Working paper

International Growth Centre

Incorporating Public Good Availability into the Measurement of Poverty

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May 2013

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IGC Report, May 2013

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Abstract

Official poverty measures in India do not explicitly account for access to public amenities and in-kind government transfers even though these vary substantially across Indian villages. This paper makes an attempt to incorporate benefits from unpaid public services into consumption decisions to arrive at more accurate measures of poverty and inequality. The analysis is based on primary data collected from 40 villages in Bihar in 2012. We consider three types of public services: schooling, health care and subsidized food grains through the Public Distribution System (PDS). We show that accounting for the use of these services leads to a narrowing of the consumer expenditure distribution and lower inequality in Bihar because the poor utilize the public facilities more intensively than other households. However, we also find that such accounting leads to a rise in the regional dispersion in poverty rates. So while the targeting within villages leads to a fall in the overall inequality, facilities are not always located in the poorest villages. Finally, we show that the changes in measured poverty from all three types of public services are positively correlated and there is clustering in the location of publicly provided goods. It is likely that this clustering has implications for growth since investments in education, health and nutrition are estimated to have high marginal returns in the literature and have also been shown to be an important historical precondition for growth many parts of the world.

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1 Introduction

Publicly provided goods and in-kind transfers vary substantially across Indian villages, yet they have never been explicitly incorporated in the official poverty measures.[1] Since public provision influences household consumption decisions and levels, poverty numbers based solely on private consumption data are necessarily biased. In this paper we present some preliminary approaches to correcting for these biases and apply them to primary survey data from roughly 2,000 households in 40 villages in Bihar.

The analysis focuses on three types of public services and transfers: schooling, health care and subsidized food grains through the Public Distribution System (PDS). Ideally, we would like to add the value of consumption from each of these to the aggregate consumption of households receiving benefits, and then compare this consumption distribution with the one based only on private consumption expenditure. The main challenge is that these goods and services are either not priced or heavily subsidized. We exploit the fact that all three have clear privately provided alternatives and use the price of these alternatives to impute values to the public services for households that benefit from them. This remains a challenge because services vary considerably by quality within both public and private sectors. We therefore consider the current approach a preliminary first attempt at answering this question.

Our main finding is that public provision results in a fall in aggregate poverty but greater regional inequality because transfers are not concentrated in the poorest villages. All three types of services considered – schooling, health care and the PDS – contribute to a *narrowing* of the consumption distribution, indicating that the poor utilize the public facilities relatively more than other households. However, schooling, and the PDS in particular, seem to induce larger spatial dispersion of poverty rates. So while the targeting of PDS beneficiaries within villages leads to a fall in the overall inequality, the regional mis-targeting is substantial. We also find that the changes in measured poverty at the village level induced by the different public services are positively correlated. This suggests that there is some degree of clustering in the provision of public amenities and transfers. Households living in villages that benefit the most from one type of facility are the ones most likely to benefit from other types of services as well.

One could reasonably argue that by using income rather than consumption data many of the above biases could be eliminated. Income data are however notoriously difficult to collect in

[1] For variations in public good provision, see, for example, Besley *et al.* (2004); Banerjee and Somanathan (2007).

India and are prone to large measurement errors. They may also be a poor measure of welfare due to large fluctuations across seasons and households' attempts to smooth consumption (see e.g. Deaton, 1997). These are some of the reasons that poverty measures in India have always been based on consumption data collected through the National Sample Survey (NSS). We use a survey which closely matches the NSS questionnaire in order to comment on likely biases in official poverty measures.

Ideally, we would have preferred to base our analysis on the nation wide NSS consumption data. However, our main problem is that these surveys do not include much information on access to public facilities. Another problem is that the NSS selects very few rural households within a village, making it difficult to talk of intra-village differences in transfers. In future work we plan to explore ways in which we can match the NSS consumption surveys with other administrative and census data to estimate the effects of public provision on inequality and poverty for other parts of India.

Our findings on the distribution of public amenities has implications for both allocative efficiency and the potential for growth in Bihar. Empirical studies on growth accounting using both historical and cross-country data have found human capital to be a significant component of growth. Surveys of this large literature find that both the level and the quality of education matters and that more educated workers help regions incorporate and assimilate new technologies into the growth process (Griliches, 1997; Barro, 2001). Deaton (2008) finds a systematic correlation between mean heights and per capita income across the Indian states. Both health facilities and nutrition are important determinants of individual and community health. If the relationship between measured health and productivity is concave, the inequality in health outcomes leads to lower per capita income. This is true even in the absence of credit constraints, since poorer families face a higher shadow cost of health investments. It is of course heightened if access to credit is limited and the economy is characterized by poverty traps. High quality public services may therefore be critical in maintaining the high rates of growth that Bihar has experienced over the last few years.

The rest of the paper is structured as follows. In the next section we describe the sample strategy and provide some descriptive statistics. Section 3 includes the proposed procedures for augmenting the private consumption data based on access to public amenities and transfers. In Section 4 we discuss the outcome of the adjustments and make some concluding remarks.

2 Data and survey design

2.1 Survey design

Our primary data were collected in rural areas of Bihar during the period September–December 2012. The main purpose of collecting the survey data was to (a) compare the pattern of consumer expenditure in villages with and without government amenities and transfers, and (b) to augment expenditures for households receiving such in-kind transfers based on the imputed costs of these to arrive at more accurate poverty measures. For this, we used three questionnaires: a household questionnaire similar to that used by the NSS, a village questionnaire to obtain village-level demographics and infrastructure, and an amenity survey which collected information on the most frequently used private and public school and health facility for each village.

In addition to recording consumption in NSS-type categories, the household survey includes information on usage of a range of publicly and privately provided amenities. For example, it records which type of schools children are enrolled in. It also contains some information on households' sickness history, as well as satisfaction with the local provision of public goods. The amenities survey is based on visits to local schools and health centres. For each village, and each of the two amenities, we visited one publicly and one privately provided institution. These choices were made as follows. If there was a government junior high school in the village with grades one to eight, then that was chosen, if not, the primary school with grades one to five was chosen. Primary schools existed in or adjacent to all villages. If there were multiple schools, we chose the one which most children attended. If a junior high school was chosen for the public school, we did the same for the private if possible, and similarly if a school with grades one to five was chosen, we chose the most popular private school. In most instances we had to go outside the village for this private school visit. We chose the schools that most villagers would be likely to send their children to and this usually corresponded to the nearest private school. For both private and public health centres, we chose the one most frequently used, without trying to find comparable public and private facilities.

2.2 Sampling

The National Sample Surveys are designed to generate estimates that are considered accurate at the level of NSS regions. There are two NSS regions in Bihar. Since we wanted our estimates

to be comparable to those from the most recent NSS, we also stratified our sample by region. More specifically, we followed a three-staged sampling procedure. In the first stage we randomly picked five districts from each of the two NSS regions. The districts were sampled with a probability that was proportional to their population in the 2001 Census. The districts of Arwal and Jehanabad appear as separate districts in the 2011 Census, but as one combined in 2001. As Arwal/Jehanabad was selected to our sample, we treat it as one district based on the 2001 census classification.

For our second stage, we sampled four villages at random within each of the ten districts. We chose this sampling procedure rather than population weighted sampling so as not to bias our sample against small villages, which are likely to have fewer amenities than larger ones. At this stage, we had to replace two villages from the original sample during our fieldwork. Both villages were located in the northern district Pashchim Champaran (Haripur and Mandhatapur). They were flooded during the period of the survey, inaccessible by car and many villagers had temporarily migrated.[2]

Finally, we randomly selected 50 households from every village for participation in the household survey. The optimal procedure for this third step would have been to first gather a list of all households in the village and then do the sampling. As we did not have the capacity to do this, we followed a simpler strategy. Based on the number of households in the village, our field manager decided the number of households *in-between* each selected household. He then set up a path for each enumerator and decided the first households for each to visit. This procedure provided the enumerators with clear selection rules, and assured that the whole village was covered.

