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The Effect of Teacher Bonuses on Learning Outcomes and the Distribution of Teacher Skill: Evidence from Rural Schools in Peru

Juan F. Castro

Bruno Esposito

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Juan F. Castro
Department of Economics
Universidad del Pacifico

Bruno Esposito
Department of Economics
Universidad del Pacifico

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Abstract

Teachers tend to avoid working in places with poor basic services, where transport costs are high and students show low performance. As a result, less advantaged students living in rural areas usually get paired with less qualified teachers. In many developing countries, teachers are offered monetary incentives to work in rural or remote schools. The literature, however, offers very little evidence about their effect on teacher qualifications. Moreover, this is the first study to produce causal evidence about the effect on these incentives on learning outcomes. This paper analyses the effect of unconditional monetary incentives on learning outcomes and the distribution of teacher skill in public rural schools in Peru. Teachers working in a rural school receive, on average, an additional 430 soles each month (around US$ 130 and approximately 30% of the starting salary). Schools are classified as rural based on the population of their community and their distance to the nearest province capital. We use a regression discontinuity design that exploits the exogenous shift in the amount of the bonus that occurs around the population and distance thresholds used to classify a school as rural. We find that the average bonus had a positive effect of around 0.16 standard deviations on reading comprehension and mathematics test scores obtained by second grade students in the 2014 and 2015 national evaluations. One of the mechanisms by which teacher bonuses can have a positive effect on learning is by making rural schools more attractive for talented teachers. We find evidence in favor of this channel. In fact, the bonus caused a shift of 0.38 standard deviations in the average score obtained by rural school teachers in the 2015 recruitment evaluation.

Keywords: teacher incentives, rural schools, regression discontinuity.
JEL codes: I21, C26.

1. Introduction and motivation

The literature about human capital formation often recognizes the importance of qualified teachers for improving the cognitive ability of students (Chetty, et al., 2010; Rivkin, Hanushek, and Kain, 2005; Chetty, Friedman and Rockoff, 2014). There is evidence that below-average students usually get paired with low-quality teachers (Haycock & Peske, 2006; Carroll, Reichardt, Guarino, & Mejia, 2000). Rural schools usually have more trouble recruiting high-quality teachers, than their urban counterparts (Casely-Hayford, 2007; Miller, 2012). This problem is often related to an imperfect recruiting system. To the extent in which teachers can decide where to work, they will avoid working in low-income districts (Loeb, Lankford and Wyckoff, 2002; Hough, 2012), where basic services are not supplied, transport costs are high and students show a low performance.

The above describes the situation of rural schools in Peru. Rural schools have poorer infrastructure and less advantaged students than urban schools (Castro and Rolleston, 2015). National student evaluations show a persistent 30 percentage point gap between the proportion of urban and rural second grade students that exhibit satisfactory reading comprehension skills. Teachers working in rural schools are also less qualified than their urban counterparts. In the 2015 recruitment test, teachers that ended up working in a public urban school scored 0.32 standard deviations above those who were allocated to a public rural school

To mitigate this problem, the Ministry of Education offers unconditional monetary incentives. The idea is to compensate teachers for the costs of working in a difficult environment. Teachers working in schools located in rural areas and other challenging environments receive an additional payment or bonus. These schools are: (i) single teacher or multi-grade; (ii) rural; (iii) located in a VRAEM[1] district; (iv) located in a national border; or (v) inter-cultural bilingual. The average monthly bonus is 430 soles and represents 30% of the starting salary.

A growing strand of the literature has already discussed the effects of conditional incentives for teachers in developed (Podgursky and Springer, 2006; Podgursky, 2008; Koppich, 2008; Vegas and Umansky, 2005; Allan and Fryer, 2011) and developing countries (Todd et al., 2015; Glewwe, Ilias and Kremer, 2010). Many of these studies report positive effects on learning outcomes. The literature, however, offers very little evidence about the effects of unconditional monetary incentives. De Ree et al. (2015) used a randomized controlled trial to

[1] Valley situated between the Apurimac, Ene and Mantaro rivers.

measure the effect of an increase in theacher salaries on learning outcomes in Indonesia. They did not find evidence of a positive effect. In another recent study, Pugatch and Schroeder (2014) empoyed a regression discontinuity design to measure the effect of uncontidional incentives on the presence of qualified teachers in rural schools in Gambia. They found a positive effect of around 10pp on the share of qualified teachers in rural schools. To the best of our knowledge, no previous study has produced causal evidence about the effect of this type of incentives on learning outcomes.

