

Contract Teachers and Student Achievement in Rural China: Evidence from Class Fixed Events

Wang Lei, Siqi Zhang, Mengjie Li, Yonglei Sun, Sean Sylvia, Enyan Yang, Guangrong Ma, Linxiu Zhang, Di Mo, and Scott Rozelle

Abstract

Education is widely considered to be the most important form of human capital, especially in less developed countries where the rates of return are generally high for all individuals, including for agricultural producers. However, for schooling to play an important role, the system of education needs to provide quality education, which among other things requires high quality teachers. Unfortunately, in many developing countries there are dramatic differences in the quality of teachers and their effectiveness. Facing fiscal constraints and growing enrollments, school systems in developing countries often supplement their teaching staff by hiring contract teachers – teachers hired on fixed-term contracts with considerably lower salaries than civil service teachers. Currently, however, there is limited evidence on how the effectiveness of these teachers compares to that of civil service teachers. We use a dataset from rural primary schools in western China to estimate the causal effect of contract teachers on student achievement. Using a value-added, cross-subject, fixed-effect approach to address potential bias arising from the sorting of teachers across and within schools, we find that gains in student scores on standardized exams in math and Chinese are 0.13 standard deviations less in classes taught by contract teachers than in classes taught by civil service teachers.

Keywords: Primary education, contract teachers, student achievement, China

Working Paper 328

November 2017

reap.fsi.stanford.edu



Contract Teachers and Student Achievement in Rural China: Evidence from Class Fixed Effects

Introduction

Education is widely considered to be the most important form of human capital (Schultz, 1961). In low and middle-income countries, the private and social rate of return—especially to primary and secondary schooling—is generally high (Psacharopoulos, 1994). Huffman (1974) shows how the impact of education on income also holds in the case of agricultural producers. High levels of education can help producers in planning, production and management and marketing phases of their family farms. There are also reasons to believe education aids households as they begin to diversify off the farm in off farm labor markets and self-employed non-farm enterprises. Of course, to achieve high ultimate outcomes from education, schooling needs to lead to learning. Fortunately, even though most of the previous literature covered by the Psacharopoulos reviews focused on quantity (since there is plenty of census and survey data on years of schooling), there is very little evidence on the impact of the quality of schooling, particularly in rural areas (which our paper is able to contribute).

In China, the empirical literature demonstrates the importance of education in raising the incomes of farm families. Lin (1991) finds that education enhances the production and efficiency of farmers when they are adopting new technologies, in this case hybrid rice. Yang (1997) empirically ties higher levels of schooling to producer performance. Zhang et al. (2002) report the high rates of return for China's farm families as they move into the non-farm sectors. Interestingly, however, in the Zhang et al. (2002) paper, a review of the literature demonstrates that not all studies of education and rates of

return in rural China have found high returns, suggesting that there may be heterogeneity across space of subpopulations.

What may cause differences in rates of return? One frequently unstated assumption of the education and rural growth literature is that for schooling to play an important role, the system of education needs to provide quality education, which among other things requires high quality teachers. Unfortunately, across China there are dramatic differences in the quality of teachers and their effectiveness (Peng, Thomas, Yang, & Li, 2006; Peng et al., 2014). There also are differences in observed learning outcomes that have been thought to exist due to differences in teaching (Wang et al., 2017).

While there may be different reasons for the heterogeneity of teaching quality across rural China (and in developing countries, in general), staffing remote schools with effective teachers can be a challenge. Qualified teachers are often unwilling to work in remote locations and local governments often lack the fiscal resources needed to pay higher teacher salaries (Pandey, 2006). As a result, there can be substantial inequality in the distribution of teacher quality between urban and remote rural areas (Luschei & Carnoy, 2010; Luschei, 2011). Teacher quality is widely regarded as one of the most important inputs – if not the most important input – for student achievement and has even been shown to have substantial effects on outcomes later in life (Chetty, Friedman, & Rockoff, 2011; Leigh, 2010; Rivkin, ushek, & Kain, 2005; Rockoff, 2004). Shortages of effective teachers in poor, rural areas may therefore have important implications for both efficiency and equity in educational delivery.

One of the main approaches that has been used by school districts to address teacher shortages in remote areas is to staff remote schools with “contract teachers,” also referred to as “para-teachers.” In briefest terms, contract teachers are teachers employed on fixed-term contracts and often sourced from the local community. Compared to civil service teachers (or teachers that are hired through the formal education system), contract teachers generally have lower levels of education and less (if any) formal pedagogical training; contract teachers also are typically paid lower salaries (Pandey, 2006).

The objective of this study is to evaluate the effects of using contract teachers to address staffing needs on student achievement. To do so, we use a primary dataset from poor regions of western China. This region provides a unique opportunity to study these policies, as both types of teachers are common. As in many other developing countries, contract teachers are thought to have played a fundamental role in expanding access to primary education in China (Robinson & Yi, 2008; Sargent & Hannum, 2005). In 1980, contract teachers made up half of the primary and secondary education teaching force in China (Kingdon, Aslam, Rawal, & Das, 2013). While the use of contract teachers has fallen since, they are still prevalent in poor and remote rural areas where the fiscal and logistical constraints that make employing contract teachers attractive persist. According to the data from the three western provinces of our study, contract teachers currently make up 9% of the teaching force.

The effect that this policy may have on student achievement is largely unclear. Existing studies in countries outside of China have suggested that—despite fewer formal qualifications—contract teachers actually outperform civil service teachers (for a review, see Kingdon et al., 2013). This result has been attributed to contract teachers facing

stronger incentives than civil service teachers (Muralidharan & Sundararaman, 2013). For example, while firing regular teachers may be untenable (e.g., for political reasons), schools may be able to more easily replace poorly performing contract teachers employed on fixed terms. It has also been argued that contract teachers may be more effective given reduced social distance with students (Muralidharan & Sundararaman, 2013). Convincing evidence on the comparative effectiveness of contract teachers from existing studies, however, primarily comes from studies on less developed areas (mostly regions in India) and results are likely to be highly dependent on context (Kingdon et al., 2013). In particular, formal qualifications may be more important for student outcomes beyond a basic level of achievement. In contrast, in more developed educational systems, the performance of civil service teachers might be expected to be higher. It has also been suggested that the employment of contract teachers may have system-wide negative effects by de-professionalizing the teaching profession (Govmda & Josephine, 2005; Kumar, Priyam, & Saxena, 2001).

In this paper we estimate the effects of contract teachers (versus civil service teachers) on student achievement using a primary dataset collected in 300 schools located in poor regions of western China. However, direct comparisons of student achievement with respect to the use of contract teachers will be biased due to across and within school sorting of teachers and students. The most obvious source of bias is that more fiscally constrained and remote school systems are more likely to face teacher shortages and also more likely to have students of comparatively lower socio-economic status. To address potential bias, we use a value-added, cross-subject, class fixed effect approach. Because classes are fixed across subjects in Chinese primary schools, we are able to control for

fixed class-level characteristics (including class composition) that could bias comparisons using variation between math and Chinese teachers teaching the same students. In using this approach, we follow several recent studies of teacher characteristics in the fields of education and economics (Clotfelter, Ladd, & Vigdor, 2007; Goldhaber, Goldschmidt, & Tseng, 2013).