In all, our final sample consists of 2000 households from 40 villages. Figure 1 is a map with district borders and the location of the 40 villages in the sample.

[2]We also replaced a third village (Rajauli in the district Nawada) because it is no longer classified as rural in the census of 2011.The complete census data of 2011 were not available at the time of our sampling, so we had to rely on the 2001 census. Still, we were able to check the rural/urban status of all our villages in 2011 on the census webpage.

FIGURE 1: Map of sample villages

2.3 Descriptive statistics

2.3.1 Household characteristics

Table 1 compares household characteristics from our survey data with two alternative NSS samples from the period July 2009-June 2010 (the 66th round). The first column contains summary statistics from our survey data, the second is the NSS sample for the ten districts included in our survey and the third includes all NSS households in rural Bihar. NSS averages all use the population weights provided by the NSS, while the figures from our primary data are weighted by the number of individuals in each household.[3]

While the three samples produce similar averages for many variables, we find that households in our sample are a bit larger and they own less land. Land cultivated is roughly the same as in the NSS sample. Surveyed households also devote a smaller share of their total budget to food, which is consistent with a downward sloping Engel curve for food and real income growth over the time period. We also find a somewhat different occupational mix, with fewer households self-employed outside agriculture and more engaged in manual labor. The distribution across social groups is roughly similar to the NSS sample.

Table 2 reports average per capita household expenditure in current prices for different years. In addition to presenting NSS numbers for the year in which those data were collected, we impute expenditures for subsequent years based on the nominal annual growth rates in gross state domestic product (GSDP) reported for Bihar. These growth rates are substantial, however, we still find that average expenditures in our survey data remain higher than the adjusted figures from the NSS. In part, this may be due to an artificially low NSS expenditure benchmark, since 2009-10 was a bad year with widespread floods and crop failures.

A comparison of the two NSS samples shows that the ten districts in our survey data seem to be representative of the rural population in Bihar. In addition, surveyed households seem roughly comparable to the NSS sample.

[3]The NSS weights are necessary to get a representative sample since the NSS does not sample households at random.

TABLE 1: Household characteristics

	Survey sample	**NSS (2009–10)**	
		10 districts	All rural
	(1)	(2)	(3)
Household size	7.06	6.14	6.30
Land owned (acre)	1.12	2.55	2.52
Land cultivated (acre)	1.08	1.02	1.05
Food share	0.58	0.60	0.61
Occupation (shares)			
Self-employed in agriculture	0.27	0.28	0.28
Self-employed in non-agriculture	0.06	0.20	0.22
Labour	0.63	0.51	0.49
Social group (shares)			
ST	0.02	0.02	0.02
SC	0.16	0.20	0.20
OBC	0.64	0.51	0.56
Others	0.17	0.27	0.22
Religion (shares)			
Hindu	0.83	0.86	0.86
Muslim	0.17	0.13	0.14
No of surveyed households	2000	864	3296

Note: All averages are over individuals. The NSS figures are weighted by NSS sampling weights.

TABLE 2: Average consumption

	Survey sample	**NSS**		**Annual GSDP growth**
		10 districts	All rural	
	(1)	(2)	(3)	(4)
2009-10		695	689	
2010-11		*845*	*837*	21.5 %
2011-12		*1043*	*1034*	23.5 %
2012*	1286	*1155*	*1145*	*22.5* %

Note: All numbers in italics are imputed. The GSDP figures are taken from Government of Bihar (2013).
* The numbers from 2012 are based on imputed GDP growth figures. We use the average annual growth rate from the two proceeding years and calculate the implied 6 months growth.

2.3.2 Access to facilities

Access to facilities varies considerably across villages in our sample. Table 3 presents summary statistics for selected facilities. Primary schools (grades one through five) are relatively accessible and most households either have a school within their village or within one kilometre of the village. Only 70 per cent of the villages have a government school with grades six to eight. Relatively few villages have private schools, although three-quarters have a private primary school within three kilometres. A little more than half of the villages have a private school with grade levels six to eight within three kilometres.

Health services are much more scarce and, unlike schools, private facilities are much more accessible than public ones. Only one out of our 40 villages has a government primary health centre (PHC) within the village. Roughly 25 per cent have a PHC within three kilometres. Private clinics are more common, and about a quarter of the villages have such a clinic.

Subsidized grains through the ration shops that are linked to the Public Distribution System (PDS) are, in principle, accessible. Over one-half of villages have a ration shop within the village, while all the others have one within four kilometres of the village.

Table 4 summarizes the availability of water, sanitation and power. Hand pumps are the major source of drinking water for most households. One-third of the sampled households report a shortage of water during the past year and the median shortage period is two months. More than three-quarters of sampled households do not have any form of latrine. Less than half of the households have electricity in their dwelling and those connected have limited access. For these households, the median number of hours per week with electricity is 20 .

TABLE 3: Access to selected facilities

	Share	**Distance***		
		Mean	Min	Max
	(1)	(2)	(3)	(4)
Schooling				
Government school with grades 1-5	0.93	0.4	0.1	0.5
Government school with grades 6-8	0.70	1.4	0.1	3.0
Private school with grades 1-5	0.17	3.7	0.5	18.0
Private school with grades 6-8	0.12	4.8	0.5	20.0
Highschool	0.12	4.8	0.5	20.0
Anganwadi centre	0.95	0.8	0.5	1.0
Health				
Government PHC	0.03	7.3	0.5	20.0
Government hospital	0.00	22.6	5.0	45.0
Private clinic	0.23	5.6	0.5	15.0
Private hospital	0.05	14.9	1.0	40.0
Other				
PDS shop	0.55	1.8	0.1	4.0
Bus stop	0.17	4.9	0.3	20.0
Train station	0.00	14.2	2.0	36.0
Commercial bank	0.15	3.4	0.5	12.0

Note: * Conditional on *not* having the particular facility within the village.

TABLE 4: Private facilities

Water and sanitation (share)	
Hand pump as major water source (share)	0.87
Water scarcity (share)	0.33
No of month scarce given scarcity (median)	2
No latrine (share)	0.78
Electricity	
Electricy in dwelling (share)	0.43
No of hours per week given electricity (median)	20

3 Adjusting for public amenities and transfers

In this section we focus on schooling, health care and distribution of subsidized grains through the PDS. We examine the results of alternative procedures for adjusting the consumption distribution to take into account access to these amenities and in-kind transfers.

3.1 Constructing updated poverty lines

The analysis that follows requires some benchmark poverty and inequality figures. The Indian Planning Commission constructs official poverty counts based on state specific poverty lines and consumption data from the NSS consumer expenditure survey. The latest poverty report is from 2009–10, in which the monthly per capita consumption threshold for rural Bihar is 656 rupees. Given the poverty line, 55.3 per cent of the rural population was estimated to be living in poverty. There are no official poverty lines for 2012. To obtain poverty estimates from our sample, we adjust the official line for rural Bihar in 2009–10 for price inflation using the Consumer Price Index for Acricultural Labores (CPIAL). Using this index, the cumulative price increase for rural Bihar was 22%.[4] This gives a poverty line of about 800 rupees for our survey period.

