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Reading achievement in China's rural primary schools: a study of three provinces

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ABSTRACT

This paper aims to explore and quantify the reading achievement of primary school students from three different regions in rural China. Using survey data on 23,143 students from Shaanxi, Guizhou, and Jiangxi provinces, we find although gaps in student reading achievement exist among the three sample provinces, all sample students exhibit low levels of reading achievement. Compared to students from other countries that participated in the Progress in International Reading Literacy Study reading tests, our sample students from rural China ranked last. Our regression analysis documented strong correlations between reading achievement and maths performance exist among the sample students in rural China. Additionally, we find male students, students with rural household registration, boarding students, and students from relatively poor families are more susceptible to having worse reading outcomes. Overall, our findings indicate the government should develop more effective policies to support reading skill development in China, especially in rural areas.

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Introduction

The development of adequate reading skills at an early age has an enormous influence on the educational outcomes of students over the long term (Clark and Rumbold 2006; Cox and Guthrie 2001; National Reading Panel, Institute of Child Health, and Human Development 2000; Slavin et al. 2009). The main impact of reading on education occurs because reading helps to develop critical thinking and comprehension skills that are foundational to learning in any subject area (Rutherford-Becker and Vanderwood 2009; Thurber, Shinn, and Smolkowski 2002; Jordan, Hanich, and Kaplan 2003). It is also believed that delays in reading development at an early age will negatively impact the education of students over the long term (Slavin et al. 2009; Whitehurst and Lonigan 2001; Good, Simmons, and Kame'enui 2001). Specifically, it is believed that when children have lower initial levels of reading skills, they will be less likely to read and, therefore, will fall further behind their peers (Pretorius and Currin 2010; Stanovich 1986). For these reasons, it is imperative that reading challenges are addressed early to decrease the likelihood that children are developmentally delayed and suffer poor educational outcomes.

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Given the importance of reading skill development for long-term outcomes, many developed countries have begun to place greater emphasis on reading and established programmes to improve student reading skills, with the ultimate goal of improving schooling outcomes (Good, Simmons, and Kame'enui 2001; Kim and Quinn 2013; Slavin et al. 2009; Whitehurst and Lonigan 2001; Kim 2006). A similar focus on reading could be valuable in developing countries, as it has been found that students in these countries often have limited access to reading resources, and, therefore, limited opportunities to develop their reading skills (Education 2011; Lavy 2015; Moloï and Strauss 2011). For example, a study conducted by the World Bank in 2007 found that the majority of primary school students in Southern and Eastern Africa did not have access to reading books at school (Moloï and Strauss 2011). This is concerning, as it has generally been found that when the reading skills of students are insufficient, their overall academic performance suffers (Gonzales et al. 2004; Martin and Mullis 2013). Other similar studies show essentially the same dynamic in many developing countries (Grantham-McGregor et al. 2007; Martin and Mullis 2013), such as Turkey (Duru and Koklu 2011) and Ghana (Owusu-Acheaw and Larson 2014).

Increased focus on reading may be particularly valuable in rural China, where severe educational inequality between urban and rural areas threatens the nation's continued economic growth and social cohesion ((Wang et al. 2013; Zhang et al. 2013). Specifically, it has been found that rural students consistently perform worse than urban students in core academic subjects, such as maths and science (Kleiman-Weiner et al. 2013; Lai et al. 2009; Li et al. 2015; Qian and Smyth 2008). These gaps are concerning because about 68% of students at the compulsory schooling level live in rural areas of the country (Ministry of Education of the People's Republic of China 2015). Given the size of the education system in China, this suggests that tens of millions of students in rural areas are not receiving an adequate education (National Bureau of Statistics of China 2016).

While the research on the subject is limited, one reason for the poor educational outcomes of rural students may be that they do not develop adequate reading skills. In general, reading is not systematically taught in school (Lu 2015; Wang et al. 2015) and students frequently are not encouraged to read (Gao 2011; Gao et al. 2018). If it is the case that reading skills and academic achievement are related, then it would be beneficial to place greater emphasis on reading in rural schools in an attempt to narrow this educational gap, as it seems to have done in certain developed contexts (Kim and Quinn 2013; Kim 2006).

In fact, education officials in China appear to be beginning to recognise the developmental potential of improved literacy. Since 2003, the government has supported investment in school libraries to provide reading books for students (Ministry of Education of the People's Republic of China 2003). More recently, the government announced a new national focus on reading in its 2014 annual work report (People.cn 2015).

In response to these policy directives (especially the most recent one released in 2014), the government launched a nationwide reading initiative in 2015 with the goal of encouraging people of all ages and professions, including children in schools, to read. However, there is evidence that these policies and efforts have not been effective at providing adequate reading instruction/materials – especially to students in rural China. In fact, in a recent set of studies, researchers have found that, despite the recent investments into libraries, students have limited access to the reading materials in school libraries; rural schools also generally lack age-appropriate reading materials (Gao et al. 2018; Liu 2015). Other studies have presented evidence that teachers and educators in

rural areas do not recognise the importance of reading and, therefore, do not encourage (and even in some cases take actions to discourage) reading outside of classwork (Wang 2012; Wang et al. 2015; Zhang 2004).

