Teacher quality, alternative hiring policy and student outcomes: Evidence from India

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Abstract

Over the past few decades the increasing numbers of contract teachers in developing countries has led to serious concerns about its effect on teacher quality. Contract teachers are in general less trained and qualified. On the other hand, they are usually hired from the local community which can lead to better montoring and accountability and therey positively affect student outcomes. This paper provides additional evidence on the difference in the quality of contract and regular civil service teachers looking at the effect of being a "local" teacher. Using a value added estimation method, based on data from a unique primary survey in India, it was found that there is not a significant difference in the performance of the two types of teachers. However, using variation in the hiring of contract teachers as an identification strategy, we observe "local" teachers have a significant and positive impact (0.21 to 0.23 sd) on student learning.

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

JEL Codes: I21,I28, J45

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1 Introduction

Many developing countries have made huge progress in increasing enrolments in primary education since the 1990's. The net enrolment ratios in primary education increased by at least 20 percentage points from 1999 to 2012 in 17 countries, 11 of which are in sub-Saharan Africa (UNESCO, 2015a). Though the rapid expansion in schooling helped many children to enter school, recent evidence has highlighted that millions of these children have failed to acquire even the most basic literacy and numeracy skills (Altinok et al., 2014; UNESCO, 2013). This has serious policy implications as studies have shown that the skills acquired rather than the years of education is pivotal for economic development (Hanushek and Woessmann, 2008; Schoellman, 2012).

With rising demand for education many of the poor and middle income countries are facing serious teachers shortages.[1] This can further exacerbate the learning crisis as teachers play a critical role in improving the quality of education (Araujo et al., 2016; Azam and Kingdon, 2015; Hanushek and Rivkin, 2006; Rockoff, 2004).

Hiring regular civil service teachers in a centralised way is costly and time consuming. With limited budgets and lack of training capacity many governments, specially in sub-Saharan Africa and South and West Asia, have thereby adopted cheaper and faster alternatives for filling teacher vacancies. These teachers hired through alternative routes are often termed as "contract teachers".[2] They have less stringent entry requirements in terms of teacher training and qualification certificates, are paid less and are usually hired in a decentralised way from the local community (Chudgar et al., 2014; UNESCO, 2015b).

This policy of hiring contract teachers helped in improving teacher supply but at the same time raised objections from various stakeholders questioning it's impact on the "quality" of teacher workforce and therefore learning outcomes. Existing research on

[1] According to UNESCO Information statistics, in order to meet the goal of Universal Primary Education by 2030 an additional 24.4 million teachers are required at primary level (UNESCO, 2016)

[2] 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 as *para teachers* while elsewhere they are called *contract teachers*. Chudgar et al. (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.

teacher quality has highlighted the difficulty in identifying specific characteristics which define an effective teacher (Kane et al., 2008; Rivkin et al., 2005). It is not clear from previous literature that contract teachers with less professional qualification and training will necessarily be less able to teach. Instead, the fact that they are more likely to be hired from the local community can positively affect student outcomes by reducing social distance between the teacher and the student and through better monitoring of these teachers by school and parents. Thus, more evidence is needed to understand the effect of different teacher hiring policies which reward different teacher characterstics on student leanring.

The objectives of this paper are therefore to estimate the impact in the quality of the two types of teachers: regular and contract, where quality is measured in terms of students' value-added scores. Understanding the importance of the local nature of contract teachers in the literature we also provide evidence on the effect of a "local" teacher, i.e a teacher who is native to the village where the school is located, on student outcomes. In our dataset not all contract teachers are hired from the local village thus we can use this heterogeneity to explore its effect on student outcomes. Also, we did not find any other study which specifically looks at the difference in performance of a local and a non-local contract teacher. Finally, we also test if any of the teacher characteristics namely qualification, training, test scores and experience explain variation in student performance.

In order to estimate contract teacher effect we make use of a unique dataset of government schools in India with student and teacher information over one academic cycle (2013-14). The data is derived from a survey commissioned by the World Bank and the Government of Bihar in collaboration with ASER Centre, New Delhi. The data has details on teachers and student characteristics, performance on tests for both teachers and students administered during the survey along with information on various classromm indicators. It was collected from four districts in the state of Bihar, India, with the purpose of benchmarking teacher competencies to build a composite picture of teachers and

teaching practices in the state.[3]

This study is closely related to the broad literature on teacher labor markets (Chudgar, 2013; Vegas, 2007) and more specifically to research on contract teachers in developing countries (Atherton and Kingdon, 2010; Bau and Das, 2017; Bourdon et al., 2010; Duflo et al., 2015; Muralidharan and Sundararaman, 2013).

The main findings are as follows: Contract teachers are not different from regular teachers in terms of student outcomes. More specifically, there is no significant difference between contract and regular teachers in grade 4 but for grade 6 contract teacher has a negative effect on student achievement, although this negative effect may be mitigated if these teachers are hired locally. Our estimates of teacher fixed effects reveal that being "local" i.e, if the teacher is native to the village where the school is, has a positive effect on student performance while teacher credentials like professional qualification and training fail to explain variation in student performance. These results highlight the need for a deeper analysis of issues concerning teacher training, hiring and deployment in order to provide quality education for all in a cost-effective manner.

The paper is divided into seven sections. In the following section we present a detailed literature review on teacher quality and the effect of hiring contract teachers on student performance. Section 3 provides background of elementary education and teacher hiring policy in India more specifically in the state of Bihar where the survey was conducted. This is followed by data and descriptive statistics. In section 5 we discuss the estimation technique and section 6 elaborates the result followed by conclusion in the last section.

2 Literature

2.1 Teacher quality: How to identify a good teacher?

One of the major impediments to the estimation of the effect of teacher on student performance is the non random allocation of students to schools and teachers. Research on accumulation of human capital strongly acknowledges the fact that child development is a

[3]Detailed information about the primary survey can be found in the report by Sinha et al. (2016)

cumulative process which depends not only on the present inputs but also on the history of past investments (Todd and Wolpin, 2003). As a consequence, to estimate teacher effects one needs to account for the selection of students into certain neighborhoods, schools and teachers on unobservable student, family and school level components. Understanding the potential bias in retrospective data many studies have employed other techniques like pal variable or experimental design to estimate the relationship between teacher quality and student achievement.