Our consumption data imply a head count ratio of 32.5 per cent. Since the head count measure is extremely sensitive to the choice of poverty line, we also compute other measures which account for the depth of poverty, namely the Poverty Gap Index (PG) and the Sen-Shorrocks-Thon Index (SST). The PG index can be interpreted as the aggregated shortfall of the poor's consumption from the poverty line, normalized by population size (Deaton and Tarozzi, 2000). The SST is a modified version of the Sen Index (Sen, 1976), and can be generated as a weighted average of the head count and the PG index (Shorrocks, 1995). We use all three of these poverty measures throughout our analysis. Since all of these measures are dependent on the poverty line, we also evaluate changes in the overall consumption inequality using the Gini index, the Theil's T index (GE_1) and the ratio of the ninth to the first decile (d9/d1). Table 5 presents sample statistics for all these measures.

[4] A similar procedure was followed by the Planning Commission prior to 2011 using a re-weighted version of the CPIAL. From 2011 onwards, poverty lines are made comparable over space and time using unit value indices obtained directly from NSS consumption data (see Government of India, 2009).

TABLE 5: Poverty and inequality measures

	Poverty			Inequality		
	HC	PG	SST	Gini	GE_1	d9/d1
	(1)	(2)	(3)	(4)	(5)	(6)
Arwal/Jehanabad	44.5	12.4	17.6	33.1	20.0	4.0
Aurangabad	41.3	9.3	13.4	30.4	19.2	3.0
Begusarai	20.5	7.2	10.4	37.7	25.8	4.9
Jamui	34.9	9.3	13.2	30.7	17.9	3.6
Katihar	28.8	5.8	8.4	36.7	26.4	4.5
Lakhisarai	41.7	9.0	13.3	35.1	30.0	3.3
Nawada	44.3	10.7	15.3	32.3	19.9	3.6
Pashchim Champaran	25.1	4.4	6.5	29.3	16.7	3.4
Siwan	18.3	3.3	4.7	36.8	27.4	4.3
Vaishali	25.9	7.2	10.4	42.7	42.5	5.3
All	32.5	7.9	11.3	36.4	27.5	4.2

3.2 Schooling

3.2.1 Access and distribution of benefits

Most villages have a government school nearby, although many of these are of poor quality. Thus, the fact that public schools are present is far from sufficient to ensure access to well-functional schools of reasonable quality. Summary statistics of school characteristics are in Table 6. These numbers are based on school visits. We use the terms "public schools" and "government schools" interchangeably. "Private schools" refer to those with tuition fees and include both officially recognized as well as unrecognized schools.

As seen from the table, the government schools we visited have larger numbers of enrolled students relative to private schools and have almost *double* the number of students per teacher and per classroom. On average, about 60 children share the same teacher and classroom in these schools. The attendance rates on the day of our visit are also substantially lower in the public schools. English is the main language of instruction in a little more than 20 per cent of the private schools but in none of the public schools. Almost all private schools offer some teaching in English at each grade level and regular tests in math and reading, in addition to annual exams. The corresponding numbers for government schools are substantially lower.

Overall, the private schools in our sample are both smaller and less crowded than the public schools and place much greater emphasis on the teaching of English.

TABLE 6: School characteristics

	Government			Private		
	mean	sd	n	mean	sd	n
	(1)	(2)	(3)	(4)	(5)	(6)
Enrolled students	404.90	210.46	40	248.08	152.93	39
Attendance on day of visit	0.64	0.16	40	0.77	0.16	37
Students per teacher	57.89	25.38	40	23.33	8.99	39
Students per classroom	63.01	34.98	40	29.36	15.80	39
Whether the school has a playground	0.40	0.50	40	0.62	0.49	39
Serves more than 3 midday meals a week	0.60	0.50	40	0.05	0.23	37
Main teaching language English	0.00	0.00	40	0.22	0.42	37
Any teaching in English (all grades)	0.38*	0.49	40	1.00	0.00	38
Tests in math and reading (all grades)	0.05*	0.22	40	0.95	0.23	38
Annual exam (all grades)	0.78*	0.42	40	1.00	0.00	38

Note: * Taken from the village questionnaire.

Tables 7(a) and 7(b) show rates of total enrollment and private school enrollment by district. Enrollment rates are quite high and, in every district, over 80% of children under 15 were enrolled in school during the year preceding our survey. Roughly seven per cent of the students at grade levels one to five are enrolled in a private school, and four per cent of those attending grade levels six to eight. These numbers are somewhat lower than the average for India as a whole, according to the NSS Employment and Unemployment Survey from 2009–10, but roughly consistent with numbers for rural Bihar. Differences in private school enrollment across districts are substantial. Nawada and Paschim Champaran have the highest shares of students in private schools.

The third column in Table 7(b) shows the same set of private school ratios conditional on having a government school within the village. These ratios are almost identical to the unconditional ones, which suggests that the lack of local government schools *per se* is not the main motivation for attending private schools. This is not of course surprising, given that all villages have public schools providing grade levels one to eight within three kilometres.

TABLE 7: Schooling

(a) Total enrollment rates

	6-10y	11-15y
	(1)	(2)
Arwal/Jehanabad	0.91	0.90
Aurangabad	0.90	0.95
Begusarai	0.83	0.78
Jamui	0.86	0.85
Katihar	0.83	0.88
Lakhisarai	0.84	0.85
Nawada	0.82	0.91
Pashchim Champaran	0.80	0.89
Siwan	0.88	0.93
Vaishali	0.89	0.96
All	0.86	0.89

Note: The table shows the number of children in the age group enrolled in school, regardless of grade level, divided by the population of the age group.

(b) Private school enrollment

	Unconditional		**Conditional**	
	g1-5	g6-8	g1-5	g6-8
	(1)	(2)	(3)	(4)
Arwal/Jehanabad	0.03	0.00	0.03	0.00
Aurangabad	0.10	0.04	0.10	0.04
Begusarai	0.08	0.07	0.06	0.02
Jamui	0.02	0.01	0.02	0.01
Katihar	0.00	0.00	0.00	0.00
Lakhisarai	0.04	0.03	0.04	0.07
Nawada	0.12	0.06	0.12	0.00
Pashchim Champaran	0.14	0.17	0.14	0.19
Siwan	0.12	0.04	0.12	0.02
Vaishali	0.06	0.01	0.06	0.01
All	0.07	0.04	0.07	0.03

Note: The number of children enrolled in private schools in the particular grade levels, regardless of age, divided by the total number of children enrolled in the same grade levels. The columns labeled "Conditional" displays private school shares conditional on having a government school within the village.

3.2.2 Adjusting for access to public schools

We have seen that private school enrollments are not especially sensitive to the presence of a government school. The differences in the student-teacher ratios and other characteristics in these two types of schools also suggest possibly large quality differences between them. In this section we propose some crude adjustments to the expenditure distribution for those attending government schools. Our challenge is to impute a value to the services provided by government schools which takes account of differences in quality within the set of public schools and between them and private alternatives.

Approach 1 – Fixed imputed values for public schools

Our first approach does not attempt to take into account quality differences. For *each* child attending a government facility, we simply add the median tuition paid by those attending a private school in our sample. The annual tuition associated with attendance at private schools varies considerably. For grades one to five and six to eight, median values are 1200 rupees and 1800 rupees respectively per year. The steps in this procedure are as follows:

1. Find all students enrolled in grade levels one to eight at a government school
2. Add the median tuition for private schooling for students at his/her grade level (1-5 or 6-8)
3. Sum over all such students in the household and convert this amount to monthly per capita expenditure.

Table 8 displays the results of this simple exercise for our poverty and inequality measures. We normalize the poverty line so as to produce the same overall head count ratio as before the adjustments. We see that public schools contribute to a narrowing of the expenditure distribution. The overall Gini coefficient decreases by 0.7 percentage points. The effects on the district-wise head counts vary from roughly -1.5 percentage points to +1.5 percentage points. These changes are not large, perhaps because of the relatively low tuition charged by most private schools.