Despite this increased focus on reading and evidence that resources in rural schools may be inadequate, little is known about the reading achievement of rural Chinese students. Although it has been demonstrated that students in cities exhibit high levels of reading achievement (Cromley 2009; Ning et al. 2016), to our knowledge, no research has identified the reading achievement levels of students in rural China. Research on this topic would be valuable, as there are valid reasons to worry about the reading achievement of students in rural China. In addition to poor educational outcomes and deficient reading resources, schools in rural China are typically under-funded (Fu 2005; Li et al. 2017), over-crowded (Wang and Lewin 2016), and staffed with less capable teachers/educators than urban schools (Guo et al. 2013; Wang and Ying 2009), all of which likely stifle the reading skill development of students (Mullis et al. 2012). Additionally, although some papers in Chinese discuss the importance of reading skills for the academic performance of students (Guo 2002; Huang 2009), no quantitative research has demonstrated whether there is a relationship between reading skills and academic achievement in rural China. Without these findings, it is difficult for us to begin to understand whether or not the recent reading programmes and activities in China have been effective and whether there should be further efforts to implement them more fully.

In order to obtain a more comprehensive understanding of student reading achievement in rural China, we also explore whether levels of reading achievement vary among certain subgroups of students in rural China. Previous studies have found that student reading achievement is correlated with student background characteristics, such as student gender, household resources and family resources (Christian, Morrison, and Bryant 1998; Dahl and Lochner 2005; Davis-Kean 2005; Greenwald, Hedges, and Laine 1996; Lietz 2006; Mullis et al. 2012). It is possible that the levels of student reading achievement are inconsistent in rural China because of the heterogeneous nature of rural Chinese students. Therefore, in this study, we also try to determine whether there are certain groups of students that are particularly susceptible to having relatively worse reading achievement.

Our research question is mainly focused on presenting evidence to understand the reading achievement of primary school students in rural China. In the study, we collected data from a sample of 23,143 rural primary school students across three provinces in different parts of China – northwest, southwest, and southeast. We also used data on student reading achievement in different countries and regions from the PIRLS tests in 2011.

To improve understanding of student reading achievement in rural China, we have four specific research questions: 1) Do primary school students from different regions of rural China have similar levels of reading achievement? 2) Compared to students from other countries and regions, do rural primary school students in China perform better or worse in reading achievement? 3) Does the reading achievement affect the academic performance of rural Chinese students? Admittedly, in this study, it is only possible to explore correlations between reading achievement and performance in maths. 4) Is there heterogeneity in the levels of reading achievement based on various observable characteristics of students?

This paper hypothesises that without adequate reading resources and instructions, students in rural China are more likely to suffer from reading difficulties and low levels of reading achievement. Specifically, compared to students from other countries and regions, all primary school students, irrespective of which region of rural China they belong to, had similar lower levels of reading achievement. The low levels of reading achievement hinder student academic performance. Moreover, there are certain sub-groups of rural Chinese students particularly susceptible to poor reading skills.

The rest of this paper is organised as follows. In the next section, we describe our sampling, data collection, and analytical approach. Our results are then presented in section three and finally we conclude in section four.

Data collection and empirical methods

In this paper, we draw on two sets of data collected in 2015 from three different regions of China. The first dataset, henceforth *Dataset 1*, collected information from 17,243 students in 135 primary schools in Guizhou and Jiangxi provinces. *Dataset 2* is comprised of information on 5,900 students in 68 primary schools in Shaanxi province. Shaanxi, Guizhou, and Jiangxi provinces are located in the northwest, southwest, and southeast of China, respectively.

There are advantages to using data from these three provinces. Large shares of the population in each province reside and work in rural areas. According to the China National Bureau of Statistics, each of these provinces had substantial proportions of their population living in rural areas in 2015 (46% in Shaanxi; 58% in Guizhou; 48% in Jiangxi – China National Bureau of Statistics of China 2016). The provinces, when combined together, are large. In total, the populations of the three provinces accounted for about 10 percent of all primary school students in China in 2015 (approximately 10 million students – Ministry of Education of the People’s Republic of China 2015). Hence, given that our data includes observations from provinces in three different regions of China, we believe our sample is broadly representative of primary school students in China, and especially students in rural areas.

Sampling

Sampling for Dataset 1 was conducted in rural areas of Guizhou and Jiangxi provinces (Figure 1). To select our sample, we first randomly selected three counties in each province, for a total of six sample counties. Within each county, we randomly selected townships and then randomly selected schools within each township. In total, we selected 135 primary schools across the two provinces to include in our sample. Second, in each sample school, we randomly chose at most two classes in grades 3 through 6 in Guizhou province and in grades 4 through 6 in Jiangxi province. In the end, we obtained a sample of 17,243 students in grades 3 to 6 in Guizhou and Jiangxi provinces (2,778 students in 15 schools in Guizhou, and 14,465 students in 120 schools in Jiangxi – Table 1).