In our paper, we begin by estimating the effect of contract teachers (compared to civil service teachers) on student achievement. We present both “as-is” estimates that include the effects of teacher characteristics correlated with contract status as well as estimates controlling for other teacher characteristics. We find that contract teachers have a negative effect on gains in student performance on standardized exams in math and Chinese relative to civil-service teachers. Although naïve comparisons of students taught by contract and civil service teachers show only minor differences in achievement, cross-subject, class fixed effect estimates show that exam scores of students taught by contract teachers improve 0.13 standard deviations less than students taught by civil service teachers. This difference is not significantly affected when controlling for observable differences in teacher characteristics, suggesting that this negative effect is mainly driven by either unobserved characteristics or by the contract itself.

Our study contributes to a growing literature on the use of contract teachers in developing countries. While there are not many, in recent years there have been a small number of experimental studies that compare contract- and regular teachers directly and results have been mixed.¹ A number of studies in the developing world have shown mixed or negative associations with the employment of contract teachers (Bourdon,

¹ Following the literature, at times we use regular teachers and civil services interchangeably in the rest of the paper.

Frölich, & Michaelowa, 2010; Vegas & De Laat, 2003). Other experimental and observational studies suggest that the students of contract teachers actually perform better than the students of regular teachers (Atherton, Kingdon, & others, 2010; Duflo, Dupas, & Kremer, 2009). These differences may be attributable to differences in institutional context that affect the quality of contract teachers selected and the effort that contract teachers make once they are employed.

The rest of the paper is organized as follows. The next section provides background on the employment of contract teachers in China. Section 3 describes our data (including survey design and characteristics of teachers, students and schools). Section 4 discusses the empirical approaches we use to derive the estimates of the effect of contract teachers on student performance. We present our primary results in Section 5 and section 6 discusses policy implications and concludes.

Background: Contract Teachers and Teacher Deployment in Rural China

The employment of contract teachers has a long history in China. The present model of employing contract teachers (called *daike* in China) has its roots in the *minban* system, first inaugurated in the mid-1940s as a way to expand educational opportunity in poor rural areas at relatively low cost (Robinson & Yi, 2008). The minban system involved the creation of schools—separate from the regular government-administered schools—that were administered and financed by local communities and employed contract teachers (then called minban teachers). These teachers were mostly community members with above-average education but no formal professional qualifications. Although the minban system was gradually phased out, the practice of employing

contract teachers persisted as regular, government-run schools—particularly those in resource-constrained and remote areas—struggled to recruit and retain good teachers. In 1980, nearly half of all teachers in primary and secondary schools were contract teachers (Fyfe & others, 2007). Over the past several decades, the employment of large numbers of contract teachers is believed to have contributed significantly to China’s impressive improvement in rural student access to education (Duthilleul, 2006; Fyfe, 2007).

One primary reason for the employment of contract teachers is their relatively low cost. Contract teachers are paid much lower salaries than civil service teachers. In a survey of Gansu Province, average contract teacher salaries were found to be just one-fifth of civil service teacher salaries (Robinson & Yi, 2008). Civil service teachers generally receive incomes above the rural average, as well as employee benefits and relative job security (Han, 2013). Contract teachers, on the other hand, work on fixed-term contracts for lower salaries and no benefits. In spite of their lower status and pay, most contract teachers do work a full teaching load comparable to their civil service teacher colleagues and many continue to work as contract teachers for many years (Robinson & Yi, 2008). In light of this vast difference in compensation, hiring contract teachers can be an attractive choice for schools looking to expand offerings or bring down class sizes at minimal cost.

As the country’s education system has developed, however, the practice of employing contract teachers has come into question. While contract teachers are much cheaper to employ, they are generally much less qualified than civil service teachers. Contract teachers generally have lower levels of education than civil service teachers and little formal pedagogical training. The majority of full-time civil service teachers in

China graduated from upper secondary schools and their employment is contingent upon obtaining proper teacher qualifications and pedagogical training (Robinson & Yi, 2008; Sargent & Hannum, 2005). By contrast, most contract teachers have either junior high school or upper secondary education at most and very few have been exposed to any sort of formal teacher training (Sargent & Hannum, 2005).

Because contract teachers are less educated and less qualified on average than civil service teachers, policymakers fear they may also be less effective teachers. In an effort to respond to these concerns, the practice of employing contract teachers has declined dramatically nationwide. The proportion of civil service teachers in primary and secondary schools has expanded rapidly, increasing by 37% among primary teachers and 63% among secondary teachers from 1985 to 2002 (Robinson & Yi, 2008). Some former contract teachers have been converted to civil service teacher status and others have been dismissed. According to the Education Statistics Yearbook of China, the share of contract teachers in China's rural primary schools declined from 13.7% in 1999 to 4.4% in 2010 (Figure 1).

Although the employment of contract teachers is declining in rural China on average—and is very low in terms of national averages—the practice is still quite persistent in certain areas. Figure 2 presents the percentage of contract teachers in rural primary schools in each province from 1999 and 2010. It is shown that the proportion of contract teachers is still very high in poorer provinces concentrated in Western China. In our three sample provinces, Shannxi, Gansu and Qinghai, the proportion of contract teachers as of 2010 is 3.2%, 10.2% and 14.1%, respectively. Gansu and Qinghai are now the two provinces with the largest proportion of contract teachers in rural primary schools.

Thus, while the importance of contract teachers has decreased since the 1980s in the country as a whole, in poor rural areas, and especially in Western China, they are still a very prevalent and important element of the education system. Given large-scale inequality between rural and urban education in China, the persistent use of contract teachers in the poorest rural areas is especially important to evaluate: if contract teachers are negatively impacting rural student learning, the practice could further intensify China's educational disparities.

Contract teachers in our sample are indeed concentrated in areas that are resource-constrained and that struggle to attract enough teachers. Figure 3 plots the association of contract teacher prevalence with county-level fiscal status. As the figure demonstrates, the schools with the greatest proportion of contract teachers are in counties with more fiscal constraints.

Although contract teachers are being phased out due to quality concerns, there is no empirical evidence of whether China's contract teachers in fact perform better or worse than civil service teachers. The comparison between contract teachers and civil service teachers in terms of their impact on student learning is not straightforward. Although it is widely acknowledged that contract teachers in China in general lack of qualifications (Sargent & Hannum, 2005), contract teachers may face stronger incentives to work hard and teach well relative to civil service teachers. Being hired as government employees, civil service teachers cannot be fired outside of dire circumstances (Han, 2013). Contract teachers, on the other hand, work on fixed-term contracts that can easily be terminated. As many of them are hired from the communities in which they work, contract teachers may also be more engaged and more committed to advancing local

goals. In a new paper by Xue et al. (2017), in the case of contract doctors, they outperform doctors that are employed in the formal health system.

Data

Survey Design

The data used in this study come from a survey of 300 schools in three provinces of western China (Shaanxi, Gansu and Qinghai) during the 2011/2012 academic year. Schools were sampled as follows. We first obtained a list of all schools in five prefectures (shown in Figure 4 - Haidong, Longan, Dingxi, Tianshui, and Ankang) which were located in counties outside of the region's urban district.² In total, 26 counties were included in the sampling frame. Within these 26 counties, 300 townships were selected from a list of all 512 townships. One school was selected from all schools in each township with at least 150 students in the school (a criterion that was chosen in order to avoid choosing (small) schools that were destined to be closed as part of the nation's school merger program).