The objective of this paper is to estimate the effect of bonuses paid to rural teachers in Peru on learning outcomes and the distribution of teacher skills. For this, we employ a regression discontinuity design. The Ministry of Education assigns rural bonuses to schools located in communities that exceed certain thresholds in terms of population and distance to the nearest province capital. We use these rules to induce exogenous variation in the amount of the bonus and identify the effect of the incentive on: (i) learning outcomes among second grade students participating in the 2014 and 2015 national student evaluation; and (ii) the distribution of teacher skills as measured by the 2015 recruitment evaluation. To check the robustness of our results, we also implement a fixed effects estimation for learning outcomes.

We find that the average bonus (S/. 430) had a positive effect of 0.17 standard deviations on reading comprehension scores, 0.15 standard deviations on mathematics scores, and 0.38 standard deviations on the scores obtained by rural school teachers in the 2015 evaluation. The fixed effect estimations confirm the positive effect of the bonus on reading comprehension scores in the average rural school.

The rest of this paper is organized as follows. In section 2, we describe the incentive scheme. In section 3, we present the empirical strategy. In section 4, we show and discuss the results. Section 5 closes with some concluding remarks.

2. Bonuses for teachers working in public rural schools in Peru

Rural bonuses were first implemented in 1990. The amount offered was less than S/. 50 (17% of the 2017 minimum wage) and was only given to single teacher schools and schools located in a national border. In 2014, the Ministry of Education changed the bonus scheme by including more school categories and increasing the amount offered. Table 1 shows the nine possible categories and the number of schools in each category in 2014 and 2015. Schools can receive more than one bonus simultaneously (see Appendix 1). In 2015, the Ministry of Education decided to increase the bonus for the “Rural 1” category from S/. 200 to S/. 500.

Table 1. Rural bonuses

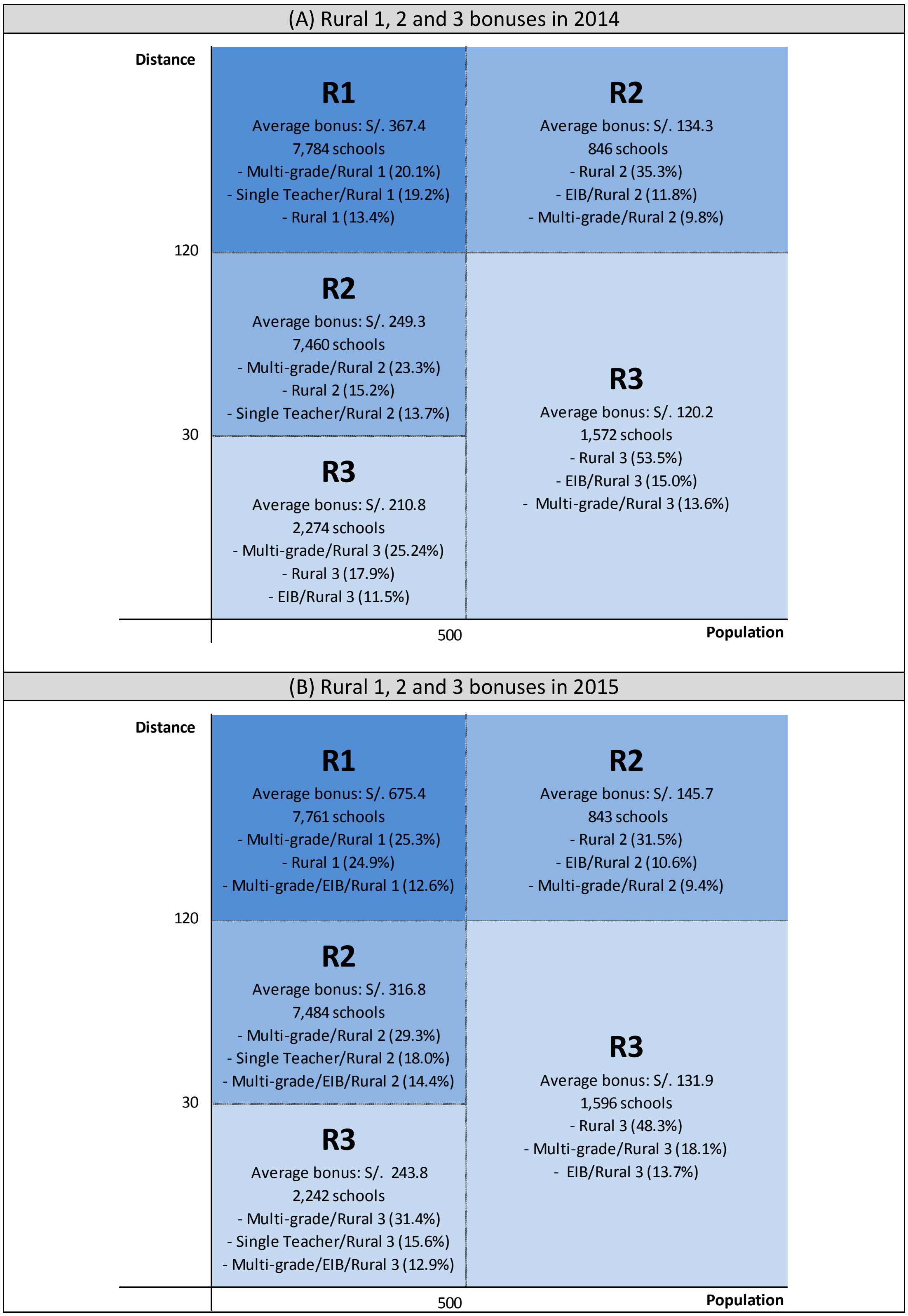
	2014			2015		
	Rural bonus (S/.)	Number of schools	%	Rural Bonus (S/.)	Number of schools	%
Single teacher	200	6,674	17.36	200	8,894	22.89
Multi-grade	140	9,745	25.34	140	12,446	32.03
Accredited intercultural bilingual	100	8,464	22.01	100	8,464	21.78
Not accredited intercultural bilingual	50			50		
Rural 1	200	10,504	27.32	500	10,504	27.03
Rural 2	100	9,667	25.14	100	9,667	24.88
Rural 3	70	4,721	12.28	70	4,721	12.15
National border	100	2,556	6.65	100	2,556	6.58
VRAEM	300	974	2.53	300	974	2.51