Dataset 2 collected information on primary school students in two prefectures of Shaanxi province (Figure 1). The sample was chosen in three steps. First, we obtained a list of schools in our two sample prefectures from local education bureaus. Second, we randomly selected 68 sample schools from this list of schools. Within each of these

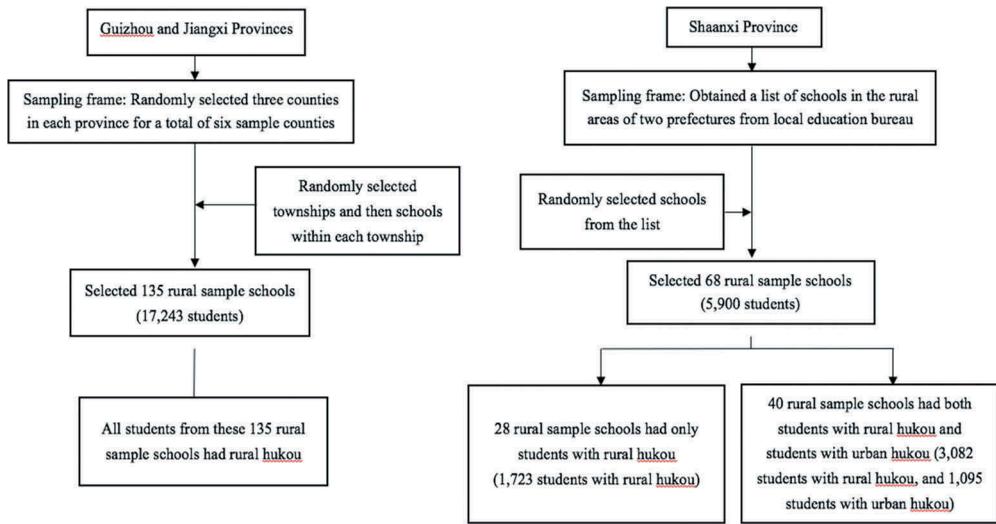


Figure 1. Sample selection procedure.

Table 1. Sample size of full sample and subsamples from Shaanxi, Guizhou, and Jiangxi provinces.

	Number of Schools	Number of Students	Number of Students in Reading Dataset				Number of Students in Maths Dataset					
			Total	Grade 3	Grade 4	Grade 5	Grade 6	Total	Grade 3	Grade 4	Grade 5	Grade 6
Full Sample	203	23,143	19,853	1,343	6,727	7,031	4,752	12,301	2,001	3,400	3,795	3,105
Shaanxi Sample	68	5,900	2,610	614	696	668	632	3,290	1,627	366	607	690
Guizhou Sample	15	2,778	2,778	729	652	664	733	1,769	374	326	336	733
Jiangxi Sample	120	14,465	14,465	–	5,379	5,699	3,387	7,242	–	2,708	2,852	1,682

Source: Authors’ own data

Note: In Jiangxi province, we only surveyed in grades 4 through 6 and, therefore, didn’t collect information from grade 3 students.

schools, we randomly selected two grades in the third through sixth grades and at most two classes from each of the two selected grades. In total, 5,900 students from 68 schools in Shaanxi province were selected for our sample (Table 1).

Data collection

The information in these two datasets was collected in two general survey blocks. In the first block, we collected data on student and family background characteristics, although the specific information gathered varied slightly between our two datasets. In both datasets, we gathered data on the gender, age, and grade levels of the sample students. In Dataset 1, students were also asked to report whether or not he/she boards at school. In addition, we asked students to fill out whether their family had eight household assets, including a car, microwave, refrigerator, camera, computer, access to the Internet, air conditioner, and flushing toilet. We then calculated the “Wealth Index” by principal component analysis

using the information on ownership of these eight items (Kolenikov and Angeles 2009). The more items a student's family owned, the higher family Wealth Index was. In Dataset 2, we asked sample students to report their household registration (hukou) status in order to distinguish between students with urban hukou ($n = 1,095$) and students with rural hukou ($n = 4,805$ – Figure 1). Such data were not needed for the students from Dataset 1 because all respondents had rural hukou. A summary of the characteristics of sample students from both datasets and all three provinces is provided in Table 2.

In the second survey block, students in all three sample provinces completed a 30-minute standardised reading test, a 30-minute standardised maths test, or both. The reading tests were constructed by trained psychometricians using test items from the Progress in International Reading Literacy Study test (henceforth *PIRLS*), an international test of reading comprehension that is widely used throughout the world (Cheung et al. 2009; Caygill and Chamberlain 2004; Mullis, Martin, and Gonzalez 2004; Tunmer et al. 2013). The test questions were carefully translated according to the PIRLS translation guidelines and the content validity was reviewed by a panel of experts and local teachers with knowledge about China's education system. In addition to evaluating the overall reading scores of students, we also examined two specific types of reading skills: "acquiring and using information" and "literary experience" (i.e. reading to learn and reading for interest or pleasure – IEA 2011) to determine whether student achievement levels in one of these skills drives differences in overall reading achievement. Also, when we compare the reading outcomes of our sample students to those of students in other countries/regions represented in the PIRLS data, we use only the scores of fourth grade students in our sample who were of the same age as the students that participated in the official administration of the PIRLS test (IEA 2011).