Within each school, we collected information on grade 4 and 5 students and their teachers. Within each study school, we randomly sampled 50 grade 4 and 5 students. When there were less than 50 students in the two grades, all students were included. The final sample used for analysis covers 11,698 students for whom no necessary data were missing. Given that the rate of missing data is low (only 9%), we expect that results

² Prefectures are the administrative regions below the province. Prefectures comprise several counties including one county-level "urban district", the main metropolitan area. The next level below counties is that of township. School districts are generally administered at the township level and are in turn administered by county-level departments of education.

should not be affected. The main results are unaffected if we use multiple imputation to address missing observations rather than dropping them.

A survey questionnaire administered to students at the beginning of the school year (September) collected detailed information on students and their families. The surveys included questions on ethnicity, age, gender, boarding status, parental schooling, parental migrant status and household assets. A separate teacher questionnaire collected information on teachers including education, teaching experience, employment status, contract status (contract teacher vs. civil-service teacher), salary, a psychological scale to measure motivation, and time use. At the end of the school year (May), both students and teachers were surveyed a second time. This second survey collected additional information on teacher time use and teaching practices during the school year.

In addition to surveys, all students were administered standardized exams in math or Chinese based on the national uniform curriculum. All students took the exams twice, once at the beginning of the academic year and once at the end of the academic year. Within each classroom, half of the students were randomly assigned to take the math exam and the rest took Chinese. To ensure coherence with the national curriculum, the tests were developed with assistance from local bureaus of education. Questions used in the math exam were drawn from the question bank of the Trends in International Mathematics and Science Study (TIMSS), an international assessment of mathematics and science knowledge of primary and lower-secondary school students. Questions used in the Chinese exam were taken from national fourth or fifth grade textbooks. To minimize cheating, two versions of each exam (with re-ordered questions) were randomly assigned to students. Students were given 30 minutes to complete the exams, which were

proctored closely by enumerators. For analysis, scores for both subject tests were normalized by the distribution of scores in each grade. A full list of variables used in the analysis along with descriptions is given in Table 1.

Characteristics of Contract and Civil Service Teachers

Table 2 shows the percentage of contract teachers among teachers in our survey. The first column shows the percentage among all teachers (including teachers who teach neither Math nor Chinese). Among 819 teachers total, 72 (8.8%) are contract teachers (Row 6). The percentage of contract teachers among Chinese teachers (9.8%) is slightly higher than among math teachers (7.4%), though this difference is not statistically significant (P -value = 0.23). Rows 1-5 in the table show that there is substantial variation across the five sample prefectures. In particular, the percentage of contract teachers is lower in Shaanxi compared to less densely populated prefectures in Gansu and Qinghai. The proportion of contract teachers in our sample is roughly consistent with official province-level statistical data (Figure 2).

Table 3 compares the characteristics of contract teachers and civil service teachers in the sample. Columns 1-4 compare contract and civil service teachers in the full sample.³ Compared with civil service teachers, contract teachers are significantly less educated. Only 69% of contract teachers finished college, as compared to 83% of civil service teachers. The disparity is even larger in terms of normal school (teaching college) attendance. While 81% of civil service teachers attended normal school, only 57% of contract teachers did. Finally, contract teachers are also paid significantly lower salaries than civil service teachers. The average monthly base salary of contract teachers in our

³ P -values in this and subsequent tables account for clustering at the school level.

sample is 1030 yuan, as compared with 1610 yuan for civil service teachers. These disparities in education and pay are entirely in line with what is commonly known about contract teachers (Pandey, 2006).

The primary analysis in this paper is based on comparisons across teachers teaching the same class. Thus, the “effective sample” used to estimate effects is comprised of students in classes where the characteristics of interest differ between math and Chinese teachers. To gauge how contract and civil service teachers included in this effective sample compare, the final two columns (Columns 5 & 6) in Table 3 test differences between contract and civil service teachers teaching the same class. These comparisons show that the magnitudes of differences between contract and civil service teachers teaching the same class remain sizeable (though only base salary remains significant given the reduced sample).

Table 4 compares the composition of classes taught by contract teachers and civil service teachers. Comparisons using the full sample (Columns 1-4), show a number of significant differences. Contract teachers in our sample are significantly more likely to teach boys, older students, students with larger families, students with less educated parents, and poorer students (Table 4, column 3-4). Of note, however, is that the size of classes taught by contract and civil service teachers is similar. This suggests that contract teachers are not being hired to reduce class sizes. Rather, they are being hired either in response to shortages of civil service teachers or in response to budgetary constraints.

Most of these differences in class composition are reduced, however, when comparing within schools (Columns 5 & 6). This could suggest that “within-school

sorting” is not much of a concern in our sample; however note that there may remain substantial sorting within schools on unobserved characteristics.

Empirical Approach

The primary challenge for comparing the effectiveness of contract and civil service teachers is the possibility of unobserved heterogeneity due to selection. First, there may exist between-school sorting of contract teacher employment. For instance, contract teachers are more likely to be employed in more remote schools where shortages of civil service teachers are more significant. Second, there may be within school sorting if contract teachers are more likely to be assigned to certain classes or subjects. To deal with this potential source of bias, our main strategy is to employ a cross-subject class fixed effects approach.

Cross-subject class fixed effects

Cross-subject class fixed effects can mitigate bias arising from between and within school sorting of teachers and students by comparing teachers who teach the same class. Because we administered exams in both math and Chinese and have information on the characteristics of both math and Chinese teachers, we can identify the effect of teacher characteristics (including contract status) by comparing achievement gains of the *same students* across teachers. Because elementary school classes are taught all subjects together in China, including class fixed effects in the model allows us to control for unobservable characteristics of students (such as ability or motivation) that could be correlated with teacher contract status.

We estimate a linearized specification of the educational production function as follows:

$$\Delta Score_{is} = \beta_0 + \beta_1 CT_{is} + \beta_2 T_{is} + \beta_3 I_{is} + \beta_4 H_{is} + \gamma_s + \varepsilon_{is} \quad (1)$$

where $\Delta Score_{is}$ is the value-added test scores of student i in school s (that is normalized test score in the beginning of the academic year minus normalized test score in the end of the academic year); CT_{is} is a dummy equals one if the teacher is a contract teacher; T_{is} is a vector of teacher characteristics (age, gender, a dummy variable indicating whether teacher has a college degree, a dummy variable indicating whether teacher attended normal school and subject taught); I_{is} and H_{is} are vectors of individual student (age, gender, boarding status and minority dummy) and household variables (household size, father's education, mother's education, whether father lives at home or not, whether mother lives at home or not, and household assets) respectively. γ_s is class fixed effect. ε_{is} is an error term. The error term is allowed to be correlated at the school level to account for clustering effects.

We estimate regressions with and without teacher and student-level controls. In regression that excludes other teacher controls (besides contract status) that estimated effect of contract teachers includes effects due to differing characteristics of contract and civil service teachers. Student level controls – while not strictly necessary for identification because students remain constant across contract and civil service teachers—are included to improve the precision of the estimates.