This type of adjustment is extremely coarse because it implicitly assumes that every household would have spent the median tuition on private schooling were the government school not available. Ideally, we would like to impute values based on "as similar as possible" individuals

enrolled in private schools. One way to go about is to estimate the schooling decision and use the predicted values to match individuals. When estimating this sort of probability model of households' school decisions, we find that the tuition paid vary little with the predicted values. We therefore do not present these results as the differences between them and the figures in Table 8 are marginal.

TABLE 8: Changes in poverty and inequality – School (i)

	Poverty			**Inequality**		
	ΔHC	ΔPG	ΔSST	ΔGini	ΔGE_1	$\Delta d9/d1$
	(1)	(2)	(3)	(4)	(5)	(6)
Arwal/Jehanabad	0.52	-0.28	-0.19	-0.80	-0.87	-0.16
Aurangabad	-0.32	-0.36	-0.73	-0.91	-0.96	-0.16
Begusarai	0.00	-0.14	-0.19	-0.57	-0.73	-0.10
Jamui	1.16	-0.22	0.32	-0.65	-0.72	-0.20
Katihar	-1.56	-0.39	-1.01	-0.72	-0.91	-0.26
Lakhisarai	-0.26	-0.13	-0.22	-0.69	-0.98	-0.09
Nawada	1.63	0.01	0.63	-0.69	-0.80	-0.08
Pashchim Champaran	-0.46	-0.17	-0.31	-0.63	-0.61	-0.18
Siwan	-1.13	-0.04	-0.47	-0.50	-0.66	-0.11
Vaishali	0.00	-0.22	-0.36	-0.62	-1.01	-0.24
All	0.00	-0.19	-0.25	-0.69	-0.90	-0.16

Approach 2 – Quality-based imputed values for public schools

Our second approach attempts to account for quality differences by imputing values to public education only for those students who attend schools of reasonable quality. To do this, we first estimate the decision to attend private school based on a restricted sample of students living in villages with both private and government schools within two kilometres of the village. This is about half of the original sample of 2727 children enrolled in school and is a group with a real choice between private and government schools.

As potential determinants of the private school choice, we use the following six binary school quality indicators for the quality of the local public school: (*i*) some teaching in English at all grade levels, (*ii*) no more than 35 students per classroom, (*iii*) regular tests in reading and math for all grade levels, (*iv*) more than one latrine per 100 students provided that latrines are reasonably clean on the day of visit, (*v*) a school playground (*vi*) more than three midday meals during the week preceding our visit.

As mentioned in Section 2.1, we visited only one private and public school in each village.

Some students in our restricted sample may well attend a public school other than the one we visited. An implicit assumption in our analysis is that the school we visited is representative of the quality of public schools in the village. Table 9 presents estimates of the determinants of choosing a private school. We estimate both a linear probability model and a probit model. In both cases, the dependent variable is a binary indicator for enrollment in a private school.

Most of the household level explanatory variables have the expected sign. Income is associated with greater private school attendance for most income levels, while females are less likely to attend private school. The only statistically significant quality variables are those related to English teaching and the number of students per classroom. These coefficients are both positive, indicating that households do in fact respond to the quality of the local public schools when deciding on whether to send their children to private school.

We use these estimates to predict the schooling decision for *all* children, regardless of whether they have a private school within reach. We define two school quality levels; *low* quality schools are those that do not teach English at all grade levels, and have more than 35 students per classroom. The remaining schools are defined as *high* quality schools. Using predicted values from the probit model, we find a threshold value for which the fraction above that value for the *estimated sample* corresponds to the actual share of students that attend a private school. Given this threshold and the coefficients from the two significant quality indicators we project schooling decisions in the *thought* situation with low quality public schools in every village.

We then adjust household expenditures as follows:

1. If students in the set above the threshold value attend public school of high quality, we assume that they would have attended a private school had they not had access to the high quality public school.
2. For all children in this set attending high quality public schools we add the median tuition paid by students at private schools to the consumption expenditure of their households.
3. We leave unchanged the consumption expenditures of households in villages with low quality public schools.

Table 10 presents changes in poverty and consumption inequality resulting from this procedure. Not surprisingly, these changes are much smaller than those in Table 8 since we have adjusted expenditures for far fewer households. Public schooling still seems to narrow the overall ex-

Table 9: Determinants of private school attendance

	Linear		Probit	
	(1)		(2)	
Log per capita income	-0.0214*	(0.0113)	-0.0153**	(0.0063)
Log per capita income ^{2}	0.0036	(0.0021)	0.0029**	(0.0013)
Female	-0.0673***	(0.0205)	-0.0517***	(0.0147)
Literate head of household	0.0376	(0.0271)	0.0282	(0.0184)
Female head of household	0.0020	(0.0210)	0.0067	(0.0169)
Backward caste	-0.0373	(0.0548)	-0.0236	(0.0342)
Self-employed agriculture	0.0793**	(0.0300)	0.0602**	(0.0264)
Self-employed non-agriculture	0.1110	(0.0753)	0.1111	(0.0734)
Nearest government school (km)	-0.0158	(0.0403)	-0.0091	(0.0321)
Nearest private school (km)	0.0035	(0.0277)	0.0010	(0.0175)
Teaching in English	-0.0739**	(0.0305)	-0.0569**	(0.0223)
No more than 35 students per classroom	-0.0551**	(0.0232)	-0.0466***	(0.0149)
Regular tests in reading and math	0.0022	(0.0528)	-0.0128	(0.0424)
No more than 100 students per latrine	0.0314	(0.0603)	0.0515	(0.0571)
Playground	0.0404	(0.0575)	0.0266	(0.0370)
Midday meal	-0.0680	(0.0445)	-0.0369	(0.0317)
Observations	1323		1323	
R^2	0.148		0.229	

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The numbers in the parentheses obust standard errors clustered at the village level. Column 2 displays the marginal effects from the probit model, evaluated at the sample means. Addition controls: age dummies, land ownership, cultivated land.

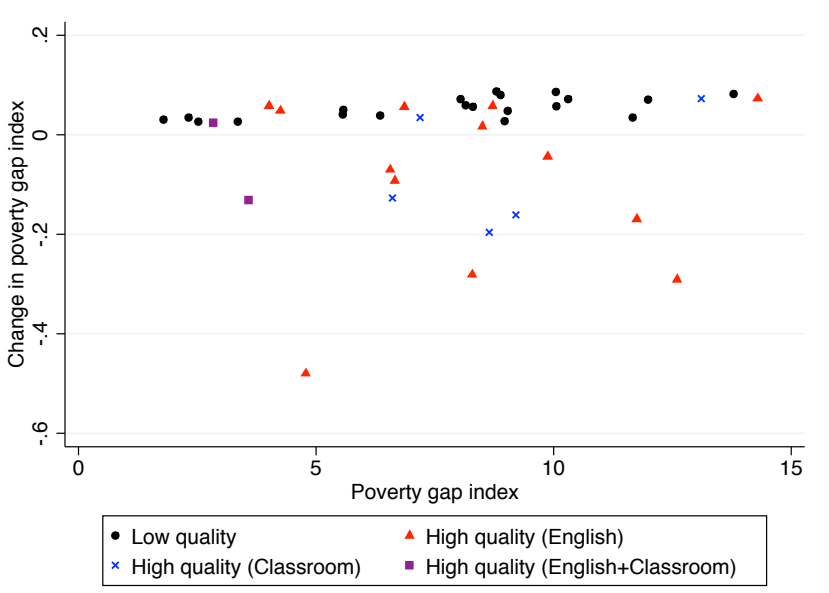
penditure distribution but not *within* every district. While children in poor households attend mainly public schools, they do not necessarily benefit the most from high quality schools and if the latter are located in wealthier areas of a district, they could increase inequality. The ones that benefit under this second adjustment procedure are those that would have opted for a private school had the public school in the village been dysfunctional. These households are unlikely to be among the poorest in our survey area.