Table 2. Average characteristics of sample students.

Variable	Mean	Std. Dev.	Min	Max
Full sample (n = 23,143)				
1. Gender (1 = male)	0.52	0.50	0.00	1.00
2. Age (years)	11.35	1.19	7.00	16.00
Guizhou and Jiangxi sample (n = 17,243)				
3. Student lives at school (1 = yes)	0.10	0.30	0.00	1.00
4. Low socioeconomic status (1 = yes)	0.50	0.50	0.00	1.00
Shaanxi sample (n = 5,900)				
5. Gender (1 = male)	0.55	0.50	0.00	1.00
6. Age (years)	10.80	1.28	7.00	15.00
7. Type of hukou (1 = rural hukou)	0.81	0.39	0.00	1.00
Guizhou sample (n = 2,778)				
8. Gender (1 = male)	0.52	0.50	0.00	1.00
9. Age (years)	11.45	1.52	7.00	16.00
10. Student lives at school (1 = yes)	0.07	0.26	0.00	1.00
11. Low socioeconomic status (1 = yes)	0.57	0.50	0.00	1.00
Jiangxi sample (n = 14,465)				
12. Gender (1 = male)	0.52	0.50	0.00	1.00
13. Age (years)	11.43	1.07	7.00	16.00
14. Student lives at school (1 = yes)	0.10	0.30	0.00	1.00
15. Low socioeconomic status (1 = yes)	0.49	0.50	0.00	1.00

Source: Authors' own data

Note: We collected information on student gender and age in Shaanxi, Guizhou and Jiangxi provinces. Information on the hukou type of students was only collected in Shaanxi province, while information on student boarding status and family assets were only collected in Guizhou and Jiangxi provinces.

Similarly, a standardised maths test was carefully designed with assistance from local education bureaus to ensure that test content was appropriate for the grade levels of students and in compliance with the national curriculum. The standardised maths test then went through several rounds of pilot testing with students in grades 3 through 6 to ensure relevance and that time limits were appropriate. The psychometric properties of the tests were then validated using data from extensive pilot testing to ensure good distributional properties (no bottom- or top-coding, for example). In this way, we ensured that the tests were of the highest quality and appropriate for the grade levels of students.

Both tests were closely proctored and carefully timed by trained enumerators. All students in Dataset 1 completed the standardised reading tests and half of the students in this sample were selected to complete the standardised maths tests. In Dataset 2, students were randomly selected to take either the standardised reading test or the standardised maths test. In total, our sample includes 19,853 students who completed the standardised reading test and 12,301 students who completed the standardised maths test (Table 1). In 9,011 cases, the students took both the reading and maths tests. For most analyses, we normalised reading and maths test scores according to the distribution of scores in each grade. The only exception is when we use raw reading test scores to compare the reading skill levels of fourth grade students in our sample to those of students in other countries/regions that participated in the PIRLS test.

Empirical strategy

We use ordinary least squares (OLS) regression analysis (both with and without control variables) to identify how reading achievement is correlated with maths performance. Our basic OLS analysis regressed our measure of reading achievement on the outcome variable of maths achievement. The model used is as follows:

$$y_{ijc} = \alpha + \beta R_{ijc} + \gamma X_{ijc} + \mathcal{E}_{ijc} \quad (1)$$

where the dependent variable y_{ijc} indicates the standardised maths test score of student i in school j and class c ; R_{ijc} represents the standardised reading score of student i in school j and class c . In order to improve the efficiency of the estimation, we also estimated the same model controlling for a set of control variables, X_{ijc} , which includes variables for student gender, age, grade level, boarding status, and a measure of household assets. By doing so, β is used to estimate the correlation between reading achievement and maths performance. In all regressions, we accounted for the clustered nature of our sample by constructing Huber-White standard errors corrected for class-level clustering.

In order to examine whether levels of reading achievement vary among different subgroups of students, we used the following OLS model:

$$y_{ijc} = \alpha_0 + \beta_0 P_i + \gamma_0 X_{ijc} + \mathcal{E}_{ijc} \quad (2)$$

In equation (2), y_{ijc} represents the standardised reading test score of student i in school j and class c ; P_i is a vector representing student characteristics, such as gender, hukou type, boarding status, and a measure of household assets. We use the variable X_{ijc} to control for student age and grade level. In this equation, the coefficient β_0 measures the reading achievement levels of students with different characteristics. We also accounted

for the clustered nature of our sample by constructing Huber-White standard errors corrected for class-level clustering.

Results

Descriptive statistics

The summary statistics for the full sample and for our three provincial subsamples are presented in [Table 2](#). From this table, we see that 52% of students in our sample are male (Row 1), which is consistent with the national gender ratio in China in 2015 (where 51% of the population was male – China National Bureau of Statistics of China 2016). Even when we evaluated the gender distribution of each of our sample provinces, we find that the gender ratio of sample students in each province was similar to the national average. Specifically, we find that 55%, 52%, and 52% of sample students were male in Shaanxi, Guizhou, and Jiangxi, respectively (Row 5, 8, & 12). The average age of students in our sample was 11.35 years old, and students ranged in age from 7 to 16 years old (Row 2). Using the sample from Dataset 1, we found that 10% of sample students in Jiangxi and Guizhou provinces boarded at school (Row 3). When we examine the registration status of sample students in Dataset 2, we find that 19% of students had urban hukou and 81% had rural hukou (Row 7). Because sample students in Dataset 1 all lived in poor, rural areas of Guizhou and Jiangxi provinces, all students in this subsample had rural hukou.