An assumption underlying the validity of the class fixed effects approach is that the differences in student achievement gains across subjects (i.e. the difference in student gains in math vs. Chinese) would have been the same if teachers of both subjects were

civil service teachers or both were contract teachers. In other words, the contract status of the math (Chinese) teacher should not influence the achievement of students in Chinese (math). A potential threat to this assumption is if contract teachers somehow influence the scores of students in subjects that they do not teach.

We present a limited test of this assumption in Appendix Table 1. Using only the sample of student scores from classes that were taught by civil service teachers, we regress student value added scores on the fraction of contract teachers employed in the school (with and without controlling for other characteristics). We find that, after controlling for county fixed effects, the proportion of contract teachers in the school is not a significant predictor of student performance in subjects taught by civil service teachers. This suggests that the assumption above is likely valid in our context.

Results

Teacher contract status and student achievement

The regression results using model (1) are reported in Table 5. When controlling for just contract teacher (column 1); contract teacher and teacher characteristics (column 2); contract teacher, teacher and student characteristics (column 3); and contract teacher, teacher and student characteristics and school fixed effects (column 4), the effect of contract teacher on suggests that contract teachers have a modestly negative effect on student achievements gains (between -0.05 and -0.06). The results are significant at the 10 percent level.

Columns 5 to 8 present the result with class fixed effects, alone (with no other controls) and with different sets of teacher and student characteristics. When controlling

for all of the unobservabilities of contract and civil service teachers the coefficient of contract teacher suggests that the value-added test scores of students taught by contract teachers are larger (in absolute value terms—from -0.13 to -0.14 standard deviations lower) than students taught by civil service teachers (columns 1 to 4). The results are also more statistically significant—significantly different than zero at the 1% level.

Interesting, we can also see from the class fixed effect estimates in columns 5 to 8 that none of the observable teacher characteristics are significant in determining student value added. These findings are in line with other recent research showing that observable teacher attributes to have limited impacts on student achievement ((Aaronson, Barrow, & Sander, 2003; Ballou, Sanders, & Wright, 2004; Hanushek, Kain, O'Brien, & Rivkin, 2005; Nye, Konstantopoulos, & Hedges, 2004; Rivkin et al., 2005; Rockoff, 2004).

Teacher effort

So what may account for the results? The effectiveness of contract and civil service teachers as measured by the class fixed effects models may differ for two primary (unmeasured) reasons. First, it also might be that there is a difference in effort between contract and civil service teachers. According to the literature (Han, 2013), because contract teachers have less job security and are more closely monitored, it would be expected that this unobserved characteristic would lead to higher scores of the students that are taught by contract teachers. Second, it has been shown in the literature (Pandey, 2006; Sargent & Hannum, 2005) and by our data (Table 3) that contract teachers have a lower ability than civil service teachers. Lower ability contract teachers, *ceteris paribus*, would be expected to produce student outcomes that were lower than higher ability civil

service teachers. Since in our results in Table 5, we see that the achievement of students of contract teachers are lower than those of civil service teachers, it appears that the ability effect (which would mean higher achievement scores for the students of civil service teachers) is stronger than the effort effect (which would mean higher achievement scores for the students of contract teachers).

Table 6 shows estimates of the effect of teacher contract status on indicators of teacher effort. Regressions in this table use the class fixed effects specification in equation (1), but with all variables aggregated to the teacher level (in columns 1 to 4). We test effects on six different indicators; the ratio of preparation time to class time over the past week (teacher reported - Column 1); days of absence in the last month (teacher reported - Column 2); total hours worked in the past week (teacher reported - Column 3); time spent on asking questions in class last week (teacher reported – column 4); times assigned homework was corrected and returned to students (student reported - Column 5); and how often students report being asked questions in class in past week (student reported - Column 6).

Across these six indicators in Table 6 (columns 1 to 6), we find no significant effects of contract teacher status. Although point estimates for several of the variables suggest that the effort of contract teachers is higher than civil service teachers, none of the estimates are significant at conventional levels. These results seem to suggest that the reason that we find contract teachers performing worse than civil service teachers in student outcomes is purely due to lower abilities of contract teachers. In other words, the insignificant results in Table 6 means that there are not large (statistically significant) offsetting positive effects coming about due to any greater effort of contract teachers. It

also means that the coefficients in Table 5 are mostly (all) due to the inferior ability of contract teachers relative to civil service teachers.

Conclusion

We draw on longitudinal data from a survey of 300 schools in Shaanxi, Gansu and Qinghai provinces to estimate the effect of teacher designation as a contract teacher, teacher employed on fixed term contracts vs. civil service teachers on gains in student achievement over one year. We find that gains in student scores on standardized exams in math and Chinese are 0.13 standard deviations less in classes taught by contract teachers than in classes taught by civil service teachers. The differences in student learning do not seem to come from different effort levels between contract teachers and civil service teachers. The difference is more likely due to the fact that contract teachers on average have lower abilities or qualifications than civil service teachers.

Our research has important implications for policymakers in China. On the national level, China continues the effort to eliminate the contract teachers system (Robinson & Yi, 2008). Although contract teachers was an effective solution to expand the access of rural students to education in the face of limited economic resources, our results support the national policy to phase out contract teachers and provide them the appropriate training to transit to civil service teacher. In the long run, scholars also suggest that bringing in large numbers of under-qualified teachers with low pay and limited job security could have deleterious effects on the schooling system (Fyfe, 2007). Studies of contract teachers in other developing nations suggest that the long-term employment of contract teachers without opportunities for professional advancement can begin to break down (Duthilleul, 2006). As a replacement of the contract teachers, the

government should increase the funding for hiring additional civil service teachers in areas with fewer economic resources.

The results also have lessons for all rural economies in low and middle-income countries. Regardless of whether a rural economy is dominated by agricultural producers or off farm workers, Schultz (1961) demonstrates there are high returns for education. However, the work of Hanushek (1986) is clear that returns only accrue to education if the schooling system is producing learning and learning is in no small part dependent on quality teaching. The policy implication of this paper—whether it is an issue of contract teacher versus civil service teachers or any other characteristic of teaching, education system must focus on finding a way to attract and keep high quality teachers. High quality teachers can form the basis of a solid schooling system and that can lead to learning and higher levels of farm income, farm output, off farm employment and overall economic growth.