For instance, Rockoff (2004) use matched student-teacher panel data set from New Jersey, USA to separate various *fixed effects* of individual, school and classroom from teacher fixed effect. Observations of same students across different teachers helped to account for student-fixed effects, while observation of same teacher teaching different classrooms was used to separate teacher fixed-effect (teacher quality) from classroom factors (like class size). Also to account for the various school level time-constant as well as time varying factors the author focused on variation *within* schools and years. It was found that a one standard deviation increase in teacher quality raised students' reading and math test scores by approximately 0.1 standard deviations, on a nationally standardised scale.

In another study Rivkin et al. (2005) use a rich source of panel data from the UTD Texas School Project with observation of students across multiple grades and cohorts. They employ a semi-parametric approach to estimate the variance in teacher quality *within* schools. Student achievement is seen as a function of student, school and teacher fixed components as well as all other time variant characteristics. To eliminate student/family time invariant factors they include the pattern of average gains between adjacent grades for a particular cohort. The lower bound estimates provide a strong evidence that teachers have powerful effects on reading and mathematics achievement. Though, not much of the variation is explained by observable teacher characteristics.

Studies from developing countries have also provide evidence on teacher quality. Azam and Kingdon (2015) estimate the relation between teacher quality and student outcomes in private schools in India. They found a much higher estimate of teacher fixed effect with

a standard deviation of 0.366 compared to the average standard deviation of 0.13 found in the US (Hanushek and Rivkin, 2012). Similar to the evidence in the US they also show that teacher characteristics like experience, education and training explain little of the variation. In another study Araujo et al. (2016) go one step further by looking at the effect of teachers on children's "executive function" along with test scores.[4]. They also found that characteristics like tenure status, teacher IQ, the Big Five personality traits, and inhibitory control and attention, were not good predictors of students' test scores, whereas measures related to the level of interaction between teachers and students in class or pedagogical practices were significantly linked to student outcomes.

The rising evidence on the role of teachers in improving student's learning has prompted active debates on measures to identify a high quality teacher. Studies on teacher quality including those mentioned above have shown that most of the observable characteristics of teachers such as qualification, training, salary or other credentials explain little of the variation in teacher effectiveness.[5] In this study we also find that various qualification criterions used for hiring regular teachers fail to predict student outcomes.

Hanushek and Rivkin (2006) in an extensive review on teacher quality, have discussed other factors that might be more relevant for measuring teacher effectiveness. Some of these include differences in teacher efforts, motivation, personnel practices (process of selection, promotion, retention etc.) and working conditions in schools. In this study we found that teachers living in the same village as the school ("local teacher") are more effective for improving student performance. The positive local teacher effect might be due to better monitoring or interaction between local teachers and children as well as their families as they are socially more similar.

In light of the existing evidence, one has less reason to believe ex ante that contract teachers who are generally exempted from the status quo on training and qualification

[4]According to the authors executive function (EF) comprises measures of children's inhibitory control, working memory, capacity to pay attention, and cognitive flexibility. These processes, measure a child's ability to regulate thoughts, actions, and emotions, all of which are central to the learning process apart from performance in tests (Araujo et al., 2016)

[5]One exception is initial years of experience. Teachers perform worse on overage in the first couple of years of their teaching career but there are no significant affect of teacher experience on student performance after accounting for initial years (Hanushek and Rivkin, 2006)

requirement might be less effective. It is therefore relevant to obtain more evidence on its effect on student performance.

2.2 Contract teachers and student outcomes

There is less doubt that contract teachers provide a cheaper and faster alternative to reduce teacher shortages and alleviate adverse pupil-teacher ratios in many developing countries (UNESCO, 2015b). But what does the evidence on the effect of contract teachers on quality of education say? Before we discuss the evidence on contract teacher effect it is important to note that the policy of contract teachers varies across regions in terms of the length of tenure, training and qualification requirements, salaries and whether the hiring is centralised or localised (Chudgar et al., 2014; Duthilleul, 2005; Fyfe, 2007; Kingdon, Aslam, et al., 2012). This variation across regions in recruitment process and incentive structures makes it more difficult to generalise their effect on student outcomes.

It is therefore not surprising that various quantitative studies on the effect of contract teachers on the quality of education find mixed results. There are studies that have found that contract teachers perform better than regular teachers (Duflo et al., 2015; Muralidharan and Sundararaman, 2013), some found no difference or heterogeneous effects (Atherton and Kingdon, 2010; Bourdon et al., 2010), while others (Vegas and De Laat, 2003) have shown that students taught by contract teachers perform worse than students of regular teachers. Since their effect depends largely on the design of the policy it is imperative to understand the "theory of change" behind contract teacher policy.

Earlier research has shown that teachers in developing countries face serious motivation problems with poorly incentivised contracts and no accountability (Chaudhury et al., 2006; Pritchett and Murgai, 2007). Contract teachers thereby provide an opportunity to improve student learning through (a) incentivised contracts (b) better monitoring or accountability at local level. We discuss below the evidence on contract teacher effect in relation to these properties.

It has been shown that incentives can help improve teacher performance (Muralidharan and Sundararaman, 2011). In this regard the sort-term contract system is believed

to provide an option to incorporate incentive structures (like renewal of contract based on performance) as opposed to the rigid permanent contracts of regular teachers. The study by Vegas and De Laat (2003) and Atherton and Kingdon (2010) discusses the effect of contract teachers under different incentives. Vegas and De Laat (2003) in their study point out that contract teachers rarely face dismissal and are hired for life just as regular teachers. This means that even with contract teachers the incentive structures might not be very different than regular teachers. 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 state of Bihar and Uttar Pradesh. They find a positive effect of contract teachers in case of Uttar Pradesh where contracts are renewed yearly but no significant effect for the sate of Bihar where contract teachers are hired on permanent basis. Thus the nature of the contracts facing these teachers can play an important role for student outcomes.

Coming next to monitoring or accountability at local level. Contract teachers are more likely to be hired locally i.e. either hired by local administration or from within the local community. This can improve student outcomes through (a) greater teacher accountability to local government, school management and/or parents which may lead to changes in teacher attendance and/or effort (Bourdon et al., 2010; Duflo et al., 2015) (b) reduced social distance between student and teacher which may lead to better understanding of student needs and reduced discrimination (Rawal and Kingdon, 2010). Contract teachers might be able to built a better rapport with the community which can prove to be important for effective learning (Pandey, 2009).[6]

Duflo et al. (2015) provide an experimental evidence to explore the mechanism of community based accountability for Kenyan schools. The objective of the study was to understand the interaction between an extra teacher (locally hired on one quarter of civil teacher salary with promotion based on performance) and school governance (more accountability) and its effect on school quality. Accordingly, the experiment involved two

[6]According to Pandey (2009)"teachers and students who share a common primary language, cultural understanding and experiences may be better able to develop inter subjectivity necessary for effective meditation".

kinds of treatment (a) allocation of an extra teacher to schools along with mechanisms to strengthen community involvement in monitoring of teachers (b) allocation of an extra teacher but no monitoring mechanism. The control schools were those with no extra teacher or monitoring mechanism. It was found that though there was a huge reduction in class size for both type of teachers students of contract teachers performed better than students of regular civil service teachers in both kind of treatment schools compared to control schools. Also, the gains were higher in schools where the community monitoring mechanism were made stronger. This study by Duflo et al. (2015) highlights the importance of governance/accountability as an important element to increase the benefits of increased teacher supply by curtailing rent seeking.