Reading achievement of students across three provinces

To understand the state of reading abilities among children in rural China, we first examined differences in reading achievement among children from rural areas of our three sample provinces. In general, compared with students in Guizhou and Jiangxi provinces, students in Shaanxi province scored higher, overall, on the standardised reading test. Specifically, the average standardised reading test score of students in Shaanxi province is 0.55 SD higher than that of students in Guizhou province and 0.72 SD higher than that of students in Jiangxi province (significant at the 1% level – [Table 3](#), Rows 1, Columns 7 & 8). Additionally, the average standardised reading test score in Guizhou is significantly higher than that in Jiangxi (by 0.16 SD – Row 1, Column 9). Students in Jiangxi clearly scored lowest on the overall standardised reading test (Row 1, Columns 8 & 9).

To better understand when these gaps in reading achievement arise between students in our sample provinces, we also examine reading achievement by grade level in [Table 3](#). Generally, we find that students from Shaanxi province perform significantly better than students from Jiangxi and Guizhou provinces across all grade levels (Rows 2 to 5, Columns 7 & 8). When we focus on the differences in reading achievement between students in rural Guizhou and Jiangxi provinces, we find that students in Guizhou generally scored higher on the reading test than students in Jiangxi province, although the differences are mostly insignificant (Rows 3 to 5, Column 9). The only exception is in grade 5 where students in Guizhou scored significantly higher (by 0.52 SD) on the reading exam than students from Jiangxi (significant at 1% level – Row 4, Column 9). These results hold if we compare scores on the two subsections, “reading to acquire and use information” and “reading for literary experience” (Rows 6 to 13, Columns 7 to 9), suggesting that



Table 3. Comparison of standardised reading test scores among students from Shaanxi, Guizhou, and Jiangxi provinces.

	Shaanxi Sample		Guizhou Sample		Jiangxi Sample		Difference Shaanxi – Guizhou ^a	Difference Shaanxi – Jiangxi ^a	Difference Guizhou – Jiangxi ^a
	Mean	SD	Mean	SD	Mean	SD			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Overall standardised reading score									
1. Total	0.60	1.01	0.05	0.99	-0.12	0.96	0.55*** (0.09)	0.72*** (0.07)	0.16** (0.07)
2. Grade 3	0.29	0.98	-0.24	0.96	-	-	0.53*** (0.15)	-	-
3. Grade 4	0.58	0.91	0.05	0.98	-0.08	0.99	0.53*** (0.15)	0.66*** (0.09)	0.13 (0.13)
4. Grade 5	0.88	1.07	0.37	0.99	-0.15	0.93	0.51** (0.20)	1.03*** (0.16)	0.52*** (0.14)
5. Grade 6	0.62	0.99	0.04	0.95	-0.12	0.97	0.58*** (0.17)	0.74*** (0.12)	0.16 (0.13)
Standardised reading score of acquiring and using information									
6. Grade 3	0.31	1.02	-0.26	0.91	-	-	0.57*** (0.15)	-	-
7. Grade 4	0.49	0.95	0.08	1.08	-0.07	0.98	0.42** (0.17)	0.56*** (0.10)	0.15 (0.14)
8. Grade 5	0.62	0.78	0.45	0.88	-0.12	0.99	0.17 (0.10)	0.74*** (0.08)	0.57*** (0.08)
9. Grade 6	0.72	1.21	0.00	1.01	-0.13	0.89	0.72*** (0.19)	0.86*** (0.13)	0.13 (0.14)
Standardised reading score of literary experience									
10. Grade 3	0.16	0.94	-0.13	1.03	-	-	0.29** (0.13)	-	-
11. Grade 4	0.58	0.90	0.03	0.94	-0.08	1.00	0.55*** (0.13)	0.65*** (0.08)	0.11 (0.11)
12. Grade 5	0.86	1.17	0.28	1.03	-0.13	0.91	0.58** (0.22)	0.99*** (0.17)	0.41*** (0.15)
13. Grade 6	0.45	0.90	0.05	0.93	-0.09	1.01	0.40*** (0.14)	0.54*** (0.09)	0.15 (0.11)

Source: Authors' own data

Note: The reading test scores were standardised in each grade across the three provinces to a mean of 0 and a standard deviation of 1.

^a Robust standard errors clustered at the class level are presented in parentheses.

differences in the overall reading scores of students were not indicative of differential performance in these specific reading skills.

Given the differences in reading achievement found between students from Shaanxi and our other two sample provinces, we sought to examine what factors may contribute to these achievement gaps. Following findings that student reading outcomes are related to household resources (Davis-Kean 2005; Dahl and Lochner 2005), we suspected that the higher levels of reading achievement demonstrated in Shaanxi may arise, at least in part, because a share of students in the Shaanxi sample have urban hukou (and, therefore, are likely from wealthier families than students with rural hukou). In fact, when we examine the average reading test scores between students in our sample with urban and rural hukou, we find that the average standardised reading test score of students with urban hukou is significantly higher than that of students with rural hukou (Appendix Table A1).