References

- Aaronson, D., Barrow, L., & Sander, W. (2003). Teachers and student achievement in the Chicago Public Schools (No. WP-2002-28). *Chicago: Federal Reserve Bank of Chicago*.
- Atherton, P., Kingdon, G., & others. (2010). The relative effectiveness and costs of contract and regular teachers in India. *Institute of Education, University of London*. Retrieved from <http://2010.economicsofeducation.com/user/pdfsiones/036.pdf>
- Ballou, D., Sanders, W., & Wright, P. (2004). Controlling for student background in value-added assessment of teachers. *Journal of Educational and Behavioral Statistics*, 29(1), 37–65.
- Bourdon, J., Frölich, M., & Michaelowa, K. (2010). Teacher shortages, teacher contracts and their effect on education in Africa. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 173(1), 93–116.
- Chetty, R., Friedman, J. N., & Rockoff, J. E. (2011). *The long-term impacts of teachers: Teacher value-added and student outcomes in adulthood*. National Bureau of Economic Research. Retrieved from <http://www.nber.org/papers/w17699>. DOI: 10.3386/w17699.
- Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007). *Teacher credentials and student achievement in high school: A cross-subject analysis with student fixed effects*. National Bureau of Economic Research. Retrieved from <http://www.nber.org/papers/w13617>. DOI: 10.3386/w13617
- Duflo, E., Dupas, P., & Kremer, M. (2009). Additional resources versus organizational changes in education: Experimental evidence from Kenya. *Unpublished Manuscript. Abdul Latif Jameel Poverty Action Lab (JPAL), Cambridge, Mass.: Massachusetts Institute of Technology*, 9(789231), 002205.
- Duthilleul, Y. (2006). *Lessons learnt in the use of “contract” teachers*. Paris: IIEP.
- Faguet, J.-P., & Sanchez, F. (2008). Decentralization’s effects on educational outcomes in Bolivia and Colombia. *World Development*, 36(7), 1294–1316.
- Fyfe, A. (2007). *The use of contract teachers in developing countries : trends and impact* (ILO Working Paper No. 399704). International Labour Organization. Retrieved from <http://ideas.repec.org/p/ilo/ilowps/399704.html>
- Fyfe, A., & others. (2007). *The use of contract teachers in developing countries: Trends and impact*. ILO Geneva. Retrieved from http://www.oit.org/wcmssp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_160813.pdf
- Goldhaber, D. D., Goldschmidt, P., & Tseng, F. (2013). Teacher value-added at the high-school level: Different models, different answers? *Educational Evaluation and Policy Analysis*, 35(2), 220–236.
- Govmda, R., & Josephine, Y. (2005). Para-teachers in India: A review. *Contemporary Education Dialogue*, 2(2), 193–224.
- Huffman, W. (1974). Decision Making: The Role of Education. *American Journal of Agricultural Economics*, 56(1), 85–97.
- Han, L. (2013). Is centralized teacher deployment more equitable? Evidence from rural China. *China Economic Review*, 24, 65–76.

- Hanushek, E. A., Kain, J. F., O'Brien, D. M., & Rivkin, S. G. (2005). *The market for teacher quality*. National Bureau of Economic Research. Retrieved from <http://www.nber.org/papers/w11154>. DOI: 10.3386/w11154.
- Hanushek, E. (1986). The Economics of Schooling: Production and Efficiency in Public Schools. *Journal of Economic Literature*, 24(3), 1141–1177.
- Kingdon, G., Aslam, M., Rawal, S., & Das, S. (2013). Are contract teachers and para-teachers a cost-effective intervention to address teacher shortage and improve learning outcomes. *London, UK: University of London, Institute of Education. Education in Pakistan's Punjab: Outcomes and Interventions*, 47. Retrieved from https://safedafe.org/~safedafe/document/learning_resources/2013/Parateachers%202013Kingdon.pdf
- Kumar, K., Priyam, M., & Saxena, S. (2001). The trouble with para-teachers. *Frontline*, 18(22), 93–94.
- Lin, J. Y. (1991). Education and innovation adoption in agriculture: evidence from hybrid rice in China. *American Journal of Agricultural Economics*, 73(3), 713–723.
- Leigh, A. (2010). Estimating teacher effectiveness from two-year changes in students' test scores. *Economics of Education Review*, 29(3), 480–488.
- Luschei, T. F. (2011). In search of good teachers: Patterns of teacher quality in two Mexican states. *Comparative Education Review*, 56(1), 69–97.
- Luschei, T. F., & Carnoy, M. (2010). Educational production and the distribution of teachers in Uruguay. *International Journal of Educational Development*, 30(2), 169–181.
- Muralidharan, K., & Sundararaman, V. (2013). *Contract teachers: Experimental evidence from India*. National Bureau of Economic Research. Retrieved from <http://www.nber.org/papers/w19440>. DOI: 10.3386/w19440.
- Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis*, 26(3), 237–257.
- Psacharopoulos, G. (1994). Returns to investment in education: A global update. *World development*, 22(9), 1325–1343.
- Peng, W. J., Thomas, S. M., Yang, X., & Li, J. (2006). Developing school evaluation methods to improve the quality of schooling in China: A pilot 'value added' study. *Assessment in education: principles, policy & practice*, 13(2), 135–154.
- Peng, W. J., McNess, E., Thomas, S., Wu, X. R., Zhang, C., Li, J. Z., & Tian, H. S. (2014). Emerging perceptions of teacher quality and teacher development in China. *International Journal of Educational Development*, 34, 77–89.
- Pandey, S. (2006). Para-teacher scheme and quality education for all in India: policy perspectives and challenges for school effectiveness. *Journal of Education for Teaching*, 32(3), 319–334.
- Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, 73(2), 417–458.
- Robinson, B., & Yi, W. (2008). The role and status of non-governmental (“daike”) teachers in China's rural education. *International Journal of Educational Development*, 28(1), 35–54.
- Rockoff, J. E. (2004). The impact of individual teachers on student achievement: Evidence from panel data. *The American Economic Review*, 94(2), 247–252.

- Schultz, T. W. (1961). Investment in Human Capital. *The American Economic Review*, 51(1), 1-17.
- Sargent, T., & Hannum, E. (2005). Keeping teachers happy: Job satisfaction among primary school teachers in rural Northwest China. *Comparative Education Review*, 49(2), 173–204.
- Vegas, E., & De Laat, J. (2003). Do differences in teacher contracts affect student performance? Evidence from Togo. *World Bank*. Retrieved from http://www-wds.worldbank.org/servlet/WDSContentServer/IW3P/IB/2003/10/24/000160016_20031024103517/Rendered/PDF/269550Vegas0Teacher1contracts.pdf
- Wang, L., Min, W., Zhang, S., Shi, Y., & Rozelle, S. (2017). Math and Chinese language learning: Where are China's vulnerable subpopulations? REAP working paper.
- Xue, H., Liu, G., Shi, Y., Yi, H., Rozelle, S., & Sylvia, S. (2017). Doctor Employment Contracts, Decentralization, and the Quality of Primary Care: Evidence from China's Iron Rice Bowl. REAP working paper.
- Yang, D. (1997). Education in Production: Measuring Labor Quality and Management. *American Journal of Agricultural Economics*, 79(3), 764–772.
- Zhang, L., Huang, J., & Rozelle, S. (2002). Employment, emerging labor markets, and the role of education in rural China. *China Economic Review*, 13(2), 313–328.