TABLE 10: Changes in poverty and inequality – School (ii)

	Poverty			**Inequality**		
	ΔHC	ΔPG	ΔSST	ΔGini	ΔGE_1	$\Delta d9/d1$
	(1)	(2)	(3)	(4)	(5)	(6)
Arwal/Jehanabad	0.00	-0.03	0.00	-0.04	-0.05	0.00
Aurangabad	0.00	0.00	-0.04	-0.05	-0.09	0.00
Begusarai	0.00	0.03	0.03	0.02	0.02	0.00
Jamui	1.47	0.06	0.78	0.00	0.00	0.00
Katihar	-0.49	-0.07	-0.30	-0.05	-0.05	-0.19
Lakhisarai	0.00	-0.01	0.01	-0.03	-0.04	0.00
Nawada	0.00	-0.02	-0.03	-0.03	-0.05	0.02
Pashchim Champaran	-1.47	-0.11	-0.63	-0.12	-0.14	0.00
Siwan	0.00	0.03	0.03	0.00	0.00	0.00
Vaishali	0.00	0.01	-0.00	-0.03	-0.09	0.03
All	-0.02	-0.01	-0.01	-0.04	-0.06	-0.00

Figure 2 plots the changes in the poverty gap resulting from this adjustment against it pre-adjusted level for villages with different public school quality characteristics. The black dots represent villages with low quality schooling, while the remaining symbols indicate villages with different types of high quality schools. Notice that public schools of the highest quality are in villages with initially low levels of poverty. These are the types of biases which limit the ability of public schooling to act as an effective mechanism for redistribution.

FIGURE 2: Changes in the PG index (by villages)



3.3 Health facilities

3.3.1 Access and distribution of benefits

Public health facilities are scarce relative to public schools. Table 11 summarizes characteristics of the public and private health facilities we visited. These visits were guided by the facilities most villagers reported as using. Public health facilities in our sample are generally larger than the private ones, they received more patients during the 30 days before our survey, they have more beds for inpatients and a larger medical staff. Consistent with other surveys of public health facilities, we found that the median number of doctors present on the day of our visit was no higher than for private clinics.

Table 12 compares the physical infrastructure and the availability of medicines in the two types of facilities. The public centres are more likely to have a laboratory, electricity, tapped water and separate latrines and washing areas. They also have a larger variety of medicines available. Despite these better amenities, most households prefer private providers. About six per cent of the surveyed households had one or more member who was inpatient at a medical institution during the past year and, among the group of inpatients, 40 per cent utilized a public service, while another 70 went to a private clinic or hospital. Consequently, around ten per cent of the inpatients stayed overnight in both private and public facilities over the past year.

The differential utilization of the two types of health care providers is even larger for out-patient treatment. About 60 per cent of the households in our sample contacted a health care provider for out-patient care during the 30 days preceding our visit. Only ten per cent of these went to a government facility, while the rest paid a higher price for some sort of private service.[5] Very few used both public and private health services.

In addition to the data on actual visits, we also asked households about the type of facility its members were most likely to use in the event of a health problem. These responses are broadly consistent with observed household behaviour. Responses to this hypothetical question indicate that only 13 per cent prefer public health care providers (compared to the ten per cent of those who actually contacted a public provider).

We also asked respondents *why* they were likely to opt for private alternatives. The two most

[5] Around 30 per cent visited so-called *quacks*, who are untrained practitioners, usually located within the village.

frequent responses were (*i*) that the public health personnel are often absent (31 per cent), and (*ii*) the government facility was further away (23 per cent). Figure 4 suggests that households that are located further away from the public centres do use them less and spend more on health care. Other common reasons for using private health care were (*iii*) long waiting lines at the public health centres (13 per cent) and (*iv*) private health practitioners provide better treatment (11 per cent).

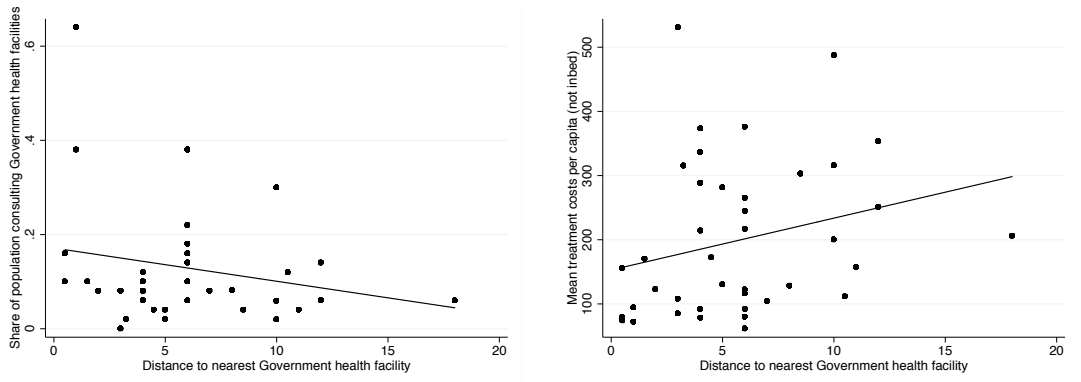
TABLE 11: Public and private health facilities: doctors and patients

	Government				**Private**			
	min	median	max	n	min	median	max	n
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Doctors	0	3	7	37	1	1	3	40
Doctors present	0	1	6	37	0	1	2	40
Other staff	2	37	310	31	0	2	19	40
Other staff present	1	6	110	33	0	2	8	39
Inpatient beds	0	6	90	38	0	1	35	40
Patients last month (in-bed)	0	206	915	34	0	0	900	39
Patients last month (not in-bed)	0	3756	9314	33	25	300	7000	40
Hours open per week	10	168	168	37	36	168	168	39

TABLE 12: Public and private health facilities: infrastructure and medicines (shares)

	Government	Private
	(1)	(2)
Infrastructure		
Laboratory	0.82	0.33
Electricity	0.87	0.93
Tap water	0.18	0.05
Water in the latrines	0.68	0.56
Separate latrine and washing area	0.82	0.65
Labor room	0.87	0.20
Sheets on inpatient beds	0.53	0.81
Available medicines		
Contraceptive	0.78	0.40
ORS (Jeevan Jal)	0.79	0.60
Analgesics (aspirin, paracetamol etc.)	0.92	0.75
Antibiotics (cotrimoxazol, penicillin etc.)	0.86	0.65
Anti-malarials (chloroquine etc.)	0.51	0.42
Antehelmintic drugs (anti-worm drugs such as mebendazole)	0.92	0.72
Iron tables (ferrous sulfate etc)	0.84	0.50
Vaccines (BCG, DPT, Tetanus, Polio)	0.79	0.12

FIGURE 3: Distance to nearest public health facility



3.3.2 Adjusting for access to government health facilities

In this section we propose one rough adjustment to the expenditure distribution for households that report using public facilities. We have made no attempt so far to take quality differences among the public health providers into account and plan to pursue this in future work.