Notes: Since a school can receive more than one rural bonus simultaneously, the percentages displayed will not add up to 100%.

Appendix 1 shows the frequency of schools by the number of rural bonuses received. Around 65% of the schools in Peru received at least one rural bonus in 2014 and 2015. The average rural bonus shifted from S/. 274.9 in 2014 to S/. 429.5 in 2015. Most of this change was due to the increase of the "Rural 1" bonus in 2015 from S/. 200 to S/. 500.

The criteria used to classify a school as Rural 1, 2 or 3 are shown in figures 1 and 2. These categories are determined by the interaction of two variables: (i) the population of the community hosting the school and (ii) the distance to the nearest province capital. The largest rural bonus in 2015 was S/. 500 soles and was given to schools located in a community with less than 500 inhabitants and more than 120 minutes away from the nearest province capital.

Figure 1. Criteria for classifying a schools as Rural 1, 2 or 3



3. Data and empirical strategy

3.1 Data

This study employs four sources of information.

(i) The results of the 2014 and 2015 Second Grade National Student Evaluations (ECE). These evaluations comprise test scores in reading comprehension and mathematics for second grade students attending the 95% of schools in Peru. Scores have been averaged within schools and standardized using the mean and standard deviation of the 2014 ECE.

(ii) The results of the 2015 teacher recruitment evaluation. This provides test scores for prospective teachers participating in the evaluation as well as their final school assignment.

(iii) The 2013 and 2014 School Census. This provides information on schools characteristics potentially relevant for learning outcomes.

(iv) The 2013 and 2014 National Household Survey. This provides information about family characteristics at the regional level.

3.2 Empirical strategy

The empirical objective is to estimate the effect of bonuses paid to teachers working in rural schools on learning outcomes among second grade student and the distribution of teacher skills.

There are two mechanisms through which these bonuses can affect learning outcomes. They can either induce a change in behavior among existing teachers (who, for instance, can decide to devote more time to their teaching duties) or provoke a shift in the distribution of skills of teachers (by, for example, attracting more talented teachers who would otherwise prefer to work in a different school). Based on this, if we consider two schools with the same characteristics (in everything except their teachers and the presence of a bonus), the school "treated" with a rural bonus can exhibit better learning outcomes through a larger quantity or quality of teaching.