Table 1: Variable descriptions

Variable	Description
Gains in Standardized Exam Score	Normalized score on standardized exams in math and Chinese at the end of the school year minus normalized test score in the beginning of the school year. Half of students in each class took math exams at the beginning and end of the school year and the other half took the Chinese exams. Exams were designed with assistance from local bureaus of education. For the math exam, grade appropriate question items were drawn from the TIMSS question bank.
Student and household characteristics	
Female (0/1)	Student is female.
Boarding student (0/1)	Student boards at school.
Age (years)	Student age in years.
Grade Four (0/1)	Student is in fourth grade.
Household size	Total number of individuals living in the student's household.
Mother has lower secondary degree or above (0/1)	Student's mother has completed junior high school education or above.
Father has lower secondary degree or above (0/1)	Student's father has completed junior high school education or above.
Father at home (0/1)	Father currently lives at home (has not migrated for work).
Mother at home (0/1)	Mother currently lives at home (has not migrated for work).
Household asset index	Index of household durable assets. Constructed using first principal component of: motorbike, tractor, car, van, refrigerator, air conditioning, computer, washing machine and dummy variables for type of housing (cave dwelling, packed earth house, cement house, apartment building, other).
Teacher characteristics	
Contract teacher (0/1)	Teacher is employed on non-civil service teacher contract (has daike or minban status).
Female teacher (0/1)	Teacher is female.
Teacher age (years)	Teacher age in years.
Teacher has a higher education degree (0/1)	Teacher has completed college or above.
Teacher attended normal school (0/1)	Teacher attended normal school.
Math teacher (0/1)	Teacher teaches math. Other teachers in sample teach Chinese.
Basic salary	Monthly base salary in thousand yuan.
Total compensation	Monthly total compensation in thousand yuan.
Teacher effort	
Time spent preparing lessons per class hour (Teacher Reported)	Teacher reported hours of preparation time per hour of instruction.
Days of absence last semester (Teacher Reported)	Number of days of absence last week reported by teachers.
Working hours last week (Teacher Reported)	Teacher reported number of hours worked last week.
Days of absence last week (Student reported)	Days of absence last week reported by students
Number of homework assignments last week (Student reported)	Student reported number of homework assignments assigned per week.
Number of homework assignments graded and returned last week (Student reported)	Student reported number of homework assignments corrected and handed back to students per week.

Times asked questions in class last week (Student reported)	Student reported number of times asked question by teacher in class last week.
Teacher effort index	Index of teacher effort. Constructed using GLS weighting procedure described in Anderson 2008.

Table 2: Percent of sample teachers that are contract teachers by prefecture

Prefecture	Full sample	Math teachers	Chinese teachers
1. Ankang, Shaanxi	1.6%	1.7%	1.5%
2. Dingxi, Gansu	9.7%	6.0%	11.9%
3. Longnan, Gansu	6.2%	2.3%	9.4%
4. Tianshui, Gansu	9.1%	7.1%	10.5%
5. Haidong, Qinghai	13.8%	17.4%	11.4%
6. Full Sample	8.8%	7.4%	9.8%

Source: authors' survey.

Table 3: Teacher characteristics by teacher contract status

	Contract teachers	Civil service teachers	Mean difference	P-value	Within classes	
					Mean difference	P-value
	(1)	(2)	(3)	(4)	(5)	(6)
1. Female teacher (0/1)	0.49	0.38	0.11	0.10	0.18	0.36
2. Teacher age (years)	34.21	36.66	-2.45	0.08	-4.17	0.38
3. Teacher has higher education degree (0/1)	0.69	0.83	-0.14	0.02	-0.09	0.67
4. Teacher attended normal school (0/1)	0.57	0.81	-0.24	0.00	-0.24	0.17
5. Math teacher (0/1)	0.33	0.42	-0.09	0.13	-0.12	0.69
6. Basic salary (yuan)	1030	1610	-580	0.00	-450	0.08
7. Total compensation (yuan)	1260	2010	-750	0.00	-470	0.14
8. Number of teachers	72	747				

Note: Column 1-4 presents the characteristics of contract and civil service teachers. Column 5-6 presents the within classes difference between contract and civil service teachers.

Source: authors' survey.

Table 4: Student and their household characteristics by teacher contract status

	Contract teachers	Civil service teachers	Mean difference	P-value	Within schools	
					Mean difference	P-value
	(1)	(2)	(3)	(4)	(5)	(6)
1. Class size (self-reported by teachers)	36.99	37.45	-0.46	0.80	-1.17	0.20
Class size (the number of students who have test scores in a class)	28.99	27.37	1.62	0.42	-0.08	0.95
Student characteristics						
2. Female (0/1)	0.47	0.52	-0.05	0.01	-0.03	0.11
3. Minority (0/1)	0.09	0.11	-0.02	0.51	0.00	0.46
4. Age (years)	10.87	10.62	0.25	0.00	0.04	0.73
5. Boarding student (0/1)	0.08	0.07	0.01	0.74	0.00	0.74
6. Grade four (0/1)	0.42	0.48	-0.06	0.34	-0.08	0.40
Student Household characteristics						
7. Household size	5.56	5.29	0.28	0.00	0.04	0.61
8. Mother has lower secondary degree or above (0/1)	0.40	0.47	-0.07	0.00	-0.03	0.17
9. Father has lower secondary degree or above (0/1)	0.18	0.28	-0.11	0.00	-0.03	0.05
10. Father at home (0/1)	0.57	0.58	-0.01	0.70	-0.00	0.89
11. Mother at home (0/1)	0.65	0.68	-0.03	0.19	-0.01	0.58
12. Household asset index	-0.28	0.02	-0.31	0.00	0.03	0.56

Notes: This table presents the characteristics of students and their household by teacher contract status. Source: authors' survey.

Table 5: The effect of teacher contract status on student achievement gains

	Dependent variable: gains in standardized exam scores ($\delta Score_{is}$)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Teacher characteristics								
1. Contract teacher (0/1)	-0.05* (0.03)	-0.06* (0.03)	-0.06* (0.03)	-0.06* (0.04)	-0.14*** (0.04)	-0.13*** (0.05)	-0.14*** (0.04)	-0.13*** (0.05)
2. Female teacher (0/1)		0.01 (0.02)	0.01 (0.02)	0.03 (0.03)		0.05 (0.04)		0.05 (0.04)
3. Teacher age (years)		0.00 (0.00)	0.00 (0.00)	0.00 (0.00)		0.01 (0.00)		0.01 (0.00)
4. Teacher has a higher education degree (0/1)		-0.02 (0.03)	-0.02 (0.03)	-0.02 (0.03)		0.03 (0.04)		0.03 (0.04)
5. Teacher attended normal school (0/1)		0.02 (0.02)	0.02 (0.02)	0.01 (0.02)		0.04 (0.03)		0.04 (0.03)
6. Math teachers		-0.00 (0.00)	-0.00* (0.00)	-0.00 (0.00)		-0.00 (0.00)		-0.00 (0.00)
Student characteristics								
7. Female (0/1)			-0.00 (0.01)	0.00 (0.01)			-0.00 (0.01)	-0.00 (0.01)
8. Minority (0/1)			-0.06** (0.03)	-0.06* (0.03)			-0.07** (0.03)	-0.07** (0.03)
9. Age (years)			-0.03*** (0.01)	-0.03*** (0.01)			-0.03*** (0.01)	-0.03*** (0.01)
10. Boarding student (0/1)			0.04 (0.04)	0.01 (0.03)			0.01 (0.03)	0.02 (0.03)
11. Grade four (0/1)			-0.04** (0.02)	-0.03* (0.02)				
12. Household size			-0.00 (0.00)	-0.00 (0.00)			-0.00 (0.00)	-0.00 (0.00)
13. Mother has lower secondary degree or above (0/1)			-0.04*** (0.01)	-0.04*** (0.01)			-0.04*** (0.01)	-0.04*** (0.01)
14. Father has lower secondary degree or above (0/1)			-0.02 (0.01)	-0.02 (0.02)			-0.02 (0.02)	-0.02 (0.02)
15. Father at home (0/1)			-0.02 (0.01)	-0.01 (0.01)			-0.01 (0.01)	-0.01 (0.01)
16. Mother at home (0/1)			-0.00	0.01			0.01	0.01

Working Paper 328**November 2017****reap.fsi.stanford.edu**

			(0.01)	(0.01)			(0.01)	(0.01)
17. Household asset index			-0.00	0.00			0.00	0.00
			(0.00)	(0.01)			(0.01)	(0.01)
School FE				Yes				
Class FE					Yes	Yes	Yes	Yes
Observations	12834	12834	12834	12834	12834	12834	12834	12834
R-squared	0.001	0.001	0.005	0.056	0.092	0.093	0.095	0.096

Note: dependent variable: gains in standardized exam scores. Coefficients and standard errors are listed. Standard errors are clustered at the school level. Significance levels of 10%, 5% and 1% are represented by *, ** and ***, respectively.