Further analysis, however, demonstrates that the gap between Shaanxi students and students from the other two provinces arise for reasons beyond an urban-rural split. Specifically, when we exclude students with urban hukou from our sample, we still find results similar to our original analysis (Appendix Table A2). So what is leading to these differences? In fact, there are still reasons to believe higher levels of household resources (and perhaps, by association, local fiscal resources) in Shaanxi may contribute to these achievement gaps. Measures of per capita GDP calculated in 2015 are higher in Shaanxi province (47,626 RMB) than in either Guizhou (29,847 RMB) or Jiangxi provinces (36,724 RMB), which could contribute to differential educational resource expenditure between these provinces (China National Bureau of Statistics of China 2016).

To understand why there are significant differences in reading achievement between students from Guizhou and Jiangxi provinces in only the fifth grade, we examine the differences in raw reading scores between our three sample provinces (Appendix Table A3). By examining the raw test scores, we are capable of comparing reading test scores across different grade levels within the same province, which is not possible using scores that were standardised separately in each grade. From this analysis, we can see that, although students from Guizhou and Jiangxi provinces had similar average reading scores in the fourth grade (23.39 points and 22.15 points, respectively), the reading scores of students in Jiangxi province fell by 2.25 points between the fourth and fifth grade (to 19.90 points), while the scores of students in Guizhou increased slightly (by 0.33 points) over the same period (to 23.72 points – Rows 2 & 3, Columns 3 & 5). In other words, while the reading skill levels of students in Guizhou province remained stable between the fourth and fifth grade, they worsened among students from Jiangxi province. For this reason, we find that there are significant differences in the standardised reading scores of fifth grade students between these two provinces.

Reading achievement of sample students compared to that of students in other countries/regions

Although we have identified gaps that exist in the reading performance of students in different provinces in China, this information does not allow us to evaluate whether the reading achievement levels of students in our sample are “high” or “low” on an international scale. In other words, our analysis shows that although students from Shaanxi province score higher on their reading achievement tests than students from the other two provinces, it is unclear whether they are doing “well” in an overall sense, or if they are

merely doing better than poorer readers in Guizhou and Jiangxi provinces. For this reason, we compare the reading achievement outcomes of our sample to those of students in other countries/regions that participated in the PIRLS test (Figures 2 and 3).

When we compare the reading achievement levels of students from our three sample provinces to those of students from other countries/regions, we find that students in rural China, including those in Shaanxi, exhibit low levels of reading achievement. Specifically, no matter whether or not we exclude students with urban hukou, the average reading test score of our sample students in grade 4 from rural China (i.e., from all three sample provinces) is 0.25. The sample areas in rural China ranked last when compared to other countries/regions that participated in the PIRLS assessment (Figure 2).

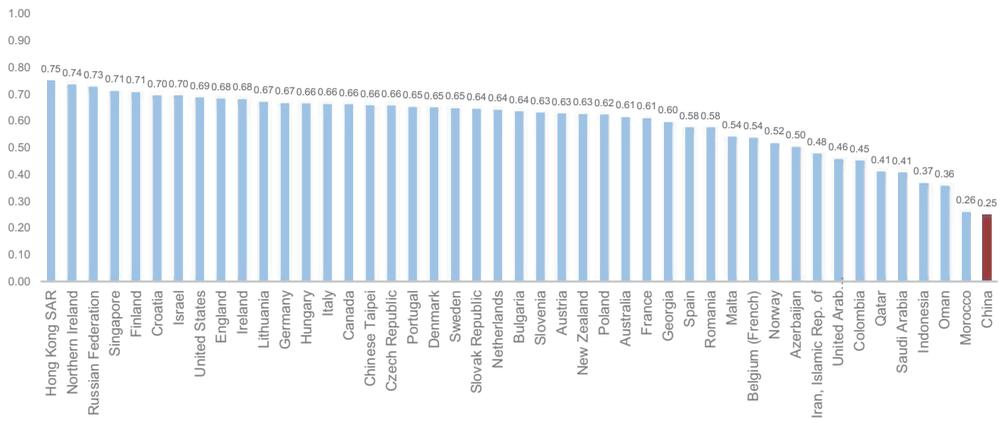


Figure 2. Reading test scores of students in our full rural Chinese sample compared to those of students from other countries/regions.

Source: Progress in International Reading Literacy Study (PIRLS) and authors’ own data. Note: The reading scores for the China sample were calculated using reading scores of grade 4 sample students from Shaanxi, Guizhou, and Jiangxi provinces. The results are calculated using the eleven uniform reading test items from the PIRLS study.