The main empirical challenge when trying to identify the effect of rural bonuses on learning outcomes with observational data is related to the presence of unobserved heterogeneity correlated with the size of the bonus. Larger bonuses are offered in schools more difficult to access and, therefore, where the supply of school inputs and the preschool skill (or "school readiness") of their students is likely poorer. Accordingly, there is a significant risk of underestimating the effect of the rural bonuses.

For teacher skills, we use the outcomes of the recruitment evaluation as a proxy. In this case, unobserved heterogeneity is related to the costs of working in a particular school. These costs exhibit a positive correlation with the amount of the bonus but have a negative effect on the average skill of teachers who decide to work there as high-performing teachers will avoid schools with high costs. As a consequence, without further identification, the effect of rural bonuses on teacher skill will also tend to be underestimated.

The empirical strategy proposed to overcome these challenges and estimate the casual effect of rural bonuses on learning outcomes has two parts. The first takes advantage of the longitudinal information available at the school level between 2014 and 2015 and employs a fixed effects estimator. The second exploits the rules used to allocate rural bonuses and employs a regression discontinuity design (RDD) to estimate the casual effect. Given the lack of longitudinal information on teacher skill, only the second approach will be implemented to estimate the effect of rural bonuses on the distribution of teacher skill.

3.2.1 Fixed effects estimator

This strategy is based on the following regression using longitudinal data:

$$S_{it} = \alpha_0 + \alpha_i + \gamma_t + \beta A_{it} + I'_{it}\lambda + x'_{it}\theta + u_{it} \qquad (1)$$

Where S_{it} denotes learning outcomes attained in school i in period t (t = 2014, 2015), α_i is a school fixed effect, γ_t is a period fixed effect, A_{it} is the size of the bonus offered in school i in period t, I_{it} is a vector containing information on school characteristics, and x_{it} is a vector containing socio-economic controls. Information on learning outcomes was obtained from the Evaluacion Censal de Estudiantes (ECE 2014, 2015). Information on school characteristics potentially relevant for learning was obtained from the Censo Escolar, and family characteristics from the Encuesta Nacional de Hogares (ENAHO). We need to rely on the ENAHO because information on students' socioeconomic status is not available in the ECE or in school administrative records. This implies that the information in x_{it} will be at the regional level.

The OLS estimate of parameter β will provide an estimate of the effect of rural bonuses on learning outcomes, holding observable school and family characteristics constant, and controlling for unobserved heterogeneity that remains constant across time. The latter is possible through the school fixed effect (α_i). This is particularly important since the most plausible source of unobserved heterogeneity in (1) is the pre-school skill of students. This is because the Peruvian education system is highly segregated so pre-school skill correlates with school quality. The assumption, thus, is that the pre-school skill of students has not changed significantly in the last two years[2].

It is worth noticing that the school inputs considered in vector I_{it} should not include teacher characteristics as we expect that the bonus can operate by shifting these characteristics. In other words, we want to estimate the total effect of a change in the rural bonus and not just the effect that operates through a change in teacher behavior.

One key element for this strategy to work is that we need enough time variation in the size of the bonus offered in a particular school. This can be achieved not only by the increase in Rural 1 bonus, but also through changes in the classification of schools.

3.2.2 Regression discontinuity

The rules employed to classify a school as rural allow one to use a regression discontinuity design to identify the effect of the bonus. This technique compares outcomes between schools located around the threshold of the variables that define a school as rural. As long as there is a functional relation between the outcome and the variable that defines rurality, schools located around the threshold are comparable. The difference is that institutions above the threshold receive the bonus while those below it do not receive the bonus. For this reason, the outcome difference between schools around the threshold can be used to identify the effect of rural bonuses on the outcomes of interest.

In our case, as explained in Section 2, there are two variables (population and distance) used to classify the school in a certain rural category and assign a certain bonus size. In addition, meeting the criteria for a certain rural bonus does not guarantee the school will receive it. For these reasons, we will implement a fuzzy regression discontinuity based on an instrumental variable estimation. The endogenous regressor is the amount of rural bonus received by the school and the instrument is an indicator variable that identifies whether the school is classified as Rural 1 or not.

[2] Even if it has changed, the period fixed effect could control for this if the shift has been homogenous across schools.

A fuzzy regression discontinuity is applicable when surpassing the threshold does not guarantee that treatment is received but it does cause an increase in the probability of receiving it (Glewwe and Todd, 2016). In our case, there are several reasons why a school can receive a bonus besides distance and population. Bonuses are assigned to schools that are single teacher, multi-grade, intercultural bilingual, VRAEM or national border. In addition, there is imperfect compliance with the criteria for classifying a school as Rural 1, 2 or 3. Because of these, crossing the thresholds of population and distance does not produce a sharp discontinuity.