In another study Bourdon et al. (2010) use an extensive data set across three countries in Africa- Niger, Togo and Mali, to analyse the effect of contract teacher policy. They find varying effects of contract teachers depending on student ability and the design of the policy. One of the main findings 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 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 centralised public employees making them free from local monitoring.

Understanding the importance of the local nature of contract teachers we also provide evidence on the effect of a "local" teacher, i.e a teacher who is native to the village where the school is located, on student outcomes. In our dataset not all contract teachers are hired from the local village thus we can use this heterogeneity to explore its effect on student outcomes. Also, we did not find any other study which specifically looks at the difference in performance of a local and a non-local contract teacher.

3 Education system and contract teachers in India

In India there exists a common school education structure (10+2) which can be divided into 4 parts, namely, primary, upper primary, secondary and higher secondary. Primary (grades 1-5) and upper primary (grades 6-8) 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 democratic structure which envisages the control and management of schools by the state governments with central government 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	1 to 5	6-11
Upper- primary	6 to 8	12-14
Secondary	9 and 10	15-16
Higher- secondary	11 and 12	17-18

Table 1: Levels of education

Since the 1990's 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, Right to Education act, 2010 (RTE) was passed making elementary education free and compulsory for all children between ages 6-14. All this subsequently helped the country make big strides in achieving its goal of Universal Elementary Education (UEE) with the Net Enrolment Ratio (NER) reaching 98 per cent in 2009-10 (Government of India, 2013).

With a steady increase in enrolment rates across most parts of the country, the focus of the government has been shifting towards improving the quality of education (Muralidharan, 2013). Many studies in recent years have highlighted the dismal state of student performance across the country. A nationwide study (Pratham, 2014a) 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. 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 (Waghmare, 2016) 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 towards more decentralised management of schools to meet the rising education demand in a cost-effective manner (Govinda and Josephine, 2004; Kingdon and Sipahimalani-Rao, 2010). Consequently, many states started to fill teacher vacancies through 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 universalising elementary education (Sarva Shiksha Abhiyan (SSA)) laid down norms that further boosted the hiring of contract teachers (Chowdhury, 2017).

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 percent (Mehta, 2009) though their numbers vary widely depending on the state.[7] The service conditions, qualifications and salaries of these teachers also differ across the country and so does the nomenclature – *shiksha mitra* in Uttar Pradesh, *shiksha sahayak* in Odisha, *niyojit shikshak* in Bihar, guest teachers in Delhi.

In sharp contrast to the early 2000s, the trend of hiring contract teachers appears to be reversing with states either trying to regularise or stop the practice completely (Ramachandran et al., 2017). New 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; Muralidharan, 2015).[8]

[7]The states where the majority of *contract* teachers have been appointed are Andhra Pradesh, Bihar, Chhattisgarh, Haryana, Jharkhand, Jammu and Kashmir, Rajasthan, Uttar Pradesh and West Bengal which together constitute 78 percent of all contract teachers in the country. (Mehta, 2009)

[8]In 2010, The National Council of Teacher Education (NCTE) was given the primary authority to formulate guidelines on teacher qualification and training standards which had to be followed by all states. Accordingly, all teachers were required to obtain centrain minimun qualification prescribed by the NCTE until 2015 to be able to teach in government schools. As many states are still heavily dependent on untrained contract teachers the deadline for obtaining the required qualification was recently extended

The ups and downs in the contract teacher policy are also reflected in our dataset. In the state of Bihar, where this study was conducted, the *Panchayats*[9] 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). In our survey data we also find evidence of this expansion in teacher hiring since 2005 (Figure 1).

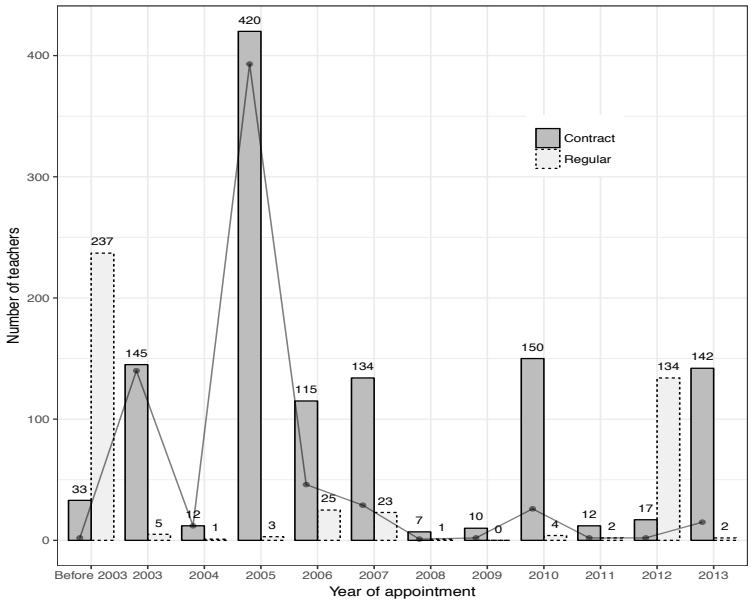


Figure 1: Number of teachers by year of appointment and teacher type. Source: Authors own calculation. This figure plots the number of teacher by year of appointment and teacher type. The line indicates the number of contract teachers appointed from the same locality where the school is located. We cumulated the number of teachers appointed before 2003 because of low frequency each year.

Of the total teachers surveyed close to 73% are contract teachers. A large proportion of these contract teachers hired were found to be native to the village where the school is located (40% of all contract teachers as opposed to less than 5% in case of regular teachers.) Thus, the policy helped in increasing local hiring on a large scale.

until 2019 (Indian Express, 2016).

