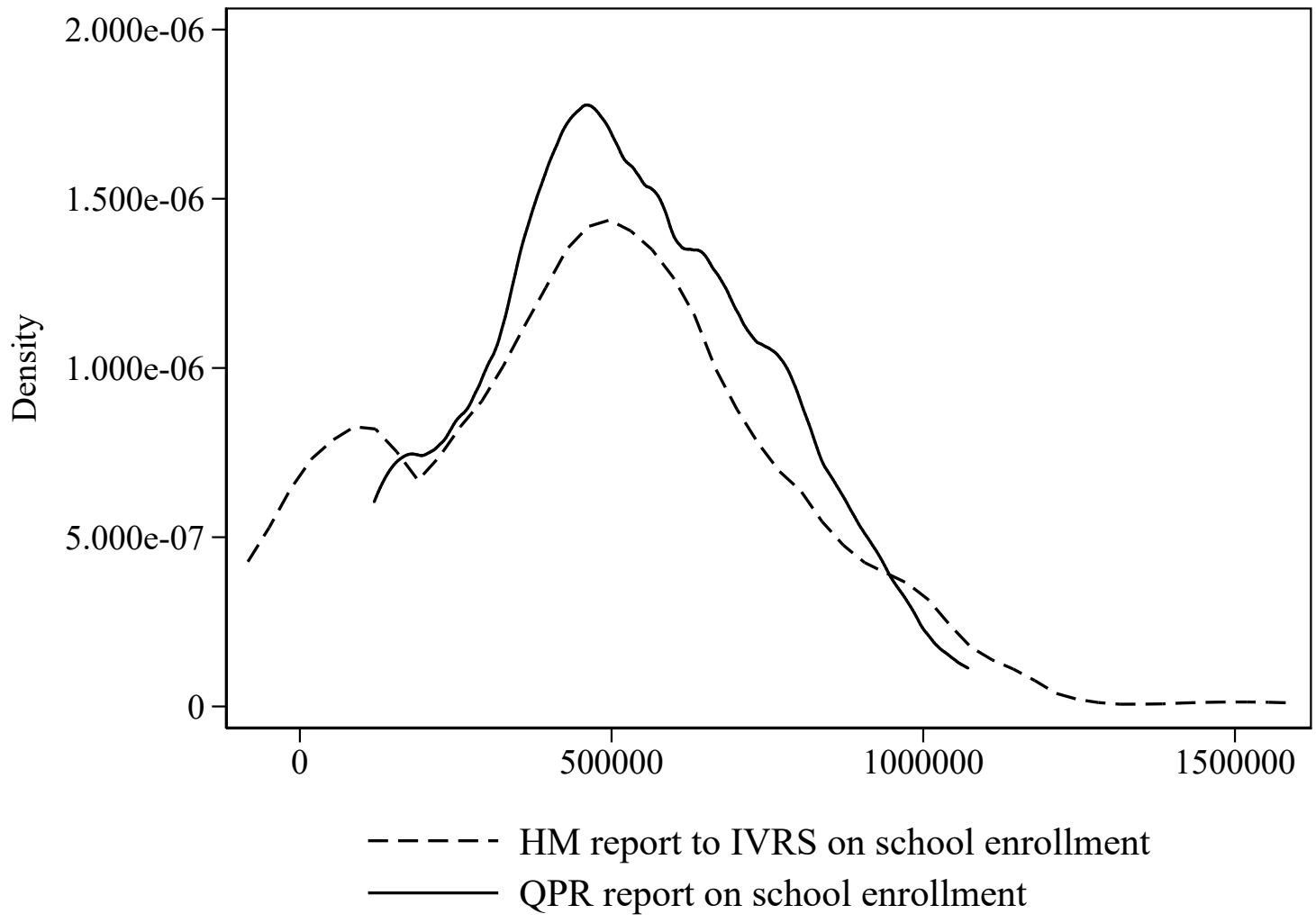
Grade	1	2	3	4	5
Baseline average	68.02	67.94	69.63	66.16	61.1
Bihar × (t - 2009) $[\gamma_1]$	-4.19***	-0.91	0.67	3.43***	4.27***
	(1.29)	(1.25)	(1.32)	(1.09)	(1.21)
Bihar × (t - 2012) × Post 2012 $[\gamma_2]$	6.17***	2.57*	-0.72	-3.01*	-2.60*
	(1.48)	(1.55)	(1.82)	(1.52)	(1.55)
Bihar × Post 2012 $[\gamma_3]$	-6.03**	-8.53***	-12.0***	-14.4***	-13.4***
	(2.56)	(2.36)	(2.60)	(2.63)	(2.85)
R Squared	0.414	0.430	0.417	0.418	0.385
No. of Observations	18571	18574	18607	18591	18502
$\gamma_1 + \gamma_2$	1.98	1.66	-0.05	0.42	1.68
p-value	0.00	0.03	0.96	0.60	0.03