The second stage specification of the instrumental variable estimation is the following:

$$S_{it} = \alpha_0 + P_{it}'\varphi_1 + D_{it}'\varphi_2 + \beta\tilde{A}_{it} + I_{it}'\lambda + x_{it}'\theta + \alpha_j + u_{it} \tag{2}$$

Where S_{it} reflects learning outcomes in school i in time t. P_{it} is a vector containing: (i) the population of the community hosting school i ; (ii) the squared value of this population; and (iii) an interaction between this population and an indicator variable identifying if the population is less than 500. Vector D_{it} contains similar variables for distance in minutes to the nearest province capital. α_j are regional fixed effects. $\tilde{A}_{it}$ corresponds to the amount of the bonus predicted according to the following first stage regression:

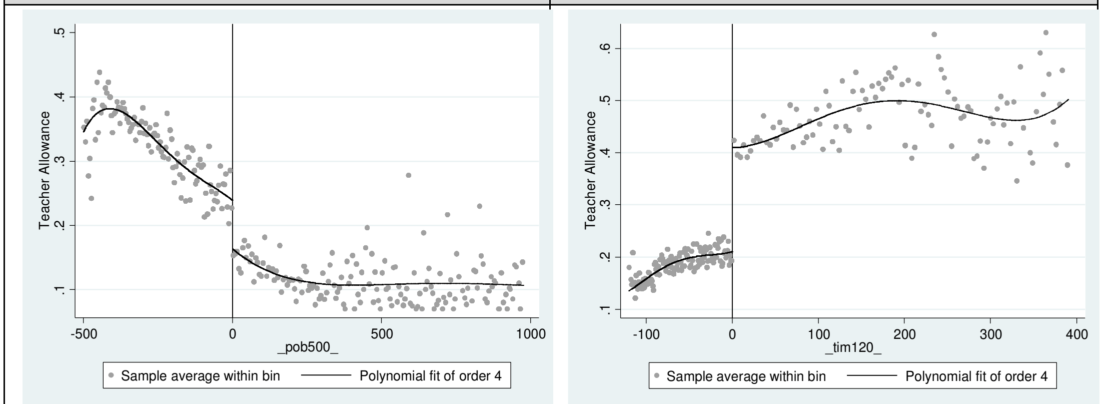
$$A_{it} = \delta_0 + P_{it}'\vartheta_1 + D_{it}'\vartheta_2 + \rho R_{it} + I_{it}'\tau + x_{it}'\omega + \alpha_j + \varepsilon_{it} \tag{3}$$

Where R_{it} is the instrumental variables and is an indicator that has a value 1 if the school is Rural 1, and 0 otherwise. Identification requires the instrument to be relevant and exogenous. Exogeneity means that the instrument should not be correlated with unobservables and this is possible because the second stage specification controls for the distance and population variables that define the instrument. These controls also account for the possibility of a quadratic relationship between distance, population and learning outcomes and for the possibility of a shift in this relationship across the thresholds used to define the instrument. The idea, therefore, is that any unobservables remaining in (2) should not be correlated with the instrument and that the effect of being classified as Rural 1, if any, should only operate through a shift in the amount of the allowance.

The relevance of the instrument depends on its significant relationship with the amount of the bonus, after controlling for the second stage covariates. Figure 2 shows that the size of bonus shifts discontinuously around the threshold for each running variable (distance to the nearest province capital and population of the community hosting the school). Further proof if the relevance of the instrument is provided by the significance of the instrument in the first stage regression and the outcome of the Stock-Yogo test (Stock and Yogo, 2005). Both are displayed in the results section (Section 4).

Figure 2. Amount of rural bonus and running variables

(A) Amount of the bonus and population of the community hosting the school (deviated with respect to 500)	(B) Amount of the bonus and distance to the nearest province capital (deviated with respect to 120 minutes)



Notes: the amount of the rural bonus (in Peruvian currency) has been divided by 1,000. The population of the community hosting the school and the distance to the nearest province capital have been deviated with respect to their corresponding thresholds (500 people and 120 minutes, respectively).

