Look no farther: The impact of local contract teachers on student outcomes

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Abstract

The increasing number of contract teachers in developing countries has led to concerns about the effect of their employment on teacher quality. Contract teachers are in general less trained and qualified. However, they are more likely to be hired from the local community, which can positively affect student outcomes by reducing social distance or through better monitoring. This paper provides evidence on the difference in the impact of contract and regular civil service teachers with a special focus on the effect of being a local teacher or native of the village. Using a value-added estimation method, based on data from a unique survey in India, we find no statistically significant difference in the performance of contract and regular teachers for both grades 4 and 6. However, within contract teachers, we observe that local teachers have a significant and positive impact (0.24 standard deviation) on student learning for grade 6.

Keywords: teacher quality, contract teacher, local teacher, developing countries

JEL Codes: I21,I28, J45

1 Introduction

Many developing countries have made substantial progress in increasing enrollments in primary education since the 1990s. Nevertheless, this rise in demand for education has met with serious teacher shortages (UNESCO, 2015). Evidence from both developed and developing countries shows that teachers play a critical role in improving the quality of education (Araujo, Carneiro, Cruz-Aguayo, & Schady, 2016; Bau & Das, 2018; Chetty, Friedman, & Rockoff, 2014b; Hanushek & Rivkin, 2006; Rockoff, 2004). With limited budget and institutional capacity, most of the developing countries find it difficult to hire good quality teachers. This problem is exacerbated by asymmetric information on teacher quality, as most of the observable characteristics such as qualification, training, salary, etc. explain little of the variation in their effectiveness.[1](Azam & Kingdon, 2015; Bau & Das, 2018; Kane, Rockoff, & Staiger, 2008; Rivkin, Hanushek, & Kain, 2005) Therefore, to ensure learning for millions of children in developing countries, identifying policies to hire quality teachers in a cost-effective manner is a matter of utmost priority.

Hiring contract teachers[2] has been advocated by many as one of the ways to improve teacher supply in a cost-effective manner for primary grades. In comparison to regular teachers, contract teachers have less stringent entry requirements in terms

[1]One exception is initial years of experience. Teachers perform more poorly on overage in the first few years of their teaching career, but there is no significant effect of teacher experience on student performance after accounting for initial years (Hanushek & Rivkin, 2006).

[2]Chudgar, Chandra, and Razzaque (2014) use the term *alternative route* for *"any teacher hiring in which some element of the standard process has been diluted to allow school systems to fill vacant teaching positions."* We follow this broad definition when we refer to contract teachers throughout the paper. The diverse nature of hiring teachers through alternative methods makes it difficult to call them by a single name. In India, they are often termed *para teachers* while elsewhere they are called *contract teachers*.

of teacher training and qualification certificates, are paid less, and are usually hired in a decentralized way from the local community (see Chudgar et al., 2014 for a detailed review on contract teachers). Earlier research has shown that teachers in developing countries face serious motivation problems with poorly incentivized contracts and lack of accountability (Chaudhury, Hammer, Kremer, Muralidharan, & Rogers, 2006; Pritchett & Murgai, 2006). In an extensive review Kremer, Brannen, and Glennerster (2013) highlight that reforms that improve accountability and incentives such as the local hiring of teachers on short-term contracts are effective in improving teacher effort. Contract teachers thereby provide an opportunity to improve student learning through (a) incentivized contracts and (b) better monitoring or accountability at the local level.

Existing evidence shows that contract teachers perform equally or even better than regular civil service teachers (Duflo, Dupas, & Kremer, 2015; Muralidharan & Sundararaman, 2013), although the effeciveness might vary depending on the incentive structures, heterogeneity in student ability, and the level of accountability and management. For instance, Bourdon, Frölich, and Michaelowa (2010) use an extensive data set across three countries in Africa (Niger, Togo, and Mali) to analyze the effect of contract teacher policy. One of the main findings of their study is that contract teachers may do better than regular teachers in a low-ability context, whereas regular teachers might do better in a less disadvantaged student environment. The authors find that in Mali contract teachers had a positive effect on student outcomes since the system worked through the local communities. In the case of Niger the effect of contract teachers was negative. This may be explained by the fact that the

system changed all contract teachers to centralized public employees, making them free from local monitoring. In another study, Atherton and Kingdon (2010) use a value-added method with school-fixed effects to estimate contract teacher effects on student test scores *within* schools in the Indian states of Bihar and Uttar Pradesh. They find a positive effect of contract teachers in the case of Uttar Pradesh, where contracts are renewed yearly, but no significant effect for the state of Bihar, where contract teachers are hired on a permanent basis. The data used for this paper are also for the Indian state of Bihar, where contract teachers are hired for life. Therefore, we do not expect to observe any impact on student outcomes through the incentive mechanism.

This paper provides additional evidence on the effect of contract teachers on student learning outcomes. Do contract teachers differ in performance from regular teachers? While most of the studies on contract teachers have focused on lower primary grades, this paper provides evidence for both grades 4 and 6. Additionally, we test if being a local/native teacher (born in the same village where school is located) explains variation in teacher quality. Earlier studies have focused on whether the hiring is centralized or decentralized to study the impact of local monitoring of teachers (Bold, Kimenyi, Mwabu, Sandefur, et al., 2018; Bourdon et al., 2010). We focus our analysis on the impact of teachers being local, i.e hired from the same village where the school is. The local nature of teachers is an important and distinctive feature that might induce them to exert more effort in difficult environments (remote areas, disadvantaged students) because of reduced social distance (Rawal, Kingdon, et al., 2010) or because they are more content to work in remote areas compared

to regular teachers (Fagernäs & Pelkonen, 2011). To estimate the effect of a local teacher we take advantage of the fact that in our dataset not all contract teachers are hired locally. For better identification of local teacher effect, we look at variation in teacher quality among contract teachers only, as they form a more homogeneous group of teachers.

In order to answer the above questions, we make use of a unique dataset from a survey commissioned by the World Bank and the Government of Bihar in collaboration with ASER Centre, New Delhi (see Sinha, Banerji, and Wadhwa (2016) for a detailed description of the survey). The matched student teacher data from public schools have details on teacher and student characteristics, performance on tests (administered during the survey) for both teachers and students, and information on various classroom indicators. The survey spans four districts in the rural areas of the state of Bihar, India. Information was collected at three points in time over one academic cycle (2013-14). To estimate the difference in the effect of the two types of teachers we use value-added specification of an education production function.

We find that although contract teachers are very different from regular teachers when it comes to various observable characteristics (professional qualification, training, age, gender), there exists no statistically significant difference between the performance of the two types of teacher for both grades 4 and 6. Though earlier studies report a positive effect of contract teachers on student performance (Duflo et al., 2015) the 'no effect' in our study could be due to the fact that contract teachers in the state of Bihar are less incentivized (Atherton & Kingdon, 2010). They are hired for life and the school or the local community has no say in renewal or

discontinuation of the contract. Our results raise similar concerns regarding large scale expansion of contract teacher hiring in public schools, as discussed by Bold et al. (2018). Due to political and administrative constraints (teacher unions etc.), most of the developing countries might find it difficult to implement flexible teacher contracts, which seems to be important for achieving learning gains.

Another mechanism through which contract teacher might have a positive affect on learning is local hiring. Comparing local and non-local contract teachers, we obtain a statistically significant and positive effect of a local teacher on student outcomes of 0.24 standard deviation for grade 6 only. The fact that hiring teachers from the local community might be important for their effectiveness in a rural setting invites further investigation with more detailed data to understand the mechanisms behind this finding.

The paper is divided into six sections. In the following section we provide a background of elementary education and teacher hiring policy in India. This is followed by data and descriptive statistics in Section 3. In Section 4 we discuss the estimation technique and Section 5 elaborates the result, followed by conclusion in the last section.

2 Education system and contract teachers in India

In India there exists a common school education structure (10+2), divided into four parts: primary, upper primary, secondary, and higher secondary. Primary (grades 1 to 5) and upper primary (grades 6 to 8) together constitute elementary education,

corresponding to the age group 6-14 years. Table 1 outlines these levels along with the associated grades and ideal age range. The school system functions under a federal structure such that the control and management of schools is under the state governments. The central government is mainly responsible for laying down broad policy frameworks with a view to maintain uniform quality standards across the nation. The central government also provides funding to states through various centrally sponsored schemes to meet education development goals.

	Grades	Age
Primary	I-V	6-10
Upper- primary	VI-VIII	11-13
Secondary	IX-X	14-15
Higher Secondary	XI-XII	16-17

Source: MHRD, 2018

Table 1: Levels of education

Since the 1990s India has witnessed continuous expansion in elementary education through various centrally sponsored programs like the District Primary Education Programme (DPEP) in 1994 and the Education for All Campaign (Sarva Shiksha Abhiyan, SSA) in 2002. In 2010 the Right to Education Act (RTE) was passed, making elementary education free and compulsory for all children 6-14 years old. Subsequently the country made considerable strides in achieving its goal of universal elementary education with the net enrollment ratio reaching 98% in 2009-10 (Government of India, 2013).

With a steady increase in enrollment rates across most parts of the country, the focus of the government has been shifting toward improving the quality of education (Muralidharan, 2013). Various studies in recent years have highlighted the dismal

state of student performance across the country. A nationwide study by ASER Centre reported that the proportion of children in rural India in grade 5 who can read a grade 2 level text is 47% and only 25.6% can solve a 3-digit by 1-digit division problem (Pratham, 2014b). In 2009 the country ranked 73 out of the 74 nations that participated in the PISA study conducted by OECD. Closely related to the issue of quality of schools is the quality of the teaching workforce. The country is not only witnessing an acute shortage of teachers, but their lack of motivation has also been a major cause of concern (Chaudhury et al., 2006).

In India the practice of hiring contract teachers gained prominence during the 1990s with the thrust in policy toward more decentralized management of schools to meet the rising education demand in a cost-effective manner (Kingdon & Sipahimalani-Rao, 2010). Consequently, many states started to fill teacher vacancies through an alternative process of hiring teachers on a fixed term contract from the local community with less strict entry restrictions (Chudgar et al., 2014). Around 2000-01, the centrally sponsored scheme of universalizing elementary education (Sarva Shiksha Abhiyan (SSA)) laid down norms that further boosted the hiring of contract teachers.

By the year 2009-10 there were about 637,000 contract teachers working in the country, with their overall proportion in government schools reaching close to 14.4% (Mehta, 2009). The service conditions, qualifications, and salaries of contract teachers vary across the country as does the nomenclature – *shiksha mitra* in Uttar Pradesh, *shiksha sahayak* in Odisha, *niyojit shikshak* in Bihar, guest teachers in Delhi. However, recent regulations with insistence on professional training cut back

the hiring of contract teachers, with many states struggling to find ways to absorb them effectively in the system (Chudgar, 2013).

In the state of Bihar, where this study was conducted, the *Panchayats* or the local self governance bodies were given the responsibility for the recruitment of contract teachers from the local communities around the year 2005-06. This led to a massive hiring drive following which about 300,000 contract teachers were hired, and the number of teachers in elementary schools almost doubled during the period 2006 to 2013 (Sinha et al., 2016).

3 Data

3.1 Background

The data for this study are derived form a survey that was commissioned by the World Bank and the Government of Bihar in collaboration with ASER Centre, New Delhi. The survey was conducted in 400 randomly selected government elementary schools in four districts in the rural areas of the state of Bihar in India.[3]

Bihar is the third most populous and one of the poorest states in India. Table 2 gives a brief overview of the four districts where the survey was carried out. Bihar has the lowest literacy rate in the country, with female literacy rate as low as 51.5% (Census, 2015). Over the last decade the state has achieved great success in increasing access to schooling but still performs poorly on various quality indicators. According to Pratham (2014a) the percent of children in grade 5 who can read a

[3]According to The Annual Status of Education Report (Pratham, 2014b) 82.4% of children in the age group 6-14 years in rural region of Bihar were attending government schools.

grade 2 level text fell from 65.4% in 2006 to 48.2% in 2014. It is also one of the states in India with lowest student attendance rates.[4] Our survey data also show that the average student attendance was as low as 57%.

District	Population (millions)	Lit. rate (all)	Lit. rate (female)	Female ratio[1]	Percent urban
Purnia	3.3	51.1	42.4	921	10.5
East Champaran	5.1	55.8	45.1	902	7.9
Jamui	1.8	59.8	47.3	922	8.3
Rohtas	3.0	73.8	63.0	918	14.5
State of Bihar	104	61.8	51.5	918	11.3
All India	1210	74.0	65.5	940	31.2

[1]Female per thousand male. Source: Census, 2015

Table 2: Description of Districts

In our survey data we find evidence of expansion in contract teacher hiring since 2005 (Figure 1). Overall, close to 73% of teachers are contract teachers and around 40% of them are hired from the village where the school is. However, there is a steady decline in the number of contract teachers hired locally, from around 60% in 2005 to less than 10% in 2013 (Figure 1). The state of Bihar still faces huge teacher shortages.[5] Data from our survey reveal that in Bihar the average student-teacher ratio for all grades combined in our sample schools is close to 62. Also, there is a high incidence of multi-grade teaching, a practice in which students of different grades sit in the same classroom, mainly due to the shortage of teachers. In our data in almost 60% of schools children in grade 4 were found sitting with another grade during the

[4]States like Uttar Pradesh, Bihar, Madhya Pradesh, and Jharkhand have student school attendance rates of below 60% in public schools (Government of India, 2013).

[5]According to an answer given in the *Lok Sabha* (lower house of Parliament), of the approx. 907,000 total vacant teacher posts in government elementary schools across India, close to 22% (203,000) are in Bihar alone (MHRD, 2016).

field visits.

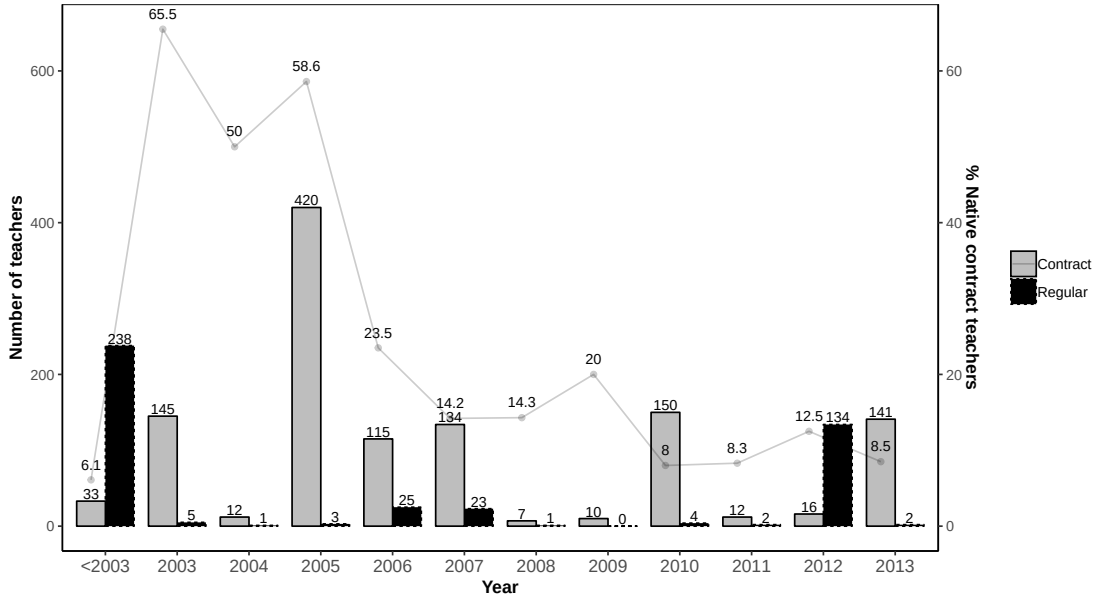

Figure 1: Number of contract and regular teachers by year of appointment and proportion of contract teachers who are native. Source: Authors' own calculation. The bar plot in the figure gives the number of contract and regular teachers by year of appointment. The line plot indicates the proportion of contract teachers that are hired locally, that is, from the same village where the school is located. Since the number of local regular teachers in very small, we do not plot it in the figure. Also, we add together the number of teachers appointed before 2003 because of low frequency for years before 2003.

3.2 Survey design and sample description

There were three phases of data collection whereby close to 400 randomly selected schools in four districts were tracked over a period of one year starting in September 2013. Information was collected through classroom and school observation formats, teacher interviews, and teacher and student assessments. The stages and periods of data collection are shown in Figure 2.

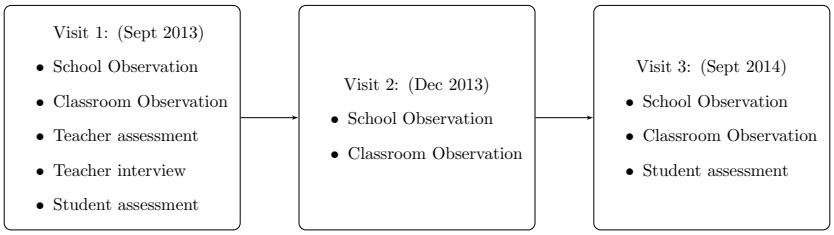

Figure 2: Stages of the survey

Of the 400 schools 214 are upper-primary in our survey data. For the purpose of our analysis we look at only these upper-primary schools since student assessments were conducted in these schools only. Ten children from grade 4 and ten from grade 6 in each upper-primary school were randomly selected and assessed in language and math at the beginning of an academic year (September 2013) and then at the beginning of the next academic year (September 2014). In Table 3 the details of the sample are given. The total number of children assessed is 4260 in baseline and 3927 in endline (Table 13 in appendix A compares the mean performance of those students that were tested in both visits and those that dropped out). A total of 1656 teachers were interviewed and assessed.

District	Schools	Teachers	% Contract	% Native[1]	Student Assessments			
					Grade 4		Grade 6	
					2013	2014	2013	2014
Purnia	60	427	73	34	600	548	600	538
E. Champaran	50	428	78	42	500	469	500	481
Jamui	53	345	79	27	530	483	530	479
Rohtas	51	456	65	36	500	465	500	464
Total	214	1656	73	36	2130	1965	2130	1962

[1]Perecent of contract teachers that are Native.

Table 3: Survey sample data

To calculate the teacher effect we need to match students uniquely to the teachers who taught them throughout the academic year. To uniquely match teachers to students of grades 4 and 6 we needed information from classroom observation. As part of the study, surveyors had to observe teaching-learning activities of language teachers in grades 4 and 6 during the lectures. Unfortunately, math teachers cannot be identified as they were not observed as part of the survey. There were three such classroom visits spread over the academic year (Figure 2). To make sure that children had the same teacher for most of the academic year, we include only those teachers who were found teaching language to the same students at least twice out of the three visits. Although this helps us to match students to teachers more confidently, it reduces our number of teachers to 339 (only language teachers) in a total of 199 schools. In Table 14 in appendix A we provide a comparison of characteristics of all teachers and those who are included in the final sample. For our main variables of interest we find no significant difference.

Table 4 provides a summary of the final data set that was used for analysis. Student z-scores were created by standardizing the language score for each grade and for each visit separately. Table 5 gives a detailed summary of student baseline and endline non-standardized scores by grade and subject. As stated earlier, students from grade 4 and 6 in upper-primary schools were assessed in language (Hindi) and math. One can see that the performance of students has improved over the academic year (Figures 4 and 5 in appendix B give the density plots of total scores of students at baseline and the endline visits to schools).

	N	Mean	St. Dev.	Min	Max
Student variables					
z-score baseline*	3,390	0.01	0.99	−1.78	2.33
z-score endline*	3,122	0.001	0.99	−2.48	1.87
Female=Yes	3,356	0.52	0.50	0	1
Age in years	3,241	10.89	1.37	8	16
Grade level variables					
Grade=6	339	0.51	0.50	0	1
Multigrade=Yes	338	0.48	0.50	0	1
% Attendance: grade 4,6 combined	336	56.20	18.46	4.55	96.67
Class size: grade 4,6 combined	337	73.3	50.0	15	396
Teacher variables					
Contract=Yes	334	0.75	0.43	0	1
Female=Yes	323	0.39	0.49	0	1
Age in years	321	37.52	9.00	20	78
Qualification					
Professionally qualified=Yes	313	0.49	0.50	0	1
Graduate or above=Yes	319	0.49	0.50	0	1
Experience (yrs.)	321	7.13	5.75	1	39
Training (days)	310	10.43	11.65	0	60
Math score	339	6.73	3.52	0	12
Hindi score	339	4.39	2.21	0	9
Work environment					
Native to village=Yes	320	0.31	0.46	0	1
Travel time (mins.)	320	38.33	55.71	0.00	720.00
Years in same school	320	5.43	3.47	1	24
No. of Transfers	317	0.35	0.82	0	4
Other activity=Yes	321	0.31	0.46	0	1
School variables					
Distance from HQ.	199	39.88	19.25	5	88
% Student attendance†	199	58.58	11.38	25.04	86.40
Infrastructure index **	199	5.08	1.46	1	7
Average Math score§	199	11.74	2.80	4.95	19.25
School size					
Total enrollment†	199	512.74	242.25	156.00	1,942.67
Total teachers†	199	8.78	3.65	2	22
Student teacher ratio †	199	61.79	23.88	19.50	156.25
Monitoring					
Principal in school=Yes	199	0.14	0.35	0	1
BRC visits‡	199	4.21	0.67	1.67	5.67
SMC meetings‡	199	3.78	0.69	1.00	5.00
Schools	199				
Teachers	339				
Students	3,390				

Notes: * z-scores were created by normalizing the total language score in each grade and in each visit
** Infrastructure index is a sum of seven indicators available in school: drinking water, toilet, separate girl's toilet, boundary wall, library, timetable, and mid-day meal menu displayed on wall.
§Average math score is calculated by taking a simple average of grade level mean math scores for grades 4 and 6.
† Student and teacher enrollment, percent attendace, and student teacher ratio were calculated by taking an average of the information from the three visits.
‡ BRC: Block Resource Co-ordinator, SMC: School management committee. The scale is average of three visits, higher value means meetings are held more often.

Table 4: Descriptive statistics

Grade 4					
Statistic	N	Mean	St. Dev.	Min	Max
Language baseline	1,660	8.1	4.8	0	18
Language endline	1,527	10.5	4.8	0	18
Math baseline	1,660	9.4	4.8	2	20
Math endline	1,527	11.5	5.1	0	20
Grade 6					
Language baseline	1,730	17.4	8.4	2	37
Language endline	1,595	21.2	8.4	0	37
Math baseline	1,730	14.2	6.0	2	28
Math endline	1,595	16.7	6.1	1	28

Table 5: Student score description by visit and grade

More than half of the children (52%) in the age group 8 to 16 in government upper-primary schools are girls (Table 4). There is a high incidence of multigrade teaching (48%). One can also notice the prevalence of low student attendance (56%) and large classes with average class size of around 73 students. More than three-fourths of the teachers are contract teacher with an average age of around 38 years. Close to 31% of all teachers are native to the village where the school is located. The proportion of teachers that are female is 39%. Almost half of the teachers are professionally trained and hold a graduate degree.

School variables were recorded three times over the academic year. Instead of using information from just one visit, we use a simple average over the three visits for certain variables such as student and teacher enrollment, attendance, and student teacher ratio. Similarly, for variables related to monitoring visits by the Block Resource Co-ordinator (BRC) and the School Management Committee (SMC) we create a scale that is an average of three visits. The questions that were asked to the primary respondent at school were (i) when was the last time the SMC had a

meeting? (ii) when was the last time a CRC or BRC functionary visited the school? Based on the response category, scores were created such that a higher value indicates that meetings are held more often.[6]

We found that most of the schools were equipped with basic infrastructure facilities. On average schools had five of the seven basic amenities listed in the questionnaire.[7] On average there are eight to nine teachers in each upper-primary government school. The probability that there is a principal appointed in school is extremely low, at just 14%.

3.3 How different are the two types of teachers?

In this section we briefly discuss the difference between contract and regular teachers and local and non-local teachers. We also check the possibility that these different types of teachers are assigned to different types of classes. Thus, we look at their differences in terms of their own characteristics and also their work environment.

Table 6 presents several teacher characteristics by teacher type. It can be seen that there are significant differences between the two types of teachers. Regular teachers are professionally more qualified (difference of almost 43 percentage points) and trained. However, when it comes to educational qualification (graduate or above) the difference between the two is not significant. Regular teachers have higher scores in language test administered during the survey (0.69 points higher) but the difference

[6]The response category and corresponding scores are: *Never,Don't Know*=0, *More than 6 months ago*=1, *During the last 6 months*=2, *During the last 3 months*=3, *During the last month=4*, *During the last week*=5, and *Today*=6

[7]Infrastructure index is a sum of seven indicators available in school: drinking water, toilet, separate girl's toilet, boundary wall, library, timetable, and mid-day meal menu displayed on wall.

is not significant in math.

	Contract	Regular	*Difference*	p.value[1]
%Female	44.63	23.46	21.17	0.00
Age in years	34.17	47.43	-13.26	0.00
%Professional qualified	38.03	81.01	-42.98	0.00
%Graduate or above	50.84	43.21	7.63	0.29
Experience	6.52	8.94	-2.42	0.04
Training (days)	8.58	15.65	-7.07	0.00
Math score	6.75	7.07	-0.33	0.44
Hindi score	4.29	4.98	-0.69	0.01
Teach Grade 6	47.22	62.20	-14.97	0.03
Multigrade=Yes	50.60	40.24	10.35	0.10
Class size	70.77	80.81	-10.05	0.12
Student attendance	55.87	56.43	-0.55	0.82
%Native to village	40.17	4.94	35.23	0.00
Travel time (min)	31.84	57.49	-25.65	0.02
Years in same school	6.26	2.99	3.28	0.00
Transfers	0.09	1.11	-1.02	0.00
BRC visits	4.26	4.06	0.20	0.03
SMC meetings	3.79	3.78	0.01	0.89
Principal in school=yes	15.08	12.20	2.88	0.64
N	252	82		

[1]p.value for t-test of difference in mean

Table 6: Difference in mean by teacher type-All teachers

We next look at the difference between the two types of teachers regarding various classroom and school level indicators. We find that contract teachers are less likely to teach upper primary grades (grade 6) compared to primary grades (grade 4) but they are not different when it comes to other classroom indicators such as the likelihood of teaching a multigrade class, class size, or class attendance. We also find that on average there are more monitoring visits (BRC visits) in the case of contract teachers than regular teachers. Another important point to notice from Table 6 is that there is

a higher proportion of female contract teachers than regular teachers (21 percentage point difference), which is interesting as the state has been struggling to increase the number of female teachers in schools. Last, we find that contract teachers are much more likely to be hired from the same village as the school compared to regular teachers (35 percentage point difference).

Noticing the stark differences between contract and regular teachers, we go a step further and consider only contract teachers to obtain a more homogeneous group of teachers and then compare the difference between a native and a non-native teacher. In Table 7 we see that local teachers are mostly female who have been teaching in the same school for a longer period. More importantly, they are not very different from non-local teachers in terms of education and training or any grade or school level indicators, except for multigrade teaching. We take advantage of this fact to isolate the impact of being a local teacher.

	Native *(mean)*	Non-Native *(mean)*	*Difference in mean*	p.value[1]
%Female	62.50	32.87	29.63	0.00
Age in years	34.90	33.74	1.15	0.22
%Professional qualified	34.41	40.71	-6.31	0.41
%Graduate or above	50.00	51.77	-1.77	0.89
Experience	8.04	5.53	2.51	0.00
Training (days)	9.01	8.28	0.73	0.56
Math score	7.02	7.07	-0.05	0.91
Hindi score	4.34	4.58	-0.24	0.36
Teach grade 6	48.96	46.85	2.11	0.85
Teach Multigrade	37.50	57.75	-20.25	0.00
Class size	75.28	68.00	7.28	0.19
Class attendance	54.85	56.63	-1.78	0.46
Travel time (min)	15.49	42.94	-27.45	0.00
Years in same school	7.75	5.31	2.43	0.00
Transfers	0.09	0.09	0.01	0.85
BRC visits	4.24	4.29	-0.05	0.53
SMC meetings	3.83	3.80	0.03	0.69
Principal in school=yes	17.71	13.29	4.42	0.45
N Teachers	96	143		

[1]p.value for t-test of difference in mean

Table 7: Difference in mean by locality (Native or not)- Contract teachers

4 Methodology

One of the major impediments to the estimation of the causal effect of teachers on student performance is the non-random allocation of students to schools and teachers. As a consequence, one needs to account for the selection of students into certain neighborhoods, schools, and teachers on unobservable student, family and school level components. One such specification is the value-added approach, which assumes that the lagged achievement score of students can account for the unobserved time-

constant history of student and family inputs, as well as for time-varying historical student and school-based inputs (Sass, Semykina, & Harris, 2014; Todd & Wolpin, 2003). Thus, to estimate the difference in the affect of the two types of teachers we use value-added specification of an education production function.[8]

Based on the theoretical underpinning that child development is a cumulative process depending on the history of family and school inputs and her/his own endowment or ability, we start our model with the commonly accepted equation of the education production function.

$$A_{it} = A_t[X_i(t), F_i(t), S_i(t), \mu_{i0}, \epsilon_{it}] \tag{1}$$

where A_{it} refers to child $i's$ achievement at the end of t years in life. $X_i(t)$, $F_i(t)$, and $S_i(t)$ refer to the histories of individual, family, and school inputs respectively. μ_{i0} represents the child's endowment or ability, which is inherited and does not vary with time, and ϵ_{it} is the error term.

As a first look at the difference in value-added by teacher type, we run a simple t-test for difference in average test scores of students. Table 8 reports the result of difference in difference of average student test scores in the first (baseline) and the last (endline) visit by teacher type for both grades separately. There are two main takeaways from this table: *first*, there is a significant difference in the average baseline scores (row 1) of students under contract and regular teachers (column 3 and 6). For instance, in grade 6 students under contract teachers perform 1.03 points

[8]For updated discussions on potential biases in value-added estimation one can look at Andrabi, Das, Khwaja, and Zajonc (2011), Bau and Das (2018), Chetty, Friedman, and Rockoff (2014a).

lower on average compared to students under regular teachers. This is indicative of some sorting of teachers by student ability. Thus, it makes a strong case for isolating initial difference in performance to estimate contract teacher effect and justifies our use of a model in which we account for initial student performance. *Second*, the initial negative differences in average scores by teacher type are reversed for grade 4 (row 3 column 3). Students under contract teachers gain significantly more than students under regular teachers between the two test dates (0.69 points on average). For grade 6 there is no significant difference (row 3 column 6). These results provide some support for the existence of positive effect of contract teachers on student performance for grade 4 only.

Assuming that the arguments in equation 1 are linear and additively separable, the model to estimate the impact of contract teacher on student performance can be written as follows:

$$A_{ijkn,t} = \lambda A_{i,t-1} + \alpha X_i + \beta S_j + \gamma C_k + \delta(Contract)_n + \phi T_n + \eta_{ijkn} \tag{2}$$

This equation is a variation of the *partial persistence* model used in Sass, Semykina, and Harris (2014). $A_{ijkn,t}$ is an indicator of current student performance or test scores. $A_{i,t-1}$ is the lagged test score, X_i, S_j, and C_k represent the current student, school, and grade characteristics respectively. $Contract_n$, the dummy for teacher type, which takes value one if the teacher is a contract teacher and zero otherwise, is our variable of interest. As a further step, we also include other teacher characteristics in the vector T_n to identify if other teacher-specific features (qualification, training, gender, and being local) explain any variation in student performance. The

above specification uses $A_{i,t-1}$ to account for all previous inputs relevant for student outcomes. Estimates could still be biased due to the selection of teachers to schools and grades. It has been documented that contract teachers work in remote or more difficult areas compared to regular teachers. If teachers are selected into schools based on school quality, then our estimates of teacher-effect would be biased. Also, there can be sorting of teachers inside schools between or within grades. We saw in Table 8 that on average contract teachers receive students with poorer results. Therefore, before making causal inferences about the effect of teacher-type we take into account the possibility of non-random allocation of teachers to schools and grades.

	Grade 4			Grade 6		
	Cont.	Reg.	*Diff.*	Cont.	Reg.	*Diff.*
	(1)	(2)	(3)	(4)	(5)	(6)
Baseline	8.01	8.58	-0.57*	17.09	18.12	-1.03**
	(0.13)	(0.25)	(0.30)	(0.25)	(0.37)	(0.45)
Endline	10.55	10.47	0.09	20.67	22.38	-1.71***
	(0.14)	(0.25)	(0.31)	(0.26)	(0.37)	(0.46)
Difference	2.62	1.93	0.69**	3.54	4.20	-0.66
	(0.14)	(0.23)	(0.31)	(0.24)	(0.49)	(0.45)

Standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table 8: Difference in student language test scores by visit and teacher type: t-test

We first check if there is any selection of teachers on observable district, school, or grades level indicators (Table 9). We run a logistic regression with teacher type as the binomial dependent variable and various school and grade level indicators along with district dummies as the explanatory variables.

Dependent variable: Contract teacher dummy			
	(1)	(2)	(3)
Distance from HQ.	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.008)
Total enrollment	-0.001*	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Student teacher ratio	0.001	0.001	0.002
	(0.006)	(0.007)	(0.008)
Teacher attendace	0.011	0.007	0.006
	(0.011)	(0.011)	(0.012)
Infrastructure Index	-0.100	-0.006	0.032
	(0.106)	(0.104)	(0.111)
Principal=Yes	0.193	-0.114	-0.169
	(0.403)	(0.429)	(0.456)
BRC visits	0.530***	0.582***	0.626***
	(0.187)	(0.197)	(0.203)
SMC meetings	0.092	0.033	0.008
	(0.206)	(0.212)	(0.216)
Average math score	-0.108**	-0.066	-0.081
	(0.048)	(0.053)	(0.055)
Rohtas		-0.975**	-0.988**
		(0.428)	(0.453)
Purnia		-0.618	-0.679
		(0.418)	(0.427)
E. Champaran		0.801	0.770
		(0.535)	(0.540)
Teach grade 6=yes			-0.628**
			(0.316)
Multigrade=yes			-0.005
			(0.355)
Class attendance			-0.001
			(0.009)
Class size			-0.001
			(0.005)
Observations	334	334	330
Pseudo R^2	0.047	0.095	0.111

Jamui district is taken as base category. Standard errors in parentheses. We use robust standard errors. *p<0.1; **p<0.05; ***p<0.01

Table 9: Logit regression of contract teachers on school and grade factors

There are four important takeaways from the regression results in Table 9. *First*, looking at the district dummies we find that contract teachers are less likely to be working in the district of Rohtas compared to Jamui (used as the base category). For other districts the difference is not significant. From Table 2 we know that Rohtas is the district with the highest literacy and urbanization rates compared to all other districts. This indicates that contract teachers are more likely to be present in resource constrained areas.

Second, we do not find any school quality variables explaining sorting of teacher to schools within district. In column 1 of Table 9 the variable *Average math score*, which we use as an indicator of initial school quality, is negative and statistically significant, implying that contract teachers are more likely to be in schools with lower student performance. But when we look at within-district variation *Average math score* is no longer statistically significant (columns 2 and 3). Thus, by including district dummies, we are more confident of our estimates of contract teacher effect, assuming that there is no sorting of teachers to schools within districts.

Third, in all specifications we notice that contract teachers are more likely to be in schools with better monitoring mechanisms. This is evident from the positive and statistically significant sign of the variable BRC visits. Contract teachers are thus more likely to be in schools that have frequent monitoring visits by the BRC (Block Resource Co-ordinator). *Fourth*, the regression specification in column 3 includes grade level indicators to check for sorting between grades. Although contract teachers are less likely to teach grade 6 compared to grade 4, other grade-level features such as multigrade teaching, class size, and student attendance do not vary significantly

between the two types of teachers.

To summarize, we do not find evidence that within-districts teachers are selecting themselves or are otherwise placed in schools based on most of the observable school or grade level quality indicators except for monitoring. So, our main approach is to estimate equation 2 and include district dummies. However, there may still be selection of teachers to schools based on unobservables. One way to deal with the non-random allocation of teachers to schools on unobservable school factors is to focus on variation in teacher effect within schools by using school fixed effects. The school fixed effect model can be written as follows:

$$A_{ijkn,t} = \lambda A_{i,t-1} + \alpha X_i + \gamma C_k + \delta(Contract)_n + \phi T_n + (\nu_j + \eta_{ikn}) \qquad (3)$$

where ν_j captures the unobserved school-level characteristics. In order to make sure that there exists variation within schools, we need at least two different teacher observations in each school. In our sample we have at most two teacher observations (one for grade 4 and another for 6). Although we can exploit this variation in teachers by grades to apply school fixed effect, we use this in our analysis only as a robustness check due to the small teacher sample size within schools.

In our sample schools the probability of selection within grades is negligible, as from the three classroom visits it was found that the incidence of multiple classes for a particular grade was very low in our sample schools. The proportion of schools with single class in grade 4 and grade 6 was 97% and 93% respectively. Thus, selection to classes within grades is not an issue.

In addition to the above models (equations 2 and 3) another way to look at the

difference in the quality of contract and regular teachers is to estimate the distribution of teacher value added by teacher type. In order to obtain teacher value added we estimate the following equation:

$$A_{in,t} = \lambda A_{i,t-1} + \alpha X_i + \sigma Tid_n + \eta_{in} \tag{4}$$

where σ is the teacher fixed effect coefficient for every teacher Tid_n. We estimate teacher fixed effect $\hat{\sigma}$ and compare the distribution for different teacher types. We then estimate equation 5 below to determine if any of the teacher characteristics (T_n) explains variation in our estimated teacher fixed effect.

$$\hat{\sigma}_{njk} = \phi T_n + \eta_{njk} \tag{5}$$

One caveat to estimating teacher fixed effect from our data is that we do not have teacher observations for more than one year or different student cohorts over time. Therefore, we cannot isolate classroom level shocks from teacher fixed effect. However, we are able to control for grade characteristics and have seen that selection to classes withinin grades is not an issue in our sample of schools. Thus, we believe that our results are relevant to estimate the impact of local contract teachers. Lastly, earlier we saw that though contract and regular teachers differ along most of their observable characteristics, local and non-local contract teachers form a more homogenous or comparable group. Thus, to isolate the impact of a local teacher we estimate the above equation by focusing only on contract teachers.

5 Results

In Table 10 we present the results from the OLS value-added specification for each grade separately with endline z score as the dependent variable and baseline scores as one of the independent variables. We also include the results for both grades combined in columns 5 and 6. The last two columns report results from the school fixed effect model (equation 3). In columns 1 and 2 we present the results for grade 4 and in columns 3 and 4 for grade 6. As we move from left to right within each grade columns, we add other teacher characteristics to isolate the effect of contract teacher on student performance. For instance, column 1 (3, 5, and 7) is the basic specification with no teacher factors except the dummy for contract teacher. In column 2 (4, 6, and 8) we include other teacher characteristics.

There are some interesting things to note from Table 10. *First*, for grade 4 the effect of contract teacher on student performance is positive though only weakly statistically significant in column 1. The effect size is 0.16 standard deviation. However, once we include other teacher characteristics, the effect is no longer statistically significant (column 2). *Second*, for grade 6 we notice that once we include all factors, contract teacher is found to have a weakly statistically significant and negative effect on student performance (-0.15 standard deviation). Most importantly we find a positive and statistically significant coefficient for being local or native to the village (0.18 standard deviation). The weak significance of contract teacher effect for both grades (and no significant difference in the school fixed specification) imply that they are not much different from regular teachers in terms of student performance. This is in line with previous results reported in the literature.

Dependent variable: Endline z- score								
	Grade 4		Grade 6		Both grades		School-fixed effect	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Contract teacher	0.16*	0.10	−0.10	−0.15*	0.01	−0.03	−0.06	0.004
	(0.08)	(0.10)	(0.08)	(0.09)	(0.06)	(0.07)	(0.07)	(0.08)
Native=yes		−0.01		0.18**		0.08		−0.06
		(0.10)		(0.09)		(0.07)		(0.08)
Female		0.10		−0.01		0.06		0.14*
		(0.09)		(0.09)		(0.06)		(0.08)
Graduate=Yes		−0.05		−0.04		−0.02		−0.04
		(0.10)		(0.07)		(0.06)		(0.07)
Professional qual=Yes		0.11		−0.06		0.03		0.12*
		(0.10)		(0.08)		(0.06)		(0.07)
Teacher test score		−0.01		−0.02		−0.01		0.003
		(0.02)		(0.02)		(0.01)		(0.02)
Experience >3 yrs.		0.02		−0.20*		−0.10		−0.10
		(0.08)		(0.11)		(0.07)		(0.09)
Training (Days)		−0.005		−0.0002		−0.002		−0.0005
		(0.005)		(0.003)		(0.003)		(0.004)
Previous year z score	0.47***	0.48***	0.46***	0.45***	0.47***	0.47***	0.48***	0.48***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Child female	−0.07	−0.07	−0.03	−0.08*	−0.05	−0.08**	−0.03	−0.05
	(0.05)	(0.05)	(0.05)	(0.05)	(0.03)	(0.04)	(0.03)	(0.03)
Child age	−0.03	−0.04	−0.03	−0.01	−0.03*	−0.03	−0.01	−0.01
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
School factors	Yes	Yes	Yes	Yes	Yes	Yes	SFE	SFE
Grade factors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummy	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Observations	1,436	1,310	1,473	1,344	2,909	2,654	2,909	2,654
R^2	0.309	0.323	0.305	0.332	0.302	0.316	0.238	0.245
Schools (n)	158	144	161	146	191	184	191	184

Notes: This table reports results from the value-added specification to estimate contract teacher effect. Observations are at student level. Columns 1-2, 3-4, 5-6 report results for grade 4, grade 6, and both grades combined respectively. In columns 7-8 we report results from the school-fixed effect specification. The schools factors included are total school enrolment, student teacher ratio, infrastructure index, principal in school, BRC visits, SMC meetings, average math score. The grade factors included are multigrade, class size (columns 5-8 also include an indicator variable for grade). Standard errors are clustered at school level. *p<0.1; **p<0.05;***p<0.01

Table 10: Value-added regression on teacher type - All teachers

Dependent variable: Endline z- score								
	Grade 4		Grade 6		Both grades		School-fixed effect	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Native=yes	−0.07	−0.08	0.14*	0.24**	0.06	0.08	−0.07	−0.13
	(0.10)	(0.11)	(0.08)	(0.10)	(0.06)	(0.08)	(0.10)	(0.10)
Female		0.11		0.03		0.09		0.11
		(0.10)		(0.11)		(0.07)		(0.12)
Graduate=Yes		−0.04		−0.01		−0.03		−0.14
		(0.11)		(0.09)		(0.07)		(0.12)
Prof. qual=Yes		0.09		−0.03		0.03		0.16*
		(0.11)		(0.08)		(0.07)		(0.08)
Teacher test score		−0.01		−0.03		−0.02		−0.01
		(0.03)		(0.02)		(0.02)		(0.03)
Exp >3		0.05		−0.32**		−0.10		−0.04
		(0.11)		(0.14)		(0.10)		(0.14)
Training (Days)		−0.003		−0.001		−0.003		−0.002
		(0.01)		(0.003)		(0.004)		(0.01)
Previous year z score	0.45***	0.46***	0.50***	0.49***	0.48***	0.48***	0.50***	0.50***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
Child female	−0.08	−0.08	−0.06	−0.07	−0.06	−0.07*	−0.03	−0.04
	(0.06)	(0.06)	(0.06)	(0.06)	(0.04)	(0.04)	(0.04)	(0.04)
Child age	−0.05*	−0.06**	0.01	0.01	−0.03	−0.04	−0.03	−0.03*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
School factors	Yes	Yes	Yes	Yes	Yes	Yes	SFE	SFE
Grade factors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummy	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Observations	1,099	1,045	987	915	2,086	1,960	2,086	1,960
R^2	0.306	0.313	0.343	0.356	0.314	0.318	0.247	0.247
Schools (n)	121	115	106	98	163	157	163	157

Notes: This table reports results from the value-added specification to estimate native teacher effect. Observations are at student level. Columns 1-2, 3-4, 5-6 report results for grade 4, grade 6, and both grades combined respectively. In columns 7-8 we report results from the school-fixed effect specification. The schools factors included are total school enrolment, student teacher ratio, infrastructure index, principal in school, BRC visits, SMC meetings, average math score. The grade factors included are multigrade, class size (columns 5-8 also include an indicator variable for grade). Standard errors are clustered at school level. *p<0.1; **p<0.05;***p<0.01

Table 11: Value-added regression on Native - Contract teacher

Next, we turn to our main question of whether being a local teacher is beneficial for learning or not. In Table 11 we run the same specifications as in Table 10 but considering only contract teachers as we saw that they constitute a more homogeneous group. Looking at the results from full-specification in columns 2 and 4 of Table 11 with native teacher as the main variable of interest, we find that for grade 4 there is no significant impact of native teachers but for grade 6 there is a statistically significant and positive effect (0.24 standard deviation) of being a native teacher on student performance.

Finally, we calculate teacher fixed effects using equation 4. We then regress the estimated value-added of each teacher on teacher characteristics. We present grade-wise results of this analysis considering only contract teachers in Table 12. Once again, it can be seen for grade 6 that the effect of native teacher is significant and positive (column 4, 0.24 standard deviation). The relationship between native teacher and teacher fixed effect becomes clear when we plot the estimates of teacher value-added by splitting between local and non-local contract teachers in Figure 3. For grade 6 one can clearly see the difference in distribution of teacher fixed effect for contract teachers who are local and those who are not.

Dependent variable=Teacher fixed effect σ					
	Grade 4		Grade 6		School Fixed effect
	(1)	(2)	(3)	(4)	(5)
Native	−0.01	−0.05	0.20*	0.24**	−0.11
	(0.12)	(0.12)	(0.11)	(0.11)	(0.10)
Female	0.09	0.08	0.04	0.01	0.09
	(0.11)	(0.11)	(0.12)	(0.12)	(0.12)
Graduate=Yes	−0.06	−0.06	0.04	0.001	−0.16
	(0.12)	(0.11)	(0.10)	(0.10)	(0.12)
Prof. qual=Yes	0.07	0.13	−0.04	−0.05	0.15*
	(0.11)	(0.12)	(0.10)	(0.10)	(0.08)
Teacher test score	−0.0005	−0.004	−0.02	−0.03	−0.01
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
Exp>3	0.02	0.05	−0.29**	−0.28*	−0.05
	(0.12)	(0.12)	(0.13)	(0.15)	(0.15)
Training (Days)	−0.01	−0.003	−0.001	−0.001	−0.001
	(0.01)	(0.01)	(0.004)	(0.004)	(0.01)
School factors	No	Yes	No	Yes	SFE
Grade factors	Yes	Yes	Yes	Yes	Yes
District dummy	Yes	Yes	Yes	Yes	No
Observations	115	115	98	98	213
R^2	0.119	0.205	0.134	0.25	0.136

Notes: This table reports results from the teacher fixed effect specification to estimate its association with teacher characteristics. Observations are at teacher level. Columns 1-2, 3-4 report results for grade 4, grade 6 respectively. In column 5 we report results with school-fixed effect. The schools factors included are total school enrolment, student teacher ratio, infrastructure index, principal in school, BRC visits, SMC meetings, average math score. The grade factors included are multigrade, class size (column 5 also includes an indicator variable for grade). Standard errors are clustered at school level. *p<0.1; **p<0.05;***p<0.01

Table 12: Regression of teacher fixed effect by grade (Native)- Contract teacher

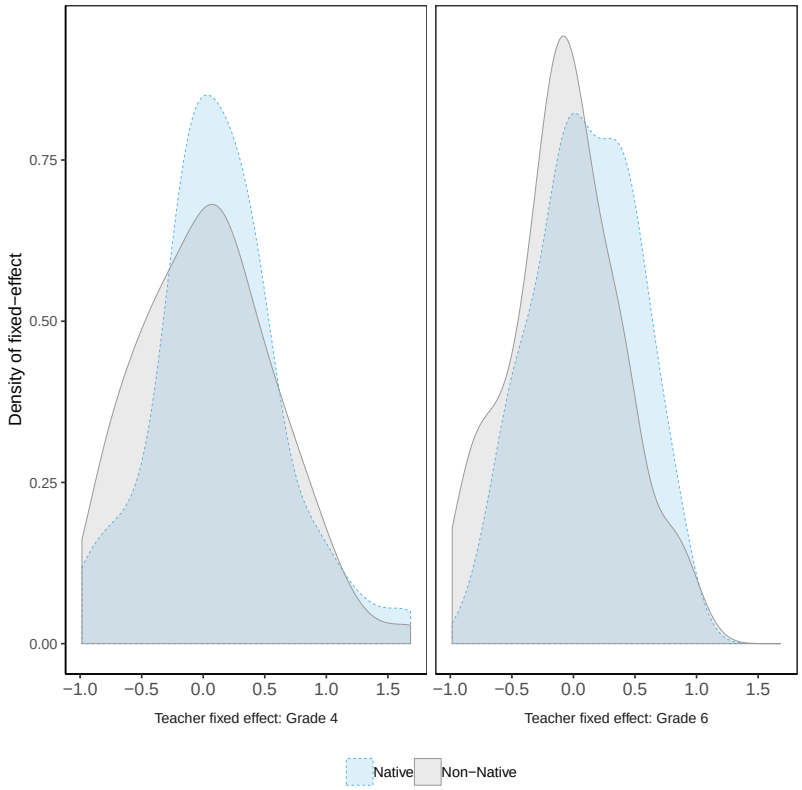

Figure 3: Density plot of teacher fixed effect by "Native" for contract teachers by grade

6 Conclusion

The increasing number of contract teachers in developing countries has led to concerns about its effect on teacher quality. Contract teachers are usually less professionally trained and qualified. However, they are more likely to be hired locally, that is, either from the local community and/or by the local administration. This can positively affect student outcomes by reducing social distance between the teacher and the student or through better monitoring of teachers. This paper provides ad-

ditional evidence on the difference in the impact of contract and regular teachers on student learning outcomes focusing on the effect of being a local or a native teacher.

Using data form a survey conducted in the rural areas of the Indian state of Bihar, we find that although contract teachers are very different from regular teachers when it comes to various observable characteristics (professional qualification, training, age, gender), there is no statistically significant difference in student outcomes from having one or the other type of teacher, for both grades 4 and 6. Earlier research reports a positive effect of contract teachers on student performance (Duflo, Dupas, & Kremer, 2015) the 'no effect' in our study could be due to the fact that contract teachers in the state of Bihar are less incentivized (Atherton & Kingdon, 2010). They are hired for life and the school or the local community has no say in renewal or discontinuation of the contract. Our results raise similar concerns regarding large scale expansion of contract teacher hiring by the government, as discussed by Bold, Kimenyi, Mwabu, Sandefur, et al. (2018). Due to political and administrative constraints (teacher unions etc.), most of the developing countries might find it difficult to implement flexible teacher contracts, which seem to be important for achieving learning gains.

The other mechanism through which contract teacher might have a positive effect on learning is local hiring. The local nature of these teachers is an important and distinctive feature that might induce them to exert more effort in difficult environments (remote areas, disadvantaged students) because of reduced social distance (Rawal, Kingdon, et al., 2010) or because they are more content to work in remote areas compared to regular teachers (Fagernäs & Pelkonen, 2011). To isolate the im-

pact of a local teacher we restrict our analysis to contract teachers so that we have a more comparable group. We obtain a statistically significant and positive effect of a local teacher on student outcomes of 0.24 standard deviation for grade 6 only. The fact that hiring teachers from the local community might be important for their effectiveness in a rural setting invites further investigation with more detailed data to understand the mechanisms behind this finding.

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A

Tables

	Both visits	Dropped-out	Difference	p.value
Grade 4				
Female=Yes	0.52	0.42	0.10	0.04
Age	10.02	10.35	-0.33	0.00
Lang. score baseline	8.03	9.01	-0.98	0.04
Math score baseline	9.30	9.84	-0.54	0.25
Contract teacher	0.81	0.83	-0.02	0.58
Native teacher	0.32	0.31	0.01	0.87
N	1527	133		
Grade 6				
Female=Yes	0.54	0.43	0.11	0.02
Age	11.69	11.81	-0.11	0.10
Lang. score baseline	17.44	16.85	0.59	0.44
Math score baseline	14.24	13.18	1.06	0.06
Contract teacher	0.71	0.61	0.1	0.01
Native teacher	0.32	0.15	0.17	0.00
N	1595	135		

Table 13: Difference in means of sample and dropped-out student

	All	Sample	Difference	p.value
School variables				
Distance from HQ.	42.06	39.88	2.18	0.48
Student attendance	58.98	58.58	0.40	0.72
Teacher attendance	74.08	74.48	-0.40	0.74
Proportion contract	72.91	72.78	0.14	0.94
Infrastructure index	5.07	5.08	-0.01	0.94
Total enrollment	509.62	512.74	-3.12	0.90
Total teachers	8.71	8.78	-0.08	0.83
Student teacher ratio	61.81	61.79	0.02	0.99
Principal in school	0.15	0.14	0.01	0.80
BRC visits	4.21	4.21	0.01	0.90
SMC meetings	3.75	3.78	-0.03	0.66
Average math score	11.78	11.74	0.04	0.88
Teacher variables				
%Contract	0.73	0.75	-0.02	0.42
%Female	0.37	0.39	-0.02	0.50
Age in years	38.39	37.52	0.87	0.12
%Professional qualified	0.55	0.49	0.06	0.05
%Graduate or above	0.52	0.49	0.03	0.30
Experience	8.72	7.13	1.60	0.00
Training (days)	9.52	10.43	-0.91	0.20
Math score	7.14	6.73	0.41	0.05
Hindi score	4.61	4.39	0.22	0.09
%Native to village=yes	0.29	0.31	-0.02	0.36
Travel time (min)	38.42	38.33	0.08	0.98
Years in same school	5.77	5.43	0.34	0.14
Transfers	0.57	0.35	0.22	0.00
N Schools	214	199		
N Teachers	1656	339		

Table 14: Difference in means of all and sampled teachers

B Figures

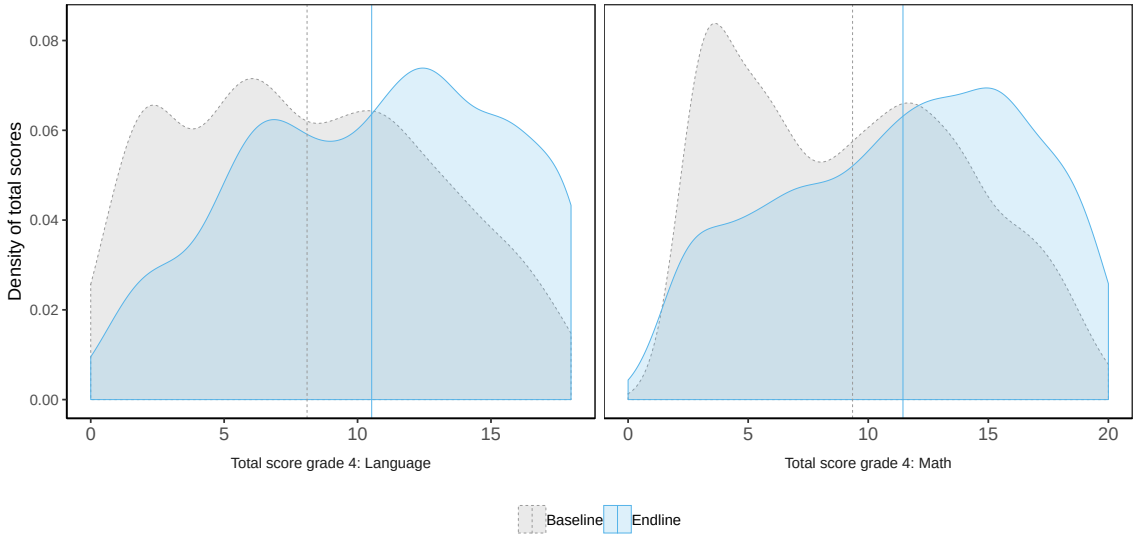

Figure 4: Density plot total scores Grade 4

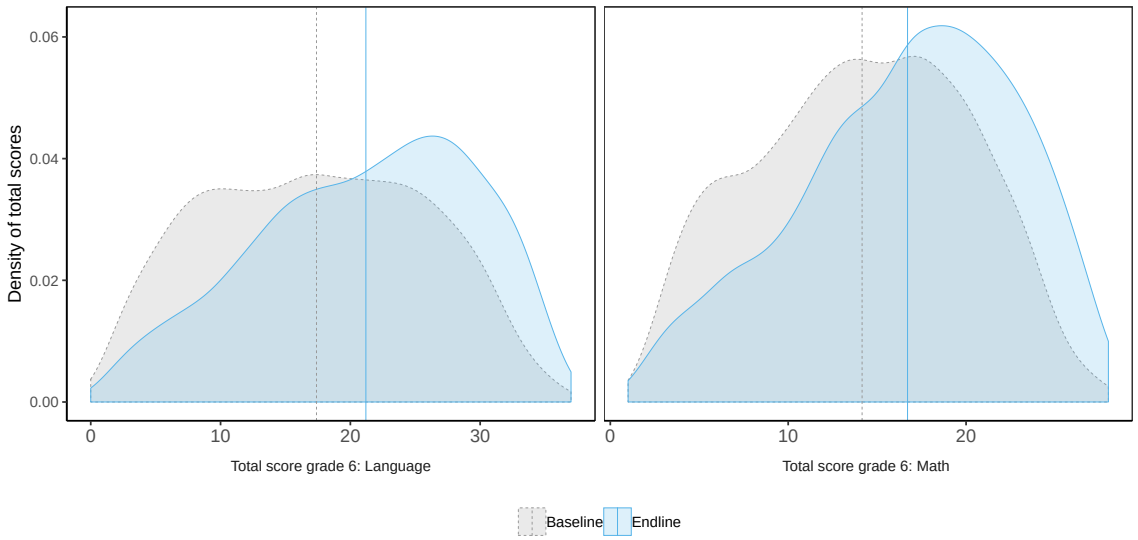

Figure 5: Density plot total scores Grade 6