Effects on Attendance

Grade	1	2	3	4	5
Baseline average	38.53	36.39	36.68	34.76	32
Bihar × (t - 2009) $[\gamma_1]$	-1.79***	-1.45**	-2.01***	-1.40***	-1.65***
	(0.63)	(0.60)	(0.54)	(0.51)	(0.53)
Bihar × (t - 2012) × Post 2012 $[\gamma_2]$	1.39**	1.00	1.06*	0.14	0.49
	(0.68)	(0.63)	(0.62)	(0.58)	(0.62)
Bihar × Post 2012 $[\gamma_3]$	6.65***	5.02***	6.06***	4.75***	5.42***
	(1.29)	(1.43)	(1.30)	(1.30)	(1.30)
R Squared	0.763	0.715	0.690	0.690	0.686
No. of Observations	18571	18574	18607	18591	18502
$\gamma_1 + \gamma_2$	-0.39	-0.45	-0.95	-1.26	-1.16
p-value	0.28	0.18	0.01	0.00	0.01

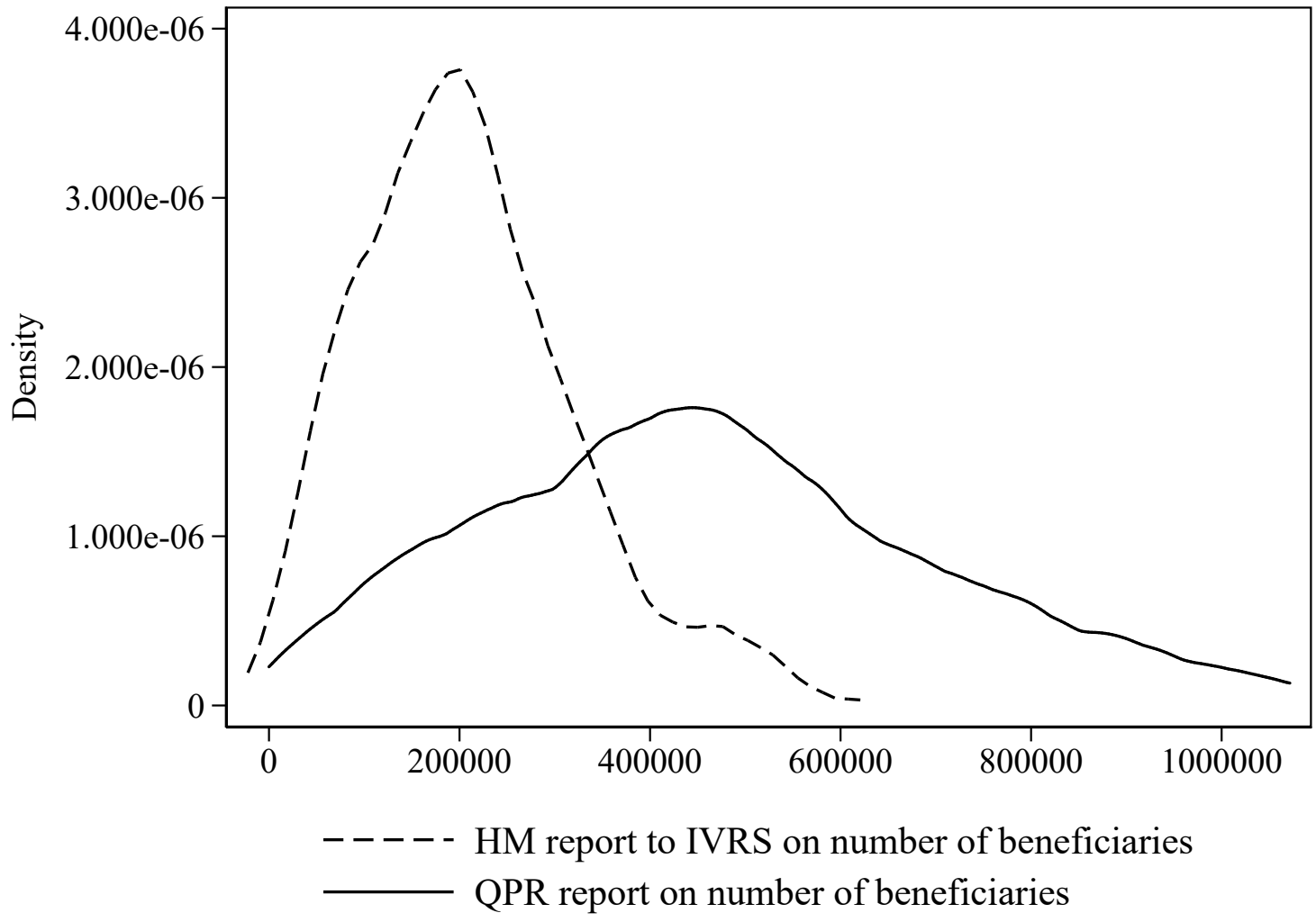
Comparison: IVRS vs QPR

Figure: Distribution of Enrollment



Comparison: IVRS vs QPR

Figure: Distribution of Beneficiaries



Quantity-Quality Tradeoff?

Dependent Variable	Fraction of Schools Observed Serving			
	Good Quality Meals (1)	Bad Quality Meals (2)	Sufficient Quantity Meals (3)	Insufficient Quantity Meals (4)
Bihar × Post	0.47***	-0.67***	0.48**	-0.60***
	(0.02)	(0.03)	(0.11)	(0.07)
R Squared	0.339	0.576	0.562	0.610