[9] A *panchayat* refers to a governance/administrative block consisting of two or more villages

4 Data

4.1 Study design and Sample description

The data for this study is derived form a survey that was commissioned by the World Bank and the Government of Bihar in collaboration with ASER Centre, New Delhi (Sinha et al., 2016). 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.[10]

	Population (millions)	Literacy rate	Literacy rate (female)	Female ratio[1]	Percent urban
Purnia	3.26	51.08	42.34	921	10.51
East Champ.	5.09	55.79	45.12	902	7.87
Jamui	1.76	59.79	47.28	922	8.26
Rohtas	2.95	73.37	62.97	918	14.45
Bihar	104	61.8	51.5	918	11.29
All India	1210	74.04	65.46	940	31.16

[1]Female per thousand male. Source: Census, 2011

Table 2: Description of Districts

Bihar is the third most populous and one of the poorest states in India. Table 2 gives a brief overview of the four districts in the state 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 (2014b) the percent of children in grade five who can read a grade two level text declined from 65.4% in 2006 to 48.2% in 2014. It is also one of the states in India with lowest student attendance rates. States like Uttar Pradesh, Bihar, Madhya Pradesh and Jharkhand have student school attendance rates of below 60 per cent in public schools (Government of India, 2013). Our survey data also shows that the average student attendance was as low as 57 percent.

There also exists huge teacher shortages in Bihar.[11] Data from our survey reveals

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

[11]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 percent (203,000)

that in Bihar, the average student-teacher ratio for all grades combined in upper-primary schools is close to 67. Also, there is a high incidence of multi-grade teaching, a phenomenon where students of different grades sit in the same class mainly due to shortage of teachers. In our data in almost 60% of schools children in grade 4 were found sitting with another grade during the field visits.

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 observations formats, teacher interviews and teacher and student assessments. The stages and periods of data collection are shown in figure 2.

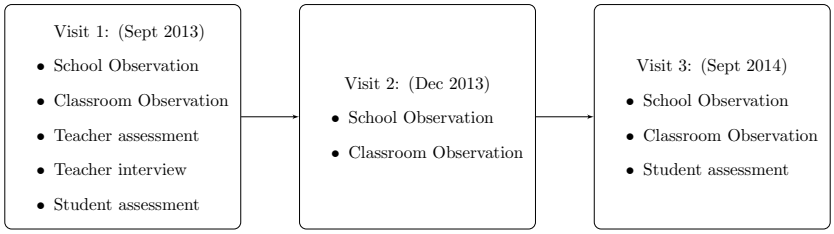


Figure 2: Stages of the survey

Out of the 400 schools 214 are upper-primary in our survey data. For the purpose of our analysis we only look at these upper-primary schools since student assessments were conducted in upper-primary 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 in 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 district-wise are listed. The total number of children assessed is 4260 in baseline and 3927 in endline (7.8% attrition). There are a total of 1656 teachers who were interviewed and assessed. The district wise distribution of contract teachers shows districts of Jamui and East Champaran have the highest proportion of contract teachers.

are in Bihar alone (MHRD,GOI, 2016)

District	Schools	Teachers	% Contract	Student Assessments			
				Grade 4		Grade 6	
				2013	2014	2013	2014
Purnia	60	427	72.77	600	548	600	538
East Champaran	50	428	77.93	500	469	500	481
Jamui	53	345	79.01	530	483	530	479
Rohtas	51	456	64.62	500	465	500	464
Total	214	1656	73.15	2130	1965	2130	1962

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. Since only about 10% of teachers reported teaching both grades 4 and 6 we can confidently identify grade specific teachers in schools. We were able to uniquely match teachers to students of grades 4 and 6 using 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. There were three such classroom visits spread over the academic year (Figure 2). To make sure that children were under 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.

4.2 Descriptive statistics

In table 4 we provide a summary of the final data set that was used for regression analysis. Student z-scores were created by standardising the total language score for each grade and for each visit separately. School variables were recorded thrice over the academic year. Instead of using information from just one visit we use a simple mean over the three visits for certain variables like student and teacher enrolment, attendance and student teacher ratio.

Similarly, for variables related to monitoring visits by Block Resource Co-ordinator (BRC) and school management committee (SMC) we create a scale which is an average of three visits. The questions which were asked from 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 implies meetings are held more often.[12] Lastly, we also create a variable to capture initial school quality called "Average math score". It is calculated by taking a simple average of grade level mean math scores for grade 4 and 6.

In our data set more than half of the children (52%) in the age group 8 to 16 in government upper-primary schools are girls (table 4). At the grade level there is high incidence of multigrade teaching where students from multiple grades sit together in one class mainly due to shortage of staff (48%). One can also notice the prevalence of low student attendance (56%) and big 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. The proportion of teachers that are female is well below fifty percent (39%). Almost half of the teachers are professionally trained and hold a graduate degree. Close to 34% of all teachers live in the same village where the school is located.

We found that most of the schools were equipped with basic infrastructure facilities. On average schools had 5 out of the seven basic amenities listed in the questionnaire.[13] On average there exists 8 to 9 teachers in each upper-primary government school. The probability that there is a principal appointed in school is extremely low at just 14%.

As stated earlier, students from grade 4 and 6 in upper-primary schools were assessed in language (Hindi) and math. Table 5 gives a detailed summary of student baseline and endline total scores by grade and subject. One can see that the performance of students has improved over the academic year. Appendix A gives the density plots of total scores of students at baseline and the endline visits to schools.

[12] *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

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

	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					
Live in same village=Yes	319	0.34	0.47	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
% Teacher attendance†	188	74.17	11.86	33.33	100.00
Proportion contract	199	72.78	17.75	25.00	100.00
Infrastructure index **	199	5.08	1.46	1	7
School size					
Total enrolment†	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
Average Math score§	199	11.74	2.80	4.95	19.25
Schools	199				
Teachers	339				
Students	3,390				

Notes: * z-scores were created by normalising the total language score in each grade and in each visit
** Infrastructure index is a sum of seven indicators available in school these are: drinking water, toilet, separate girl's toilet, boundary wall, library, timetable and mid-day meal menu displayed on wall
† Student and teacher enrolment, percent attendace and student teacher ratio was 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.
§Average math score is calculated by taking a simple average of grade level mean math scores for grade 4 and 6.

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

4.3 How different are the two types of teachers?

In this section we briefly discuss the difference between the two types of teachers and also the possibility that contract and regular teachers are affected to different types of schools and classes. Thus, we look at their differences in terms of (i) teacher characteristics (ii) classroom and work environment and (iii) student performance/value-added.