The empirical strategy is the same for teacher skill. The second stage regression is the following:

$$Q_{it} = \alpha_0 + P'_{it}\varphi_1 + D'_{it}\varphi_2 + \beta\tilde{A}_{it} + I'_{it}\lambda + x'_{it}\theta + w'_{it}\alpha + u_{it} \tag{4}$$

Where Q_i is the average score obtained in the 2015 recruitment evaluation by the teachers who joined school i after the test. The remaining variables are the same as in (2) and the first stage regression is the same as in (3).

4. Effects on learning outcomes and teacher skills

The estimated effects of the bonus on learning outcomes are displayed in tables 2 and 3 (reading comprehension and mathematics, respectively). The amount of the bonus paid in each school has been normalized considering the size of the average bonus in the sample (S/. 430). Therefore, the estimated coefficients should be interpreted as the effect of the average bonus. Column 1 displays the results of the fixed effect estimation over the complete sample of urban and rural schools. Column 2 presents the results of the fixed effect estimation over the sample of rural schools only. Column 3 also presents the results of the fixed effect estimation but over the sample of rural schools that have complete information about population and distance. Finally, Column 4 displays the results of the RDD estimation over this same sample.

The fixed effect and RDD estimations identify different parameters. The interpretation of the effects also varies according to the sample considered. Column 1 presents the effect of the average bonus on the average school. This effect amounts to 0.28 standard deviations for reading comprehension (see Table 2). Column 2 presents the effect of the same bonus but on the average rural school. This effect amounts to 0.12 standard deviations for reading comprehension. It is reasonable to find a smaller effect in rural schools for two reasons. First, an additional payment of a given amount will be more effective in attracting talented teachers to schools where is less costly to work. The average school faces less problems in terms of poor basic services, high transport costs and low performing students than the average rural school. Second, the average school has a richer endowment of learning inputs complementary to teacher skill than the average rural school. Therefore, the same increase in teacher talent or time devoted to teaching is likely less productive in the average rural school.

If we compare columns 2 and 3 in Table 2 we will see that the fixed effect estimation of the effect of the average bonus on a rural school is robust to restricting the sample to those schools with complete distance and population information. The RDD estimate presented in column 4 corresponds to the effect of the bonus on a rural school characterized by a population and distance in the vicinity of the thresholds considered to classify a school as Rural 1. The size of this effect is around 0.17 standard deviations. This estimate is somewhat larger than the fixed effect estimation but remains within standard errors.

Table 3 presents the results for mathematics. The effect of the average bonus according to the RDD estimation is similar to that obtained for reading comprehension and amounts to 0.15 standard deviations. Remarkably, the fixed effect estimations are not significant for this learning outcome. Notice that the fixed effect estimations are now close to zero or even negative. It is possible that the assumption required for identification in this case (i.e. that unobserved heterogeneity remains time invariant) no longer holds and these estimates are affected by a negative bias.

Table 4 presents the results for test scores obtained in the 2015 teacher evaluation. Since there is not enough information to employ a fixed effects panel regression, we present OLS estimates in the three samples considered. It is worth noticing that all these regressions (columns 1, 2 and 3) report negative and significant estimates. This is consistent with unobserved heterogeneity (i.e. the costs related to working in a particular school) having a positive correlation with the amount of the bonus and a negative correlation with teacher skill. The effect has, therefore, been underestimated. The RDD estimate is free of this bias and provides positive effect of 0.38 standard deviations on the average test scores obtained by the teachers who work in a rural school located in the vicinity of the population and distance thresholds used to classify a school as Rural 1.

Table 2. Effects on reading comprehension (2014 and 2015 national student evaluations)

	(1) FE Complete sample	**(2)** FE Rural schools	**(3)** FE Rural schools complete data	**(4)** RDD Rural schools complete data
Rural bonus	**0.284***** **(0.030)**	**0.124***** **(0.032)**	**0.102***** **(0.037)**	**0.168***** **(0.063)**
Observations	34,098	16,738	12,832	12,832
R-squared	0.229	0.256	0.255	0.248
Number of schools	17,049	8,369	6,416	6,416
Regional fixed effects	NO	NO	NO	YES
School and time fixed effects	YES	YES	YES	NO
Controls	YES	YES	YES	YES
First Stage	-	-	-	0.393***
Stock-Yogo test	-	-	-	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: column 1 displays the results of the fixed effect estimation over the complete sample of urban and rural schools. Column 2 presents the results of the fixed effect estimation over the sample of rural schools only. Column 3 presents the results of the fixed effect estimation over the sample of rural schools that have complete information about population and distance. Column 4 displays the results of the RDD estimation over the sample of rural schools that have complete information about population and distance. Estimated coefficients correspond to the effect of increasing the rural bonus by S/. 430 (the amount of the average bonus). Test scores have been standardized using the mean and standard deviation of the 2014 evaluation. Control variables include: school is multi-grade, school is single-teacher, school received workbooks on time, number of preschool years of primary students, school has laboratory, school has library, school has computers, school has electricity, school has drinking water, school is connected to the public sewer system and mothers' average number of years of education in the region. First stage indicates the coefficient of the instrumental variable in the first stage regression and its significance. Stock – Yogo test indicates whether the null hypothesis of weak instruments can be rejected with, at least, 10% significance.