No. of Observations	180	180	180	180

Effect of IVRS on Attendance and Meals Served

Dependent Variable	Average Daily Attendance	Average Daily Meals	Average Daily Attendance over Enrollment	Average Daily Meals over Enrollment
	(1)	(2)	(3)	(4)
Panel A: Number of Completed Calls				
No. of Completed Calls	0.622***	0.910***	0.210***	0.304***
	(0.12)	(0.10)	(0.04)	(0.03)
No. of Observations	1848321	1979727	1841305	1972677
R Squared	.81	.735	.391	.425
Average over treatment period	169	126	60	46
Percentage Impact	9.2	18	8.8	16
Panel B: Intensity of Completed Calls				
Completed Call Intensity	0.144***	0.227***	0.047***	0.075***
	(0.03)	(0.02)	(0.01)	(0.01)
No. of Observations	1848321	1979727	1841305	1972677
R Squared	.81	.735	.391	.425
Average over treatment period	169	126	60	46
Percentage Impact	8.5	18	7.9	16

Effect of IVRS on Probability of MDM Provision

Average	90.542	90.542
	(1)	(2)
Completed Call Intensity	0.011*	
	(0.01)	
No. of Completed Calls		0.056*
		(0.03)
R Squared	0.791	0.791
No. of Observations	256426	256426