Table 6 presents several teacher characteristics by teacher type. It can be seen that there are significant differences between the two types of teachers, with regular teachers more likely to be 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 insignificant. The two types differ in performance in language test administered during the survey (regular teachers scoring 0.69 points higher) but not in math.

We next look at the difference between the two types of teachers regarding various classroom level indicators. These indicators are derived from the classroom observation formats. We find that contract teachers are less likely to teach upper primary grades (grade 6) compared to primary grades (grade 4). They are not different when it comes to other classroom indicators like the likelihood of teaching a multigrade class, class size or class attendance.

Another important point to notice from table 6 is the local nature of contract teachers.

	Contract *(mean)*	Regular *(mean)*	*Difference in mean*	p.value[1]
General				
%Female	44.63	23.46	21.17	0.00
Age in years	34.17	47.43	-13.26	0.00
Qualification				
%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
Classroom environment				
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
Work environment				
%Live in same village	40.76	14.81	25.94	0.00
%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
%Other activity	34.17	22.22	11.94	0.06
N	252	82		

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

Table 6: Difference in teacher characteristics and classroom environment by teacher type

Not only they are more likely to live in the same village as school corresponding to lower travel time compared to regular teachers, they are also native to the village where the school is located (about 40% compared to less than 5% in case of regular teachers) . They are also more likely to remain in a particular school and hardly have any transfers to other schools. This is not surprising as the earlier policy in Bihar requires contract teachers to be hired and work locally to increase accountability at the local level. Lastly, we find a higher proportion of contract teachers to be female (21 percentage point difference) which is another positive feature of their workforce as the state has been struggling to increase the number of female teachers in schools.

As a first look at the difference in the value-added by teacher type we run a simple t-test for difference in average test scores. Table 7 presents 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 take away from this table, *first* there exists 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 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 the use of a difference in difference approach.

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

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). This results provides some basis for the existence of positive effect of contract teachers on student performance only for grade 4.

5 Methodology

Based on the theoretical underpinning that child development is a cumulative process depending on the history of family and school inputs and his own endowment or ability we start our model with the commonly accepted equation of the education production function (Sass et al., 2014; Todd and Wolpin, 2003).

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

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 child's endowment or ability which is inherited and does not vary with time and ϵ_{it} is the error term. The subscript t on A_t allows the impact of inputs and endowments to depend on the age of child. According to this model inferences based on cross-section data which do not account for the history of inputs suffer from serious omitted variable bias and are therefore unreliable for causal inferences.

The specification above is highly demanding in terms of data. Researchers have come up with alternative forms of the model to deal with the problem of omitted variable bias. One such specification is the Value-added approach. In this model its is assumed that the lagged achievement score of students can be used as a regressor to account for the unobserved time-constant history of student and family inputs, as well as for time-varying historical student and school-based inputs. Assuming that the arguments in equation 1 are linear and additively separable the model to estimate the impact of contract teacher and 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 to the *partial persistence* model used in Sass et al. (2014). $A_{i,t-1}$ 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.

We also include other teacher characteristics in the vector T_n to identify if other teacher specific features (qualification, training etc.) explain any variation in student performance. The OLS estimates using the above specification will be unbiased assuming that the past test score and current school, grade and teacher inputs are not correlated with the error term η_{ijkn}.

Another aspect which needs to be controlled for before making causal inferences about the effect of teacher-type is the non-random allocation 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 selected into schools based on school quality then our estimates of teacher-effect would be biased. Also, there can be sorting of teachers in schools between or within grades. We saw in table 7 that on average contract teachers receive students with worse results.

We check if there is any selection of teachers on observable district, school or grades level indicators (Table 8). First we regress the proportion of contract teachers on various school indicators along with district dummies. We also run a logistic regression with teacher type as the binomial dependent variable.

There are four important take aways from the regressions results in Table 8. *First*, looking at the district dummies we find Rohtas district has far fewer contract teachers compared to Jamui district (on average 14.2 percent less) while for other districts the difference is not significant. From table 2 we know that Rohtas is the district with highest literacy and urbanisation rates compared to all other districts. This confirms that the allocation of contract teachers is more likely to be present in resource constrained areas.

Second, we do not find any school quality variables explain sorting of teacher to schools within district. In columns 1 and 3 of table 8 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 more statistically significant (columns 2 and 4) thus by including district dummies we are more confident of our estimates of contract teacher effect assuming that there is no sorting of teachers

	Proportion contract		Logit model: Contract =1		
	(1)	(2)	(3)	(4)	(5)
Distance from HQ.	−0.008	−0.003	−0.006	−0.005	−0.005
	(0.062)	(0.061)	(0.007)	(0.007)	(0.007)
Student enrolment	0.003	0.009	−0.001*	−0.001	−0.001
	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)
Student teacher ratio	0.004	−0.025	0.001	0.001	0.002
	(0.070)	(0.073)	(0.006)	(0.007)	(0.008)
Infrastructure Index	−1.862**	−1.398	−0.102	−0.008	0.028
	(0.940)	(0.911)	(0.105)	(0.104)	(0.110)
Principal=Yes	9.055***	6.939**	0.227	−0.086	−0.143
	(3.233)	(3.153)	(0.401)	(0.428)	(0.452)
BRC visits	0.504	0.737	0.539***	0.587***	0.631***
	(1.962)	(1.858)	(0.187)	(0.196)	(0.203)
SMC meetings	1.533	1.902	0.087	0.031	0.006
	(1.613)	(1.720)	(0.204)	(0.211)	(0.215)
Average Math Score	−0.936**	−0.682	−0.105**	−0.064	−0.079
	(0.418)	(0.413)	(0.048)	(0.053)	(0.055)
Grade level					
Grade=6					−0.641**
					(0.314)
Multigrade=Yes					−0.028
					(0.351)
Class attendance					0.0001
					(0.008)
Class size					−0.001
					(0.005)
District dummy					
Rohtas		−14.238***		−0.983**	−1.006**
		(4.005)		(0.427)	(0.453)
Purnia		−4.756		−0.614	−0.677
		(3.624)		(0.419)	(0.428)
E.Champaran		−2.920		0.811	0.774
		(3.775)		(0.534)	(0.539)
Observations	199	199	334	334	330
Pseudo R^2	0.0739	0.1443	0.0439	0.0935	0.1107

Notes: 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 8: Contract teachers on school and grade factors

to schools within districts.