Table 3. Effects on mathematics (2014 and 2015 national student evaluations)

	(1) FE Complete sample	(2) FE Rural schools	(3) FE Rural schools complete data	(4) RDD Rural schools complete data
Rural bonus	**0.003** **(0.035)**	**-0.019** **(0.039)**	**-0.073*** **(0.044)**	**0.147**** **(0.075)**
Observations	34,098	16,738	12,832	12,832
R-squared	0.071	0.057	0.057	0.198
Number of schools	17,049	8,369	6,416	
Regional fixed effect	NO	NO	NO	YES
School and time fixed effects	YES	YES	YES	NO
Controls	YES	YES	YES	YES
First Stage	-	-	-	0.393***
Stock-Yogo test	-	-	-	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: column 1 displays the results of the fixed effect estimation over the complete sample of urban and rural schools. Column 2 presents the results of the fixed effect estimation over the sample of rural schools only. Column 3 presents the results of the fixed effect estimation over the sample of rural schools that have complete information about population and distance. Column 4 displays the results of the RDD estimation over the sample of rural schools that have complete information about population and distance. Estimated coefficients correspond to the effect of increasing the rural bonus by S/. 430 (the amount of the average bonus). Test scores have been standardized using the mean and standard deviation of the 2014 evaluation. Control variables include: school is multi-grade, school is single-teacher, school received workbooks on time, number of preschool years of primary students, school has laboratory, school has library, school has computers, school has electricity, school has drinking water, school is connected to the public sewer system and mothers' average number of years of education in the region. First stage indicates the coefficient of the instrumental variable in the first stage regression and its significance. Stock – Yogo test indicates whether the null hypothesis of weak instruments can be rejected with, at least, 10% significance.

Table 4. Effects on the average score of rural school teachers in the 2015 recruitment evaluation

	(1) FE Complete sample	**(2)** FE Rural schools	**(3)** FE Rural schools complete data	**(4)** RDD Rural schools complete data
Rural bonus	**-0.221*** (0.052)**	**-0.166*** (0.055)**	**-0.152** (0.062)**	**0.384** (0.184)**
Observations	3,092	1,406	1,036	1,036
R-squared	0.067	0.060	0.062	0.098
Regional fixed effects	YES	YES	YES	YES
Controls	YES	YES	YES	YES
First Stage	-	-	-	0.589***
Stock-Yogo test	-	-	-	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: column 1 displays the results of the fixed effect estimation over the complete sample of urban and rural schools that were selected by at least one of the teachers participating in the 2015 evaluation. Column 2 presents the results of the fixed effect estimation over the sample of rural schools only. Column 3 presents the results of the fixed effect estimation over the sample of rural schools that have complete information about population and distance. Column 4 displays the results of the RDD estimation over the sample of rural schools that have complete information about population and distance. Estimated coefficients correspond to the effect of increasing the rural bonus by S/. 430 (the amount of the average bonus). Control variables include: school is multi-grade, school is single-teacher, school received workbooks on time, number of preschool years of primary students, school has laboratory, school has library, school has computers, school has electricity, school has drinking water, school is connected to the public sewer system and mothers' average number of years of education in the region. First stage indicates the coefficient of the instrumental variable in the first stage regression and its significance. Stock – Yogo test indicates whether the null hypothesis of weak instruments can be rejected with, at least, 10% significance.

5. Concluding remarks

In many developing countries, teachers are offered bonus payments to work in remote areas and under particularly difficult conditions (e.g. facing high transport costs or working with students with low performance). The literature, however, offers very little evidence about the effect of these incentives on teacher characteristics and, to the best of our knowledge, no evidence so far about their effect on learning outcomes.