Table 6: The effects of contract status on teacher effort

	Dependent variable:					
	(1)	(2)	(3)	(4)	(5)	(6)
	Time spent preparing lessons per class hour (Teacher Reported)	Days of absence last semester (Teacher Reported)	Working hours last week (Teacher Reported)	Time spent on asking questions in class last week (Teacher reported)	Number of homework assignments graded and returned last week (Student reported)	Times asked questions in class last week (Student reported)
Contract teacher (0/1)	-0.66 (0.91)	-1.06 (3.53)	0.12 (0.34)	0.17 (0.20)	-0.39 (0.34)	-0.17 (0.23)
Teacher characteristics	YES	YES	YES	YES	YES	YES
Student characteristics	YES	YES	YES	YES	YES	YES
Household characteristics	YES	YES	YES	YES	YES	YES
Class FE	YES	YES	YES	YES	YES	YES
Observations	819	819	819	819	12834	12834
R-squared	0.876	0.746	0.846	0.816	0.875	0.837
Mean of sample	0.87	1.81	45.64	19.06	3.73	2.78

Note: Coefficients and standard errors are listed. Standard errors are clustered at the school level. Significance levels of 10%, 5% and 1% are represented by *, ** and ***, respectively.

Appendix Table 1: Fraction of contract teachers employed in the school and student performance in civil service teacher taught classes

	Dependent variable: gains in standardized exam scores ($\delta Score_{is}$)			
	(1)	(2)	(3)	(4)
Fraction of contract teachers in school	-0.09 (0.07)	-0.09 (0.08)	-0.07 (0.08)	0.00 (0.08)
Teacher characteristics		Yes	Yes	Yes
Student characteristics			Yes	Yes
Household characteristics			Yes	Yes
County FE				Yes
Observations	11698	11698	11698	11698
R-squared	0.000	0.001	0.005	0.016

Note: dependent variable: gains in standardized exam scores. Coefficients and standard errors are listed. Standard errors are clustered at the school level. Significance levels of 10%, 5% and 1% are represented by *, ** and ***, respectively.

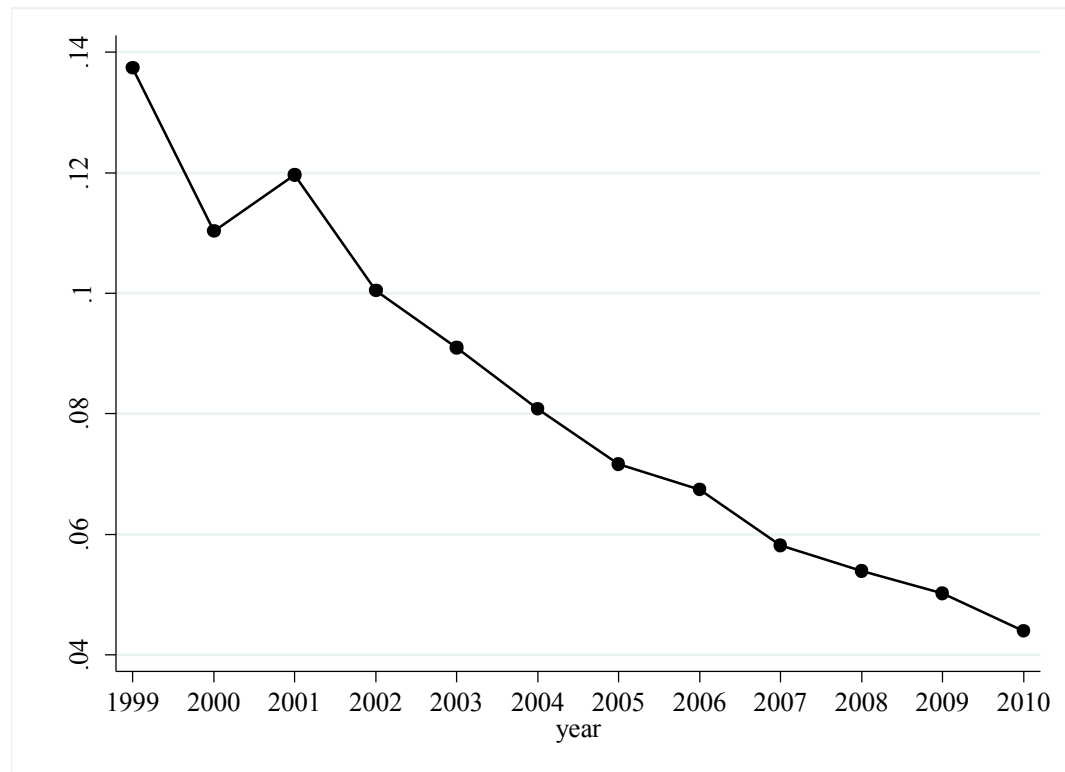


Figure 1: Percent of contract in China's rural primary schools: 1999-2010
Source: China Education Statistics Yearbook, various years.