Third, in all the specification we notice that contract teachers are more likely to be in schools with better monitoring mechanisms. For instance in table 8, schools in which there is an appointed principal have higher proportion of contract teachers (columns 1 and 2) also contract teachers are more likely to be in schools that have frequent monitoring visits by the BRC (columns 3 to 5).[14]

Fourth, the regression results in column 5 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 like multigrade teaching, class size and student attendance do not vary significantly between the two types of teachers.

To summarise, we do not find evidence that within districts teachers are selecting themselves or otherwise affected into 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:

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

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) thus, although we can exploit this variation in teachers by grades to apply school fixed effect we use this in our analysis as a robustness check only due to the small teacher sample size within schools.

In our sample schools the probability of selection within grades is negligible as from the

[14]It would be interesting to explore why in case of contract teachers we observe more monitoring visits by the BRC but this is outside the scope of our paper.

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 percent and 93 percent respectively. Thus, selection to classes within grades is not an issue.

5.1 Teacher fixed effect

In addition to the above models (equations 2 and 3) another way to look at the difference in the quality of the two types of teachers is to estimate the distribution of teacher value added by teacher type.

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

Where σ is the estimated teacher fixed effect coefficient for every teacher Tid_n. Next, we test if the distribution of estimated teacher fixed effect $\hat{\sigma}$ is significantly different for the two types of teachers. Finally, we estimate equation 5 below where T_n represent teacher characteristics to analyse if any other teacher characteristics explains variation in our estimated teacher fixed effect.

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

6 Results

Following the above methodology we present the results of value-added and teacher fixed effect models.

6.1 Value-added estimates

In Table 9 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 control variables. We also include the results for both grades combined in column 9. The last column presents results from the school fixed effect model (equation 3). In

columns 1 to 4 we present the results for grade 4 and in columns 5 to 8 for grade 6. As we move from left to right within each grade columns we keep adding more factors to isolate the effect of contract teacher on student performance. For instance, column 1 (and 5) is the basic specification with no district, school or teacher factors. In column 2 (and 6) we include district dummy, in column 3 (and 7) we add school factors and in column 4 (and 8) we further add teacher characteristics. Thus, columns 4 and 8 correspond to the full specification in equation 2.

There are some interesting things to note from table 9. *First*, for grade 4 the effect of contract teacher on student performance is positive and statistically significant in columns 2 and 3 while we do not include any teacher characteristics, with an effect size of 0.16 standard deviation. However, once we include other teacher characteristics the effect is no more statistically significant (column 4). *Second*, for grade 6 we notice that once we include all factors, contract teacher is found to have a negative effect on student performance (-0.21 standard deviation) but the negative effect is almost compensated by the positive coefficient of the variable "Live in same village" (0.18 standard deviation).

These results imply that the effect of contract teachers depends on the grades they are assigned to. They might be more effective for lower grades. The fact that variable "Live in same village" is positively related to student performance is explored further when we estimate teacher fixed effect to understand better the mechanisms which might affect performance of teachers.

When we look at the results for both grades combined the coefficient on contract teacher is no more statistically significant. This implies that contract teacher are no different from regular teachers in terms of student outcomes. Once again the only teacher characteristic that is positive and weakly statistically significant is the variable "Live in same village" (0.11 standard deviation). The school fixed effect model in the last column also shows no effect of contract teacher.

	Grade 4				Grade 6				Both grades	School-fixed effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Contract teacher	0.10	0.16**	0.16*	0.07	−0.11	−0.09	−0.10	−0.21**	−0.07	−0.10
	(0.09)	(0.08)	(0.08)	(0.10)	(0.08)	(0.08)	(0.08)	(0.10)	(0.07)	(0.08)
Student characteristics										
Previous year z score	0.52***	0.51***	0.47***	0.48***	0.51***	0.50***	0.46***	0.46***	0.47***	0.48***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Child female	−0.07	−0.07	−0.07	−0.07	−0.03	−0.03	−0.03	−0.08*	−0.08**	−0.05*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.03)
Child age	−0.03	−0.03	−0.03	−0.04*	−0.02	−0.02	−0.03	−0.001	−0.02	−0.01
	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)
Grade level factors										
Multigrade=Yes	−0.15*	−0.11	−0.01	0.05	−0.08	−0.07	0.01	−0.05	−0.02	0.06
	(0.09)	(0.09)	(0.09)	(0.10)	(0.08)	(0.08)	(0.09)	(0.09)	(0.07)	(0.11)
Class size	0.002	0.002	0.002	0.001	0.002**	0.002**	0.0005	0.0001	0.001	0.002**
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
School level factors										
Distance from HQ.			0.0001	0.001			0.0002	0.0001	0.0000	
			(0.002)	(0.002)			(0.002)	(0.002)	(0.001)	
Total enrolment			0.0001	0.0002			0.0003	0.0002	0.0002	
			(0.0003)	(0.0003)			(0.0003)	(0.0003)	(0.0002)	
Student teacher ratio			−0.003*	−0.003*			−0.001	−0.002	−0.002	
			(0.002)	(0.002)			(0.002)	(0.002)	(0.001)	
Infra. Index			0.02	0.02			0.02	0.01	0.02	
			(0.03)	(0.03)			(0.03)	(0.03)	(0.02)	
Principal=Yes			0.14	0.09			0.03	0.08	0.04	
			(0.13)	(0.12)			(0.12)	(0.12)	(0.11)	
BRC visits			0.11*	0.12**			0.07	0.06	0.09**	
			(0.06)	(0.06)			(0.05)	(0.05)	(0.04)	
SMC meetings			−0.12*	−0.13**			−0.02	0.01	−0.05	
			(0.06)	(0.06)			(0.05)	(0.06)	(0.05)	
Avg math score			0.04**	0.03*			0.04*	0.05***	0.04**	
			(0.02)	(0.02)			(0.02)	(0.02)	(0.01)	
Teacher characteristics										
Same village=yes				−0.01				0.18**	0.11*	0.05
				(0.09)				(0.09)	(0.06)	(0.07)
Female				0.11				0.01	0.04	0.09
				(0.09)				(0.09)	(0.06)	(0.08)
Graduate=Yes				−0.002				−0.05	−0.03	0.01
				(0.09)				(0.07)	(0.06)	(0.07)
Teacher test score				−0.01				−0.01	−0.01	0.01
				(0.02)				(0.02)	(0.01)	(0.02)
Experience				0.001				−0.01	−0.003	−0.01
				(0.01)				(0.01)	(0.005)	(0.01)
Training (Days)				−0.01				−0.001	−0.003	−0.001
				(0.005)				(0.003)	(0.003)	(0.004)
District dummy	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Observations	1,436	1,436	1,436	1,321	1,473	1,473	1,473	1,370	2,691	2,691
R^2	0.2768	0.2873	0.3087	0.3270	0.2924	0.2946	0.3053	0.3350	0.3204	0. 2452
Schools (n)										184

Notes: We use cluster robust standard errors at school level.
*p<0.1; **p<0.05;***p<0.01

Table 9: Value-added regression by grade on teacher type: y=endline z- score

6.2 Teacher fixed effect

In this section we calculate teacher fixed effects using equation 4. In Table 10 we present grade wise results for all teachers. Figure 3 gives a density plot of teacher fixed effect for contract teachers that are living in the same village as school and those that are not from the village and in table 11 we present grade wise results considering only contract teachers.