In this paper, we estimated the effect of bonus payments currently offered to teachers working in public rural schools in Peru on reading comprehension and mathematics learning outcomes and on the distribution of teacher skills. Bonus payments can affect learning outcomes by inducing a behavioral change among existing teachers (who, for example, can devote more hours to their teaching duties due to the additional payment) or by changing the distribution of teacher skill by making rural schools more attractive for talented teachers. This paper explores this second channel by looking into the effect of the rural bonus on the average score obtained in a recruitment test by the teachers who decided to work in a rural school.

We used a regression discontinuity design that exploits the exogenous shift in the amount of the teacher bonus around the distance and population thresholds used by the Ministry of Education to classify a school as rural. We found that the average bonus (around S/. 430) caused increases of around 0.17 and 0.15 standard deviations in reading comprehension and mathematics test scores, respectively, obtained in the 2014 and 2015 national student evaluations by second grade students. This same bonus caused a positive shift of 0.38 standard deviations in the average score obtained by rural teachers in the 2015 recruitment evaluation.

Combined, these results provide robust evidence of a positive effect of rural bonuses on learning outcomes and suggest that one of the mechanisms is by attracting more talented teachers to rural schools. Knowing that teachers are responsive to this type of unconditional monetary incentives is important for the design of interventions aimed at closing the significant disparities observed between urban and rural schools in Peru. In fact, these gaps still amounted to 0.69 and 0.45 standard deviations in the 2015 reading comprehension and mathematics student evaluation, respectively, and to 0.32 standard deviations in the average scores obtained by teachers in the 2015 recruitment evaluation. Our results indicate that, in the absence of rural bonuses, these gaps would have been around 25% and 33% larger in reading and mathematics, respectively, and more than twice as large in teacher skill.

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Appendix 1. Frequency of schools by number of rural bonuses received

	2014				2015			
	Number of Schools	%		Average rural bonus	Number of Schools	%		Average rural bonus
No bonus	12,738	33.13	33.13	0.0	13,156	33.85	33.85	0.0
One bonus	6,292	16.36		124.3	3,013	7.75		138.2
Rural 2	*1,974*		*5.13*	*100.0*	*739*		*1.90*	*70.0*
Rural 1	*1,909*		*4.96*	*200.0*	*351*		*0.90*	*100.0*
Rural 3	*1,738*		*4.52*	*70.0*	*1268*		*3.26*	*500.0*
Multi-cultural Bilingual	*243*		*0.63*	*50.0*	*243*		*0.63*	*50.0*
National Border	*159*		*0.41*	*100.0*	*158*		*0.41*	*100.0*
Single Teacher	*148*		*0.38*	*200.0*	*155*		*0.40*	*200.0*
Multi-grade	*80*		*0.21*	*140.0*	*66*		*0.17*	*140.0*
VRAEM	*41*		*0.11*	*300.0*	*33*		*0.08*	*300.0*
Two bonus	12,597	32.76		280.2	14,395	37.04		422.3
Multi-grade/Rural 2	*2400*		*6.24*	*240.0*	*3097*		*7.97*	*240.0*
Single Teacher/Rural 1	*2150*		*5.59*	*400.0*	*3012*		*7.75*	*700.0*
Multi-grade/Rural 1	*2142*		*5.57*	*340.0*	*2838*		*7.30*	*640.0*
Single Teacher/Rural 2	*1543*		*4.01*	*300.0*	*2081*		*5.35*	*300.0*
Multi-cultural Bilingual /Rural 2	*1091*		*2.84*	*150.0*	*470*		*1.21*	*150.0*
Multi-grade/Rural 3	*1088*		*2.83*	*210.0*	*1417*		*3.65*	*210.0*
Other	*2183*		*5.68*	*227.9*	*1480*		*3.81*	*238.5*
Three bonus	5,477	14.24		371.3	6,769	17.42		506.1
Multi-grade/Multi-cultural Bilingual/Rural 2	*1,235*		*3.21*	*290.0*	*1659*		*4.27*	*290.0*
Multi-grade/Multi-cultural Bilingual/Rural 1	*992*		*2.58*	*390.0*	*1248*		*3.21*	*690.0*
Other	*3,250*		*8.45*	*396.4*	*3,862*		*9.94*	*539.4*
Four bonus	1,347	3.50	3.50	536.9	1,529	3.93	3.93	733.3
Total	38,451	100.00	100.00	**274.9**	38,862	100.00	100.00	**429.5**

Notes: total average rural bonus excludes schools without any rural bonus.