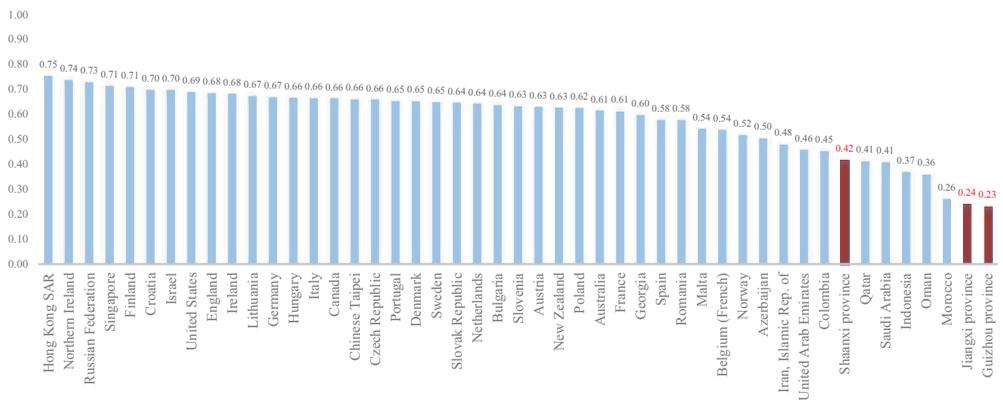


Figure 3. Reading test scores of students in our subsamples from Shaanxi, Guizhou and Jiangxi provinces compared to those of students from other countries/regions.

Source: Progress in International Reading Literacy Study (PIRLS) and authors’ own data. Note: The reading scores for the three subsamples were calculated using reading scores of grade 4 sample students from Shaanxi, Guizhou, and Jiangxi provinces. The results are calculated using the eleven uniform reading test items from the PIRLS study.

Because we found that students from Shaanxi performed significantly better than those from either Guizhou or Jiangxi, we also examined how the reading achievement of students from each of our three sample provinces compared to that of students from other countries/regions, separately. From this analysis presented in [Figure 3](#), we find that students in our Shaanxi sample performed poorly compared to the samples of students from other countries/regions, but they ranked better than our samples from Guizhou and Jiangxi provinces. Specifically, compared to students in the 44 countries and regions represented in the PIRLS data, we find that our samples of students from Jiangxi and Guizhou still performed worse than students from all other countries/regions, while the sample of students from Shaanxi performed better than those from only five countries. These results confirm that the levels of reading achievement among students in our sample are, indeed, low. Additionally, although we find that students from Shaanxi province exhibit higher levels of reading achievement than their peers in Guizhou and Jiangxi provinces, they still perform poorly on an international scale.

The relationship between reading achievement and maths performance

Following the literature base demonstrating that reading skills have substantial impacts on overall academic performance (Clark and Rumbold 2006; Cox and Guthrie 2001; National Reading Panel, Institute of Child Health, and Human Development 2000; Slavin et al. 2009), we examined the correlation between standardised reading and maths test scores among students in our sample. To do so, we first compared the relative levels of maths performance among students in our three sample provinces, and the results of this analysis are displayed in [Table 4](#). We found that patterns in maths performance were similar to those found for reading achievement: students in our Shaanxi sample performed significantly better than students living in either Guizhou or Jiangxi provinces (Columns 7 & 8). Additionally, the average standardised maths scores were similar for sample students from Guizhou and Jiangxi provinces (Column 9).

Given that the differences in maths performance between our sample provinces mirror the differences in reading achievement, we examined whether reading achievement and maths performance among students in our sample were significantly correlated. The results of our regression analysis presented in [Table 5](#) show that levels of reading achievement are significantly correlated with maths performance. Specifically, we find that, when controlling for observable characteristics, a one standard deviation increase in standardised reading test scores is correlated with a 0.62 SD increase in standardised maths test scores (significant at 1% level). As has been expressed in the literature (Rutherford-Becker and Vanderwood 2009; Thurber, Shinn, and Smolkowski 2002; Jordan, Hanich, and Kaplan 2003), there appears to be a close association between reading and school achievement, in general. This is believed to be the case because improved reading comprehension skills, themselves, allow students to read and understand “word problems” better, while improved critical thinking skills allow students to think through and solve maths problems more easily.



Table 4. Comparison of standardised maths test scores among students from Shaanxi, Guizhou, and Jiangxi provinces.

	Shaanxi Sample		Guizhou Sample		Jiangxi Sample		Difference Shaanxi – Guizhou ^a	Difference Shaanxi – Jiangxi ^a	Difference Guizhou – Jiangxi ^a
	Mean	SD	Mean	SD	Mean	SD			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Total	0.32	0.96	-0.13	1.04	-0.11	0.97	0.45*** (0.09)	0.42*** (0.06)	0.02 (0.08)
2. Grade 3	0.08	0.96	-0.35	1.08	-	-	0.43*** (0.11)	-	-
3. Grade 4	0.50	0.84	-0.13	0.99	-0.05	1.00	0.63*** (0.16)	0.55*** (0.12)	-0.08 (0.11)
4. Grade 5	0.65	0.86	-0.17	0.97	-0.12	0.98	0.82*** (0.12)	0.76*** (0.08)	-0.05 (0.10)
5. Grade 6	0.49	0.97	0.00	1.06	-0.19	0.91	0.50*** (0.18)	0.68*** (0.10)	0.19 (0.16)

Source: Authors' own data

Note: The maths test scores are standardised in each grade across the three provinces to a mean of 0 and a standard deviation of 1.