We begin by estimating the probability that a household consults *any* type of health practitioner. Table 13 presents estimates from two different probability models. In both cases, the dependent variable is a binary indicator for whether the households consulted a health practitioner in the past 30 days or not. Most explanatory variables are not statistically significant at any reasonable level. Households with small children (0-2 years old) and elders (above 60 years old) are more likely to visit a health care provider. Income does not seem to affect the likelihood of a visit. We speculate that this is due to two opposing forces; conditional on sickness, fewer poor households may consult medical personnel, yet as a group, they might be more prone to sickness. The distance to the nearest private health clinic seems to be negatively correlated with the probability of a visit. This may be explained by better health, resulting from the existence of the facility or from other correlated but unobservable characteristics of these village.

We next combine the predicted values from the probit model with each household's own perception of which type of health facility they are likely to visit in the case of a "normal" health problem. Of course, we cannot know whether their response to this question corresponds to the type of facility they actually would have chosen. Still, as discussed above, actual behavior does broadly match these responses. For example, only three per cent of those stating a preference for private providers visited a public service. However, roughly 25 per cent of those preferring government health care did visit some type of private provider.

As an estimate of the value of the government health service we simply use the difference in median costs of public and private health services for out-patient treatment. These are 20 rupees and 144 rupees for public and private services, respectively. These differences could of course be influenced by differences in the types and seriousness of illnesses treated within these two types of institutions. We have done nothing to address this so far.

For all households who responded that they are likely to use the government health service we add the difference in medians, multiplied by the predicted probability derived above. Thus, the added amount could be interpreted as the expected monetary gain of using public health care providers rather than private ones. We do not add anything to households who state that their

preference is for private health care.

TABLE 13: Determinants of consulting a health practionner.

	Linear		Probit	
	(1)		(2)	
Log income	-0.0038	(0.0132)	-0.0040	(0.0132)
Log income^2	-0.0004	(0.0020)	-0.0003	(0.0020)
Backward caste	0.0513	(0.0314)	0.0525	(0.0321)
Small children (0-2)	0.0391	(0.0417)	0.0392	(0.0420)
Small children^2	-0.0190	(0.0213)	-0.0191	(0.0213)
Other children (2-16)	0.0379**	(0.0176)	0.0380**	(0.0177)
Other children^2	-0.0058**	(0.0029)	-0.0058**	(0.0029)
Elderly (> 60)	0.0219	(0.0473)	0.0174	(0.0496)
Elderly ^{2}	0.0121	(0.0246)	0.0153	(0.0265)
Other adults (17-59)	-0.0187	(0.0245)	-0.0194	(0.0251)
Other adults^2	0.0030	(0.0032)	0.0031	(0.0033)
Muslim	0.0535*	(0.0318)	0.0540*	(0.0318)
Nearest PHC (km)	-0.0012	(0.0024)	-0.0011	(0.0024)
Nearest sub-PHC (km)	0.0023	(0.0045)	0.0024	(0.0044)
Nearest government hospital (km)	0.0003	(0.0012)	0.0003	(0.0012)
Nearest private clinic (km)	-0.0069**	(0.0035)	-0.0069*	(0.0035)
Nearest private hospital (km)	0.0009	(0.0011)	0.0009	(0.0012)
Observations	2000		2000	
R^2	0.016		0.013	

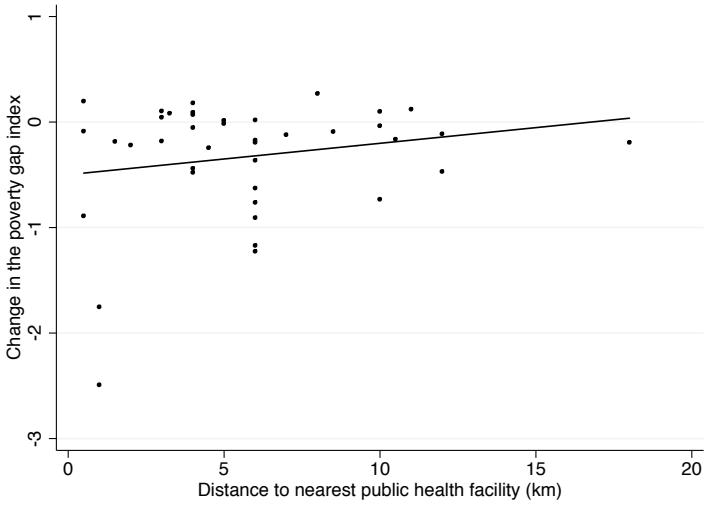
Note: * p<0.1, ** p<0.05, *** p<0.01. Column 2 displays the marginal effects from the probit model, evaluated at the sample means. Additional controls: land ownership, cultivated land, occupation

Table 14 shows the resulting changes in poverty and consumption inequality. As for schooling, we normalize the poverty line so as to produce the same overall head count rate as before the adjustment. We find that public health care narrows the expenditure distribution overall, and also within each district. The effects on the district head counts vary from -2 percentage points (Aurangabad) to +1.5 percentage points (Jamui). Figure 4 plots the changes in the poverty gaps against the distance to the nearest government provider for all sample villages.

TABLE 14: Changes in poverty and inequality – Health

	Poverty			Inequality		
	ΔHC	ΔPG	ΔSST	ΔGini	ΔGE_1	$\Delta d9/d1$
	(1)	(2)	(3)	(4)	(5)	(6)
Arwal/Jehanabad	-0.96	-1.52	-2.62	-0.99	-1.10	-0.38
Aurangabad	-1.99	-0.76	-1.76	-0.64	-0.67	-0.15
Begusarai	0.63	-0.13	0.21	-0.12	-0.18	0.00
Jamui	1.47	-0.13	0.54	-0.24	-0.23	-0.08
Katihar	0.00	-0.16	-0.27	-0.29	-0.34	-0.30
Lakhisarai	-0.09	0.11	0.16	-0.12	-0.23	0.00
Nawada	0.23	-0.03	0.22	-0.15	-0.17	-0.00
Pashchim Champaran	0.83	-0.08	0.05	-0.27	-0.28	-0.02
Siwan	-0.32	0.05	-0.09	-0.08	-0.10	0.00
Vaishali	0.35	-0.63	-0.79	-0.45	-0.71	-0.19
All	0.00	-0.33	-0.43	-0.36	-0.46	-0.13

FIGURE 4: Changes in the poverty gap index (by villages)



3.4 The public distribution system

3.4.1 Access and distribution of benefits

The final adjustment we consider is for in-kind transfers to selected families from the public distribution system (PDS). The PDS is a nationwide scheme, which distributes subsidized grains, in addition to a few essential commodities, through so-called fair price shops or control shops. In Bihar, as in most other Indian states, the distribution system is centered around the provision of rice, wheat and kerosene. Households that are classified as *below poverty line* (BPL) are entitled to rations of rice and wheat, while every rural household in principal is entitled to some quantity of subsidized kerosene. In addition to the general BPL ration card, there is the Antyodaya ration card (AAY), which gives so-called ultra-poor households a larger subsidy. An AAY cardholder is entitled to 35 kg of rice every month at a rate of 3 rupees per kg. In our survey sample, 47 per cent of the households hold a BPL card, while 7 per cent own an AAY card.