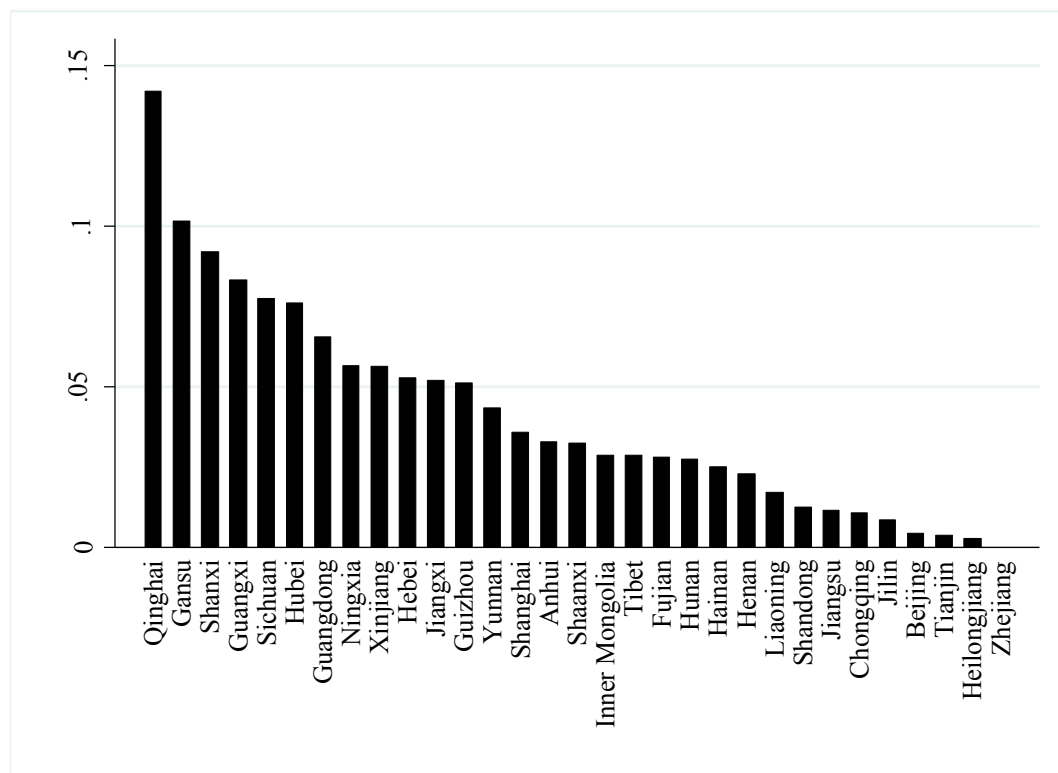


Figure 2: Proportion of contract teachers in rural primary schools by province in 2010

Source: China Education Statistics Yearbook, 2010

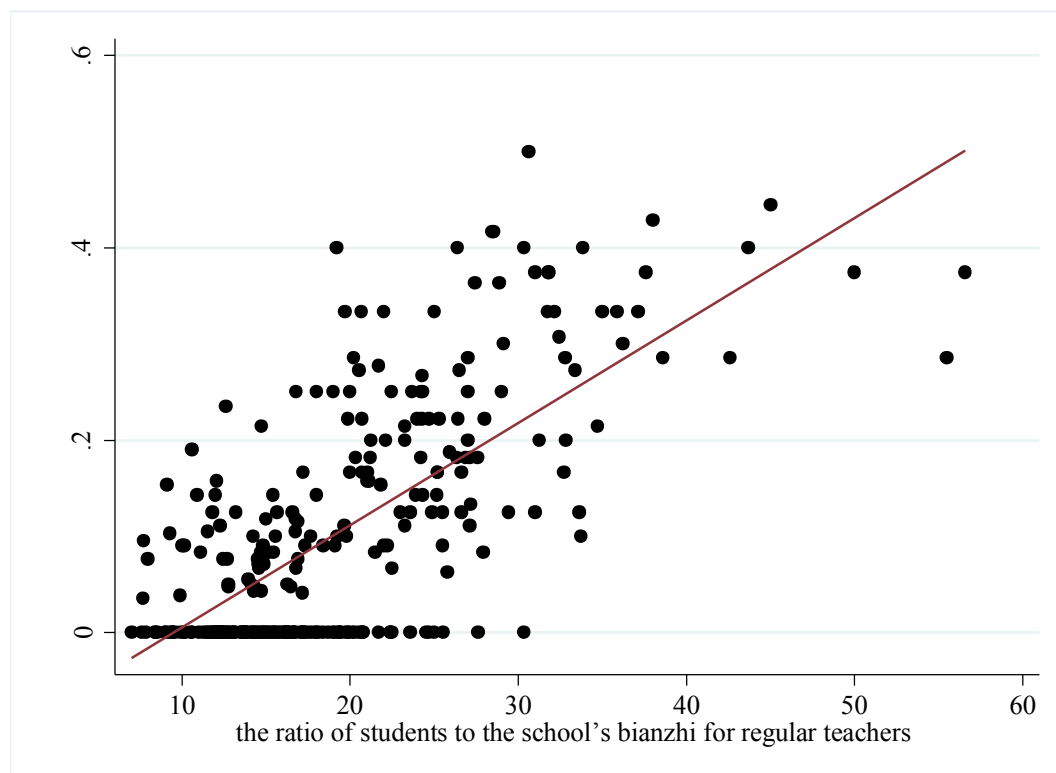


Figure 3: Teacher shortage and proportion of contract teachers

Source: Author's survey in 300 schools.

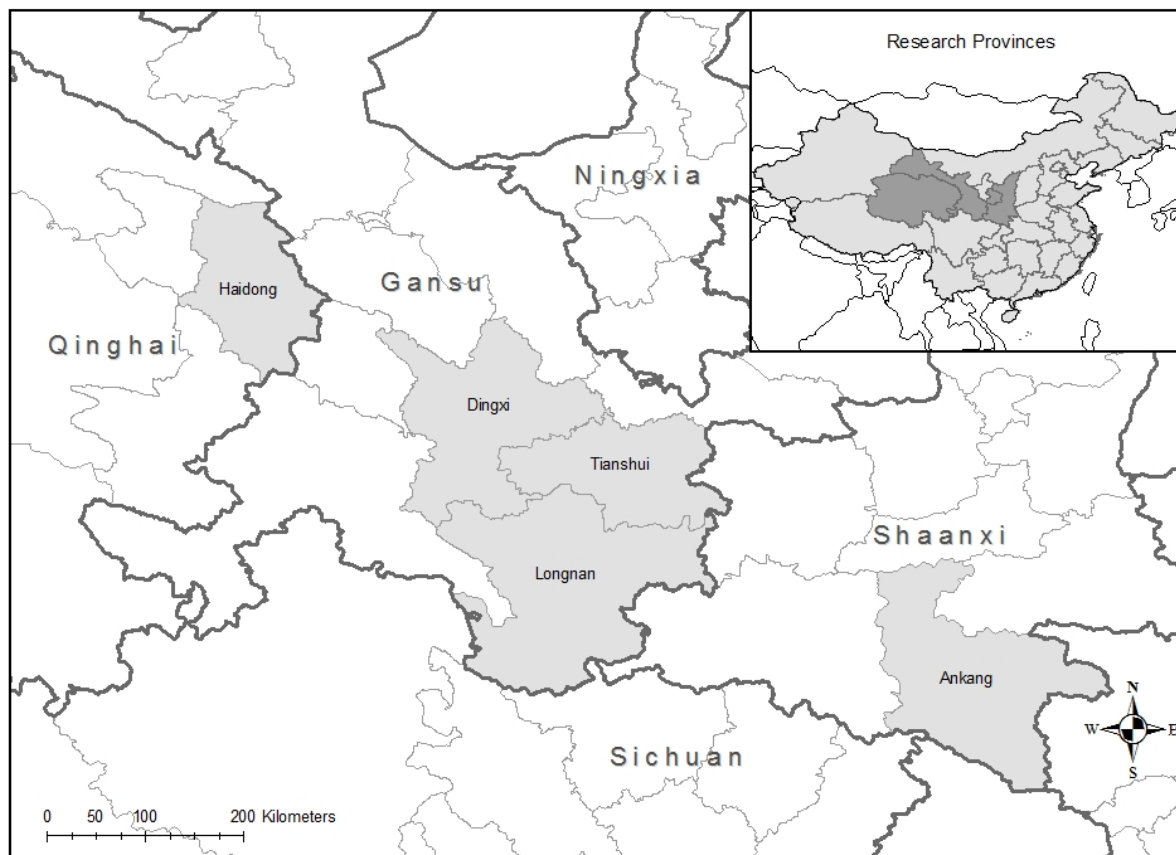


Figure 4: Survey regions