From Table 10 it can be seen that variables like professional qualification, training, experience etc. do not explain variation in teacher fixed effect. Also, contract teachers

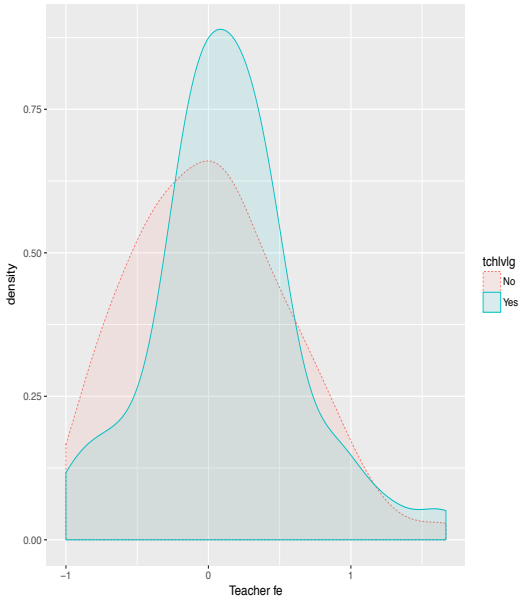
do not explain much variation in teacher value added for grade 4. For grade 6 it seems the negative effect of being a contract teacher is almost compensated by the fact that the teacher is lives in the village (local teacher). This relation between local teacher and teacher fixed effect becomes more clear when we plot the estimates by teacher locality (same village as school) in figure 3. For grade 6 one can notice the difference in distribution of teacher fixed effect for teachers who live in the same village as school and those that do not.

We further explore variation in teacher fixed effect using data on contract teachers alone. In table 11 we present grade wise results for contract teachers alone. Once again, it can be seen for grade 6 the effect of teacher who lives in close proximity to school is significant and positive (around 0.21 standard deviation to 0.23 standard deviation.)

	Grade 4				Grade 6			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Contract teacher	−0.05	−0.03	0.07	0.08	−0.22**	−0.19*	−0.18*	−0.19*
	(0.10)	(0.10)	(0.10)	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)
Same village=yes	0.08	0.05	0.04	0.003	0.22**	0.18*	0.19**	0.19**
	(0.10)	(0.10)	(0.10)	(0.10)	(0.09)	(0.09)	(0.10)	(0.10)
Female	0.10	0.11	0.08	0.08	0.02	0.02	0.001	−0.01
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.10)
Graduate=Yes	0.001	0.01	−0.02	−0.02	−0.01	−0.01	−0.01	−0.04
	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)
Language score	−0.01	−0.01	−0.01	−0.01	0.01	−0.001	−0.003	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Experience	0.001	−0.003	−0.002	0.001	−0.01	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Training (Days)	−0.01*	−0.01	−0.01	−0.01	−0.001	−0.0004	−0.001	−0.0000
	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)
Grade factors	No	Yes	Yes	Yes	No	Yes	Yes	Yes
District dummy	No	No	Yes	Yes	No	No	Yes	Yes
School factors	No	No	No	Yes	No	No	No	Yes
Observations	146	145	145	145	150	149	149	149
R^2	0.05	0.083	0.138	0.215	0.076	0.134	015	0.208

Notes: We use robust standard errors.
*p<0.1; **p<0.05;***p<0.01

Table 10: Regression of teacher fixed effect on teacher characteristics by grade- All teachers



(a) Grade 4

(b) Grade 6

Figure 3: Density plot of teacher fixed effect by "living local/ non-local" -Contract teachers by grade

	Grade 4				Grade 6			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Same village=yes	0.11	0.02	−0.04	−0.02	0.23**	0.21**	0.22**	0.21**
	(0.14)	(0.14)	(0.13)	(0.13)	(0.10)	(0.10)	(0.11)	(0.11)
Female	0.10	0.12	0.12	0.16	0.01	0.04	0.03	0.04
	(0.11)	(0.11)	(0.12)	(0.12)	(0.11)	(0.11)	(0.12)	(0.11)
Graduate=Yes	−0.02	−0.03	−0.06	−0.004	0.01	0.03	0.02	0.02
	(0.11)	(0.12)	(0.12)	(0.12)	(0.10)	(0.10)	(0.10)	(0.10)
Prof. qual=Yes	0.003	0.01	0.03	0.08	−0.03	−0.04	−0.04	−0.03
	(0.11)	(0.11)	(0.11)	(0.12)	(0.10)	(0.10)	(0.10)	(0.10)
Language score	−0.01	−0.01	−0.005	−0.01	−0.01	−0.02	−0.02	−0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Training (Days)	−0.01	−0.01	−0.01	−0.004	−0.0003	−0.0000	−0.001	−0.0004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.004)	(0.004)	(0.004)	(0.004)
Experience	0.02	0.02	0.02	0.02	−0.03	−0.03*	−0.03*	−0.04*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Grade factors	No	Yes	Yes	Yes	No	Yes	Yes	Yes
District dummy	No	No	Yes	Yes	No	No	Yes	Yes
School factors	No	No	No	Yes	No	No	No	Yes
Observations	113	113	113	113	98	97	97	97
R^2	-0.021	0.009	0.03	0.039	0.003	0.024	-0.002	0.08

Notes: We use robust standard errors.
*p<0.1; **p<0.05;***p<0.01

Table 11: Regression on teacher fixed effect by grade-Only contract teacher

7 Conclusion

Contract teachers constitute a major proportion of the teaching workforce in the state of Bihar, India. We found that they are more likely to be working in less developed districts (table 8) and with lower performing students (table 7) compared to regular teachers. Therefore, our *first* take-away is that contract teachers are more likely to be working in poor and disadvantaged regions.