Effects of School Characteristics on Completed Calls

Average	14.688	14.688	14.688
	(1)	(2)	(3)
Primary with Upper Primary	-0.97***		
	(0.14)		
Primary with Upper Primary and Secondary	0.21		
	(0.41)		
Upper Primary Only	-1.17***		
	(0.23)		
Upper Primary with Secondary	-0.74**		
	(0.30)		
Urban	-0.52***		
	(0.17)		
Girls	2.85***		
	(0.81)		
Co-educational	1.70***		
	(0.45)		
Shift school	-0.30		
	(0.18)		
Distance from District HQ	0.0026		
	(0.00)		
School enrollment (DISE)	-0.0062***	-0.00017	-0.00026
	(0.00)	(0.00)	(0.00)
No. of Teachers	0.070	0.0040	0.042**
	(0.05)	(0.02)	(0.02)
No. of Classrooms	0.58***	0.053***	0.0087
	(0.09)	(0.01)	(0.01)
No. of Common Toilets	0.011	0.034	0.045
	(0.15)	(0.02)	(0.05)
No. of Girls Toilets	-0.22	-0.018	-0.0032
	(0.67)	(0.04)	(0.07)
No. of Boys Toilets	2.62***	0.074*	0.057
	(0.55)	(0.04)	(0.07)
Boundary wall	0.16***	0.0046	-0.0086
	(0.02)	(0.01)	(0.01)
Access to Tap Water	-0.29	0.081	0.062
	(0.27)	(0.15)	(0.19)
Number of Blackboards	-0.057***	0.015***	-0.029***
	(0.02)	(0.00)	(0.01)
School FEs		✓	✓
Academic Year FEs		✓	✓
School-specific TTs			✓
R Squared	0.109	0.894	0.954
No. of Observations	230515	230366	230366

DiD Estimates on Arithmetic Test: Public Schools

Grade	1	2	3	4	5
Baseline average	1.78	2.51	3.14	3.7	4.09
Bihar × (t - 2009) $[\gamma_1]$	0.17***	0.13***	0.21***	0.23***	0.25***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
Bihar × (t - 2012) × Post 2012 $[\gamma_2]$	-0.21***	-0.18***	-0.29***	-0.24***	-0.28***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Bihar × Post 2012 $[\gamma_3]$	-0.14**	-0.086	-0.15	-0.21***	-0.18**
	(0.06)	(0.08)	(0.09)	(0.08)	(0.08)
R Squared	0.152	0.154	0.205	0.232	0.224
No. of Observations	59993	55869	56553	52612	58026
$\gamma_1 + \gamma_2$	-0.04	-0.04	-0.08	-0.01	-0.03
p-value	0.04	0.08	0.00	0.69	0.34

DiD Estimates on Reading Test: Public Schools

Grade	1	2	3	4	5
Baseline average	1.76	2.52	3.17	3.78	4.18
Bihar × (t - 2009) $[\gamma_1]$	0.18***	0.14***	0.24***	0.22***	0.23***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Bihar × (t - 2012) × Post 2012 $[\gamma_2]$	-0.23***	-0.21***	-0.33***	-0.24***	-0.25***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Bihar × Post 2012 $[\gamma_3]$	-0.17**	-0.15*	-0.26**	-0.29***	-0.24***
	(0.07)	(0.09)	(0.10)	(0.09)	(0.09)
R Squared	0.160	0.151	0.172	0.174	0.153
No. of Observations	60423	56142	56782	52837	58190
$\gamma_1 + \gamma_2$	-0.05	-0.06	-0.09	-0.01	-0.02
p-value	0.01	0.02	0.00	0.68	0.53