^a Robust standard errors clustered at the class level are presented in parentheses.

Table 5. Correlation between the standardised reading and maths test scores among students from Guizhou and Jiangxi provinces.

Dependent variable	Standardised maths test score	
	(1)	(2)
1. Standardised reading test score	0.61*** (0.01)	0.62*** (0.01)
2. Gender (1 = male)		Yes
3. Student lives at school (1 = yes)		Yes
4. Low socioeconomic status (1 = yes)		Yes
5. Age (year)		Yes
6. Grade		Yes
7. Constant	-0.06*** (0.02)	-0.06 (0.14)
8. Observations	9,011	9,011
9. R-squared	0.348	0.370

Source: Authors' own data

Note: 1. Robust standard errors clustered at the class level are presented in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

2. All sample students took the reading exam in Guizhou and Jiangxi provinces, and a portion of the students in these provinces also took the maths exam. In Shaanxi, students completed either the standardised reading test or the standardised maths test. Therefore, we use the sample of students who took both the reading and maths exams in Guizhou (1,769) and Jiangxi (7,242) provinces.

Reading achievement among different subgroups of students

To determine whether certain student characteristics are correlated with reading achievement among our sample in rural China, we evaluated whether differences in reading achievement emerge between students with different observable characteristics. As can be seen from the results presented in Table 6, the average reading test scores of male

Table 6. The relative performance on the standardised reading test of students with different characteristics from Shaanxi, Guizhou, and Jiangxi Provinces^a.

Variable	Standardised reading test score	
	Shaanxi Sample (1)	Guizhou and Jiangxi Sample (2)
1. Gender (1 = male)	-0.15*** (0.03)	-0.11*** (0.02)
2. Type of hukou (1 = rural hukou)	-0.67*** (0.11)	
3. Student boards at school (1 = yes)		-0.17*** (0.05)
4. Low socioeconomic status (1 = yes)		-0.11*** (0.02)
5. Age (years)	Yes	Yes
6. Grade	Yes	Yes
7. Constant	1.41*** (0.30)	0.32** (0.14)
8. Observations	2,610	17,243
9. R-squared	0.119	0.013

Source: Authors' own data

Note: Robust standard errors clustered at the class level are presented in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

^a We collect information of student gender, age, and grade in Shaanxi, Guizhou, and Jiangxi provinces. Information on hukou type was only collected in Shaanxi province. Information on student boarding status and family assets were only collected in Guizhou and Jiangxi provinces. Therefore, we ran two regressions, one focusing on Shaanxi students while the other one focusing on Guizhou and Jiangxi students.

students are 0.15 SD lower than those of female students in Shaanxi province, and 0.11 SD lower than those of female students in Guizhou and Jiangxi provinces (significant at the 1% level – Row 1). These results are consistent with the findings from previous research, which also shows that female students have higher levels of reading achievement than male students (Lietz 2006; Mullis et al. 2012; Smith et al. 2012).

Using our sample from Shaanxi province, we find that students with rural hukou perform 0.67 SD worse on our measure of reading achievement than students with urban hukou (significant at the 1% level – Row 2). A difference of this magnitude is perhaps not surprising. Students with urban hukou are more likely to be from wealthier families and more well-off areas and, therefore, are more likely to have greater access to educational resources. Existing evidence has found positive correlations between family/school resources and the reading outcomes of students (Dahl and Lochner 2005; Davis-Kean 2005; Greenwald, Hedges, and Laine 1996). Therefore, this evidence supports our finding that students with urban hukou are more likely to score higher on the reading test than their peers.

There are also gaps in reading achievement among other subgroups. For example, differences in reading achievement also emerged based on whether students boarded at school, as we found that boarding students in our sample from Guizhou and Jiangxi provinces scored 0.17 SD lower on the reading test than their peers (significant at the 1% level – Row 3). Our analysis also revealed that students with lower socioeconomic status have an average level of reading achievement 0.11 SD lower than that of students from households with higher household socioeconomic status (significant at the 1% level – Row 4). The literature base supports our findings. Previous studies found that family involvement is an important input for the reading skill development of students (Christian, Morrison, and Bryant 1998; Davis-Kean 2005). Therefore, boarding students may perform worse on our measure of reading achievement because they lack the individualised attention that students who live at home receive from parents and caregivers. Additionally, previous findings also suggest that students from higher-income households are more likely to have better reading outcomes than their peers (Chen, Lee, and Stevenson 1996; Davis-Kean 2005; Blanch et al. 2013). Like the gap in reading achievement found between students with urban and rural hukou, the gap found between students with higher and lower levels of household assets is likely due to the levels of resources available to students.

Although differences in the reading achievement of students based on hukou, boarding status, and household asset values are likely related to systemic differences in household and school resources, it is not as clear why significant differences emerge between the genders. To investigate this further, we present analysis of the gender gap in reading achievement in Table 7. We see that the overall reading test scores of male students are lower than those of female students in each of our sample grades (Rows 1 to 4). It appears that these differences in overall reading achievement are due to lower