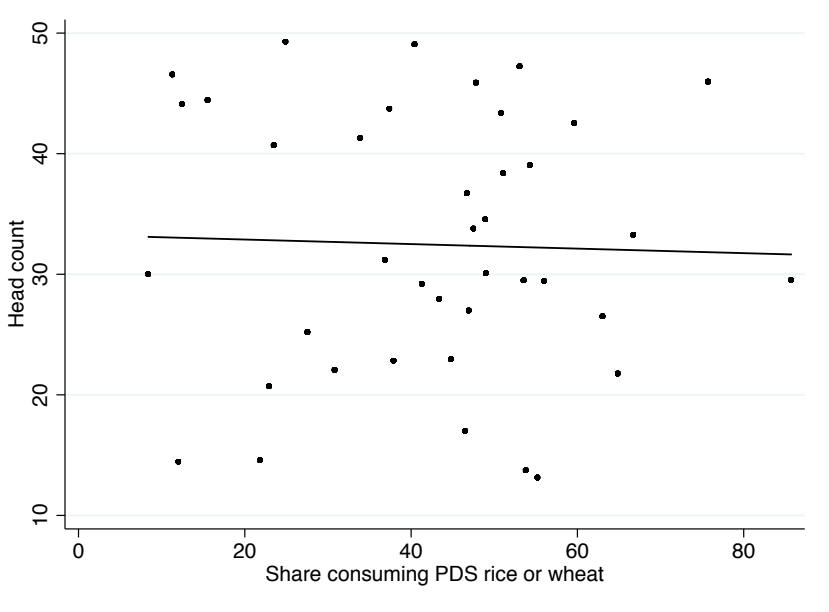
Table 15 summarizes PDS consumption according to the distance of the village from the nearest ration shop. The first set of numbers shows the percentage of households consuming *any* positive amount of PDS rice or PDS wheat during the month preceding our field survey. About 20-30 per cent of the entitled households did not consume any PDS staples during this period. We also find that a larger share of the AAY entitled households tend to get their rations when there is a ration shop *within* the village. The pattern is less clear for BPL cardholders and for average consumption conditional on any PDS consumption. This suggests that access is key, and that the differences in the shares from the first panel are not driven by demand. When households travel a longer distance for the ration shop they seem to buy either more or the same amount as those with a ration shop within the village.

The spatial variation in PDS consumption is not encouraging, given that these are intended to be targeted transfers. For example, there is little or no correlation between (*i*) the number of poor in a village and the share of the population holding a BPL or AAY card or (*ii*) between the number of poor in a village and the share of the population consuming any PDS staples. This second correlation is illustrated in Figure 5. We also find that households living in relatively poor villages are slightly worse off in terms of PDS consumption; conditional on being owners of a ration card, fewer households consume any PDS rice or wheat, and if they do, they consume less on average.

TABLE 15: PDS consumption of rice and wheat

	Distance to nearest ration shop (km)		
	0	< 2	$2 - 4$
Any PDS consumption (share)			
Antyodaya	0.84	0.73	0.71
BPL	0.78	0.72	0.80
Others	0.03	0.00	0.00
Average consumption conditional (kg)			
Antyodaya	31.90	36.94	34.67
BPL	24.88	25.20	24.27
Others	32.31	–	–
Number of months received ration			
Antyodaya	9.46	9.13	8.38
BPL	8.99	8.64	8.96

FIGURE 5: PDS consumption and head counts (by village)



3.4.2 Adjusting for access to the PDS

Both rice and wheat can reasonably be classified as necessities. An alternative interpretation of the PDS is therefore that its benefits are close to being income transfers. This interpretation, which effectively neglects substitution effects, is reasonable for households that either have an *optimal consumption level which lies above the quantity available from fair price shops* and/or *could easily and costlessly re-sell the subsidized items at a higher rate.*

The first condition seems likely to hold for a large fraction of poor households, in particular for consumption of rice and wheat. Staple grains have a relatively low price per calorie and are therefore the major food component for most poor households (Behrman and Deolalikar, 1988; Jensen and Miller, 2008). Thus, given this reliance on cereals, regardless of access to subsidized goods, and given that the PDS items are supplied with quotas, the substitution effect is likely to be rather limited. The poor are likely to purchase large amounts of grains in any case. The fact that almost all households consuming either PDS rice or wheat also consume the same items through the regular market, suggests that the amount supplied is below their optimal level.[6]

Based on our treatment of these grains as income transfers, we use the following adjustment procedure:

1. We compute district-wise median unit values for the two items, separately for market and PDS purchases by dividing the value of consumption by the quantity purchased.
2. We evaluate the household specific *quantity* consumed from the PDS by the local market unit value. Since the PDS prices are lower than the market prices, this raises the expenditure level of households reporting PDS consumption.

The median unit values for each of our districts are displayed in Table 16. The unit values suggest that there is a large degree of homogeneity in terms of prices across the villages in our sample. They also suggest that the PDS prices are roughly one-third the market prices in the case of rice, and a little less than half of the market prices for wheat. The subsidy is therefore far from negligible. Table 17 contains district-level changes in the poverty and inequality measures. As was the case for schooling and health care, the PDS contributes to a narrowing of the overall

[6]For rice and wheat this applies for 97.2 per cent and 90.2 per cent, respectively. Of course, there could also be other reasons for households to do additional purchases in the open market. For example, the PDS items might not be available when the consumers need them, or they might be of different quality as compared to the market goods. Khera (2011) takes up some of these issues.

expenditure distribution. The gini coefficient for the full sample is for example reduced by 0.6 points. This finding is however not very impressive as it requires only a minimum degree of successful targeting.

TABLE 16: Unit values

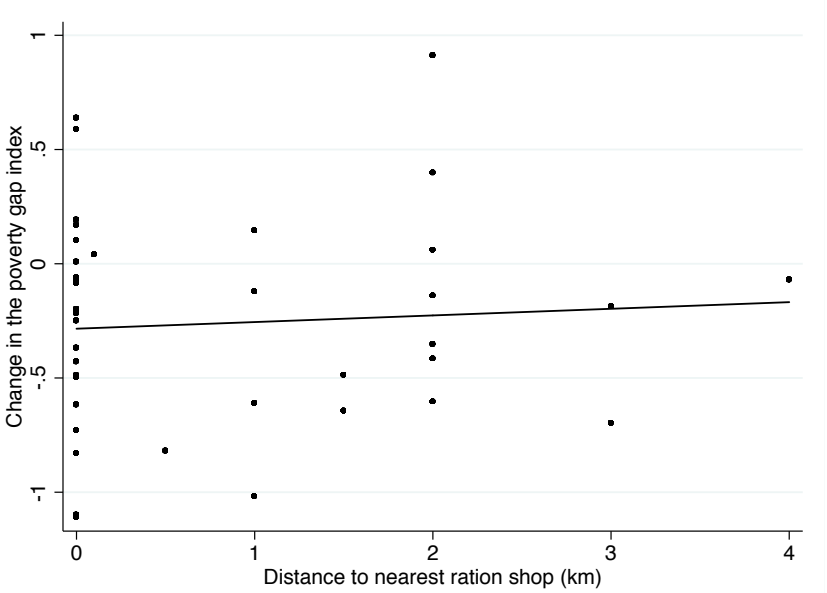
	Rice			**Wheat**		
	AAY	BPL	Market	AAY	BPL	Market
Arwal/Jehanabad	4.2	7.0	16.0	4.0	7.0	14.0
Aurangabad	3.9	6.7	16.0	3.3	7.0	14.0
Begusarai	3.0	6.7	21.8	3.0	6.5	15.0
Jamui	4.0	7.0	20.0	3.3	6.6	15.0
Katihar	4.7	7.0	20.0	3.2	6.0	15.0
Lakhisarai	6.1	7.3	20.0	6.9	8.0	15.0
Nawada	3.8	6.8	15.9	4.0	7.2	15.0
Pashchim Champaran	5.2	6.6	20.0	5.0	6.0	14.0
Siwan	3.3	7.0	20.0	3.0	6.0	15.0
Vaishali	3.0	6.7	20.0	2.8	6.5	16.0
All	3.9	6.9	19.0	3.6	6.7	14.8