DiD Estimates on Arithmetic Test: Private Schools

Grade	1	2	3	4	5
Baseline average	2.6	3.39	3.93	4.22	4.48
Bihar × (t - 2009) $[\gamma_1]$	0.12**	0.062	0.27***	0.25***	0.18***
	(0.05)	(0.06)	(0.08)	(0.06)	(0.05)
Bihar × (t - 2012) × Post 2012 $[\gamma_2]$	-0.0071	0.092	-0.24**	-0.086	-0.11
	(0.08)	(0.08)	(0.10)	(0.08)	(0.09)
Bihar × Post 2012 $[\gamma_3]$	0.022	-0.050	-0.20	-0.35**	-0.16
	(0.12)	(0.16)	(0.17)	(0.17)	(0.17)
R Squared	0.242	0.239	0.233	0.212	0.185
No. of Observations	10588	9258	7713	6828	6582
$\gamma_1 + \gamma_2$	0.11	0.15	0.03	0.16	0.08
p-value	0.06	0.01	0.59	0.01	0.33

DiD Estimates on Reading Test: Private Schools

Grade	1	2	3	4	5
Baseline average	2.63	3.45	4.06	4.3	4.54
Bihar × (t - 2009) $[\gamma_1]$	0.19***	0.072	0.25***	0.15**	0.10**
	(0.06)	(0.07)	(0.07)	(0.07)	(0.05)
Bihar × (t - 2012) × Post 2012 $[\gamma_2]$	0.026	0.16*	-0.18**	0.12	-0.021
	(0.09)	(0.09)	(0.08)	(0.10)	(0.07)
Bihar × Post 2012 $[\gamma_3]$	-0.12	-0.15	-0.27*	-0.39**	-0.055
	(0.14)	(0.17)	(0.16)	(0.17)	(0.15)
R Squared	0.235	0.192	0.150	0.132	0.103
No. of Observations	10628	9288	7748	6845	6590
$\gamma_1 + \gamma_2$	0.22	0.23	0.07	0.27	0.08
p-value	0.00	0.00	0.20	0.00	0.23

Conclusion

- Independent Data based assessment indicates that MDM provision improved post IVRS
- State Official Data based assessment indicates beneficiary take-up reducing and rice consumption and cooking costs increasing
- Central government audit based data reveals that quality and sufficiency of meals improving
- Taken together, IVRS reduced leakage in the system and improved the efficacy of delivery provision
- Enrollment in schools decline but attendance increases

Headmasters with Mobile Phones

◂ ivrs

District	Fraction	District	Fraction
Araria	.99	Madhubani	.98
Arwal	1	Munger	1
Aurangabad	.99	Muzaffarpur	.9
Banka	.99	Nalanda	.99
Begusarai	.99	Nawada	.99
Bhagalpur	.99	Pashchim Champaran	.9
Bhojpur	.99	Patna	.98
Buxar	.99	Purnia	.99
Darbhanga	.99	Purvi Champaran	.99
Gaya	.99	Rohtas	.99
Gopalganj	.99	Saharsa	.99
Jamui	.99	Samastipur	.99
Jehanabad	.99	Saran	.99
Kaimur (Bhabua)	.99	Sheikhpura	1
Katihar	.99	Sheohar	.9
Khagaria	.99	Sitamarhi	.99
Kishanganj	.97	Siwan	.99
Lakhisarai	.99	Supaul	1
Madhepura	.99	Vaishali	.99

Changes in the Number of Schools

◂ DiD: AWPB

	Primary Schools		Upper Primary Schools	
	(1)	(2)	(3)	(4)
Bihar × 2010	-86.0***	-98.2***	-14.0***	-21.5**
	(20.04)	(31.73)	(4.70)	(10.14)
Bihar × 2011	-129.3***	-183.9***	-18.7**	-31.8**
	(24.30)	(39.28)	(7.53)	(12.70)
Bihar × 2012	-34.0	-99.7***	17.7	5.56
	(47.74)	(34.55)	(16.39)	(10.59)
Bihar × 2013	-122.2***	-202.0***	-5.91	-25.8**
	(43.14)	(39.46)	(14.18)	(10.92)
Post IVRS - Pre IVRS	7.03	-18.11	12.79	5.97
School Characteristics	No	Yes	No	Yes
R Squared	0.929	0.932	0.958	0.958
No. of Observations	785	785	785	785