Second, we find contract teachers are not different from regular teachers in terms of student outcomes. More specifically, there is no significant difference between contract and regular teachers in grade 4 but for grade 6 contract teacher has a negative effect on student achievement, although this negative effect may be mitigated if these teachers are hired locally (table 9).

Other papers on contract teachers have found positive effect of contract teacher on student outcomes (Duflo et al., 2015; Muralidharan and Sundararaman, 2013). It is important to understand the mechanisms behind the 'no effect' obtained in our study. One of the explanations is that in Bihar unlike other states, contract teachers are hired for life. This nullifies the incentive mechanism of the contract system where ideally renewal should be based on performance (as noted by Atherton and Kingdon (2010)). Therefore, the contract teachers in Bihar are less incentivised.

Third, our teacher fixed effect estimates (table 11) reveal that contract teachers who are "local", i.e. native to the village where the school is, perform better for grade 6 than those who are not local (0.21 to 0.23 sd). The positive local teacher effect could be due to reduced "social distance" between the teacher and students and their parents leading to better interaction and/or due to monitoring of teachers by school and parents (Pandey, 2006; Rawal and Kingdon, 2010).

Four, we also show that various criterions required to qualify for the post of regular teachers like teacher training and certification fail to predict teacher effectiveness. This is not surprising as most of the studies both in developed and developing countries have found that teacher qualification, training or other related credentials perform poorly in predicting teacher quality (Araujo et al., 2016; Azam and Kingdon, 2015; Hanushek and

Rivkin, 2006; Kane et al., 2008; Rivkin et al., 2005). This implies heavy reliance on strict entry level criterions for hiring and promotion of teachers might not be the best way to deal with the persistent learning crisis facing many developing countries.

The importance of teacher quality in improving school performance and the subsequent inability to identify the factors influencing it highlights the need for further research in this direction. The above empirical evidence gives us less reason to believe that the less professionally qualified and relatively inexperienced contract teachers would reduce teacher quality. On the other hand, the fact that hiring teachers from the local community might be important for their effectiveness needs further exploration with more detailed data.

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A Student score distribution

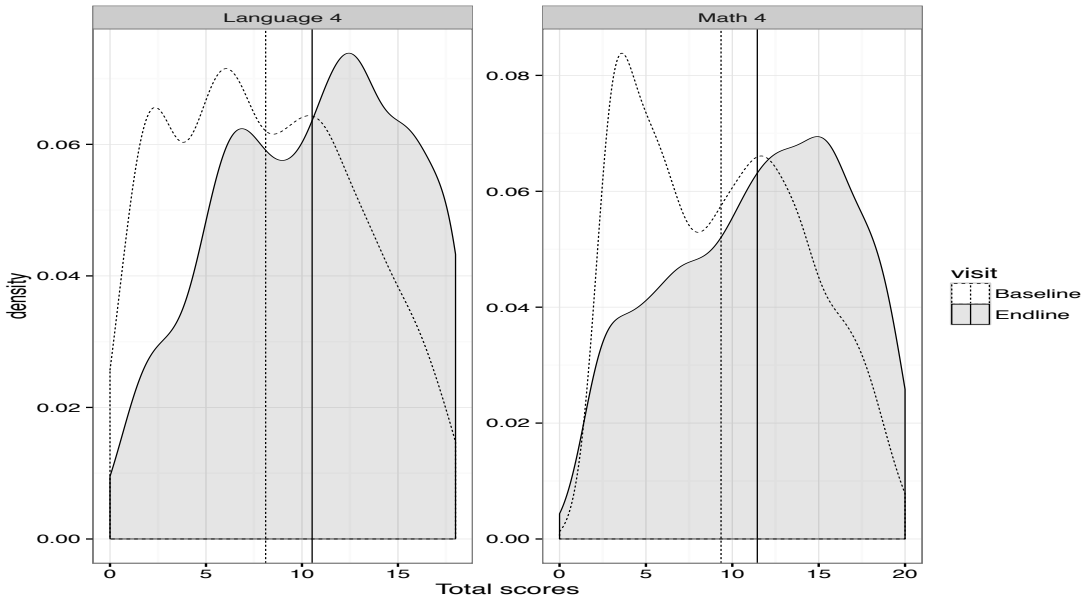

Figure 4: Density plot total scores Grade 4

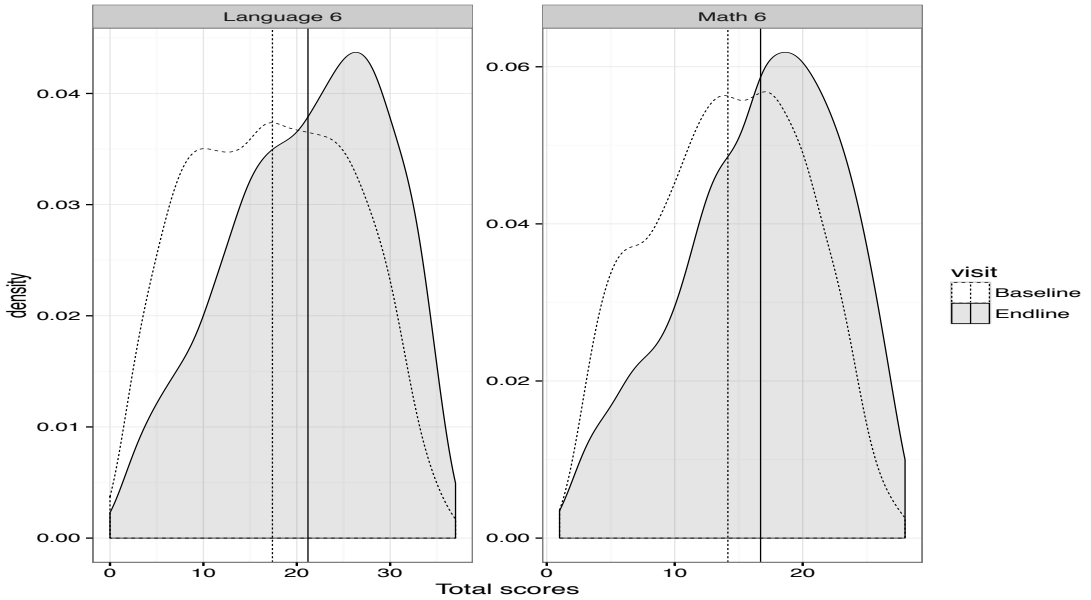

Figure 5: Density plot total scores Grade 6