TABLE 17: Changes in poverty and inequality – PDS

	Poverty			**Inequality**		
	ΔHC	ΔPG	ΔSST	ΔGini	ΔGE_1	$\Delta d9/d1$
	(1)	(2)	(3)	(4)	(5)	(6)
Arwal/Jehanabad	-0.35	-0.46	-0.72	-0.74	-0.79	-0.32
Aurangabad	-0.32	-0.16	-0.34	-0.56	-0.72	-0.06
Begusarai	-1.44	-0.33	-1.49	-0.75	-0.98	-0.21
Jamui	1.09	-0.84	-0.37	-1.11	-1.13	-0.14
Katihar	-0.39	-0.18	-0.36	-0.52	-0.70	-0.34
Lakhisarai	1.46	0.27	0.83	-0.37	-0.53	0.00
Nawada	1.24	0.10	0.78	-0.45	-0.47	-0.12
Pashchim Champaran	1.84	-0.14	0.37	-0.40	-0.46	-0.11
Siwan	-1.13	-0.20	-0.65	-0.54	-0.70	-0.09
Vaishali	-2.38	-0.63	-1.99	-0.87	-1.43	-0.22
All	0.00	-0.26	-0.40	-0.62	-0.84	-0.12

Figure 6 plots the changes in the village-wise poverty gaps against the distance to the nearest ration shop. Although the relationship is rather weak, the figure still suggests that subsidized grains can have a large impact on the degree of poverty in villages with a shop nearby.

FIGURE 6: Changes in the PG index (by villages)



4 Discussion of results

Official Indian poverty measures do not explicitly take into account access to public facilities. In this paper we have made a first attempt at accounting for the value of public schooling, health care and the PDS, based on primary data collected in rural Bihar. The preliminary analysis reveals that all three types of government services tend to narrow the expenditure distribution. They also lead to less poverty in terms of measures such as the PG and the SST indices, which take into account the depth of the expenditure deprivation. This holds even as we normalize the overall head count ratio to the same level as before the adjustments, and suggests that the poor in our sample tend to utilize the public facilities. Table 18 summarizes these results.

TABLE 18: Overall changes in poverty and inequality

	Poverty			**Inequality**		
	ΔHC	ΔPG	ΔSST	ΔGini	ΔGE_1	$\Delta d9/d1$
	(1)	(2)	(3)	(4)	(5)	(6)
Schools						
Direct imputation	0.00	-0.19	-0.25	-0.69	-0.90	-0.16
Quality-based imputation	-0.02	-0.01	-0.01	-0.04	-0.06	-0.00
Health care	0.00	-0.33	-0.43	-0.36	-0.46	-0.13
PDS	0.00	-0.26	-0.40	-0.62	-0.84	-0.12

We also examine the village-wise dispersion of poverty. Figure 7 plots the changes in the head counts for the four adjustments considered above, versus the initial head count. The graphs are far from encouraging. The spatial variation of poverty increases when we adjust for these public services. This finding indicates that the services are not always provided in the poorest villages. For the PDS adjustments, the village-wise variation in head counts increases from 0.333 to 0.354 in terms of the coefficient of variation. This finding is worrisome, especially since the PDS is intended to be targeted towards the poor. We find a similar pattern for public schooling but that relationship is weaker. The coefficient of variation on village-wise poverty rates increases from 0.333 to 0.349 for the schooling adjustments (fixed imputed values). For health care however, the pattern is the opposite, and our adjustments make a larger dent in poverty for the poorest villages. Here the village-village dispersion falls to 0.329 in terms of the coefficient of variation.

Finally, Table 19 displays the correlation coefficients of the village-wise changes in head counts from the different adjustments. For schooling it uses the changes from the direct imputation

approach.[7] The correlation coefficient between the PDS and health care is the only one significant at a reasonable level. We do find that the changes resulting from all three adjustments are positively correlated which suggests some clustering in the provision of public amenities and transfers. Households in villages that benefit from one type of public transfers are also more likely to benefit from others.

FIGURE 7: Changes in head counts

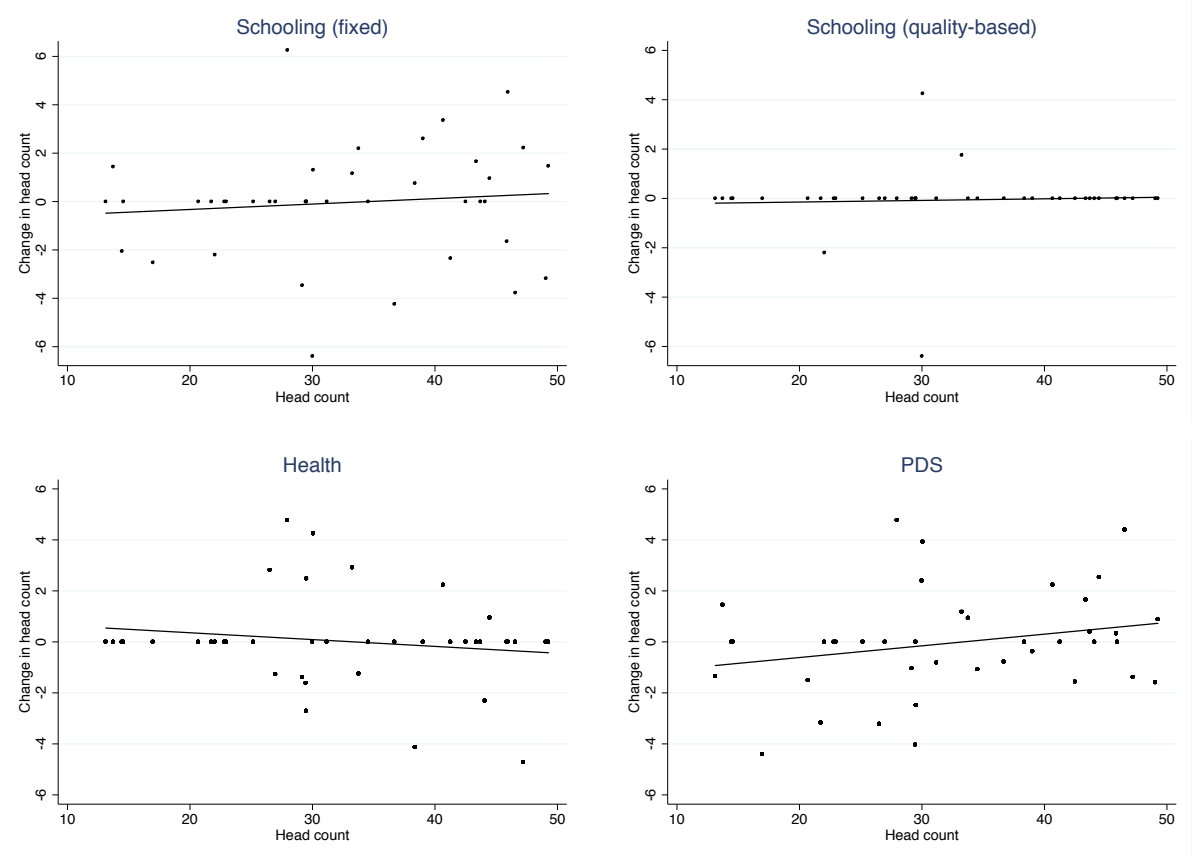


TABLE 19: Correlation village-wise head count adjustments

	Schooling	Health care	PDS
Schooling	1.00		
Health care	0.21	1.00	
PDS	0.22	0.34	1.00

In future work we plan to take a more careful look at appropriate procedures to make theses adjustments and to combine our primary data with the NSS expenditure surveys to examine the effects of public goods on measures of inequality and poverty.

[7]This is just for a clearer presentation. The correlation coefficients for the quality-based imputations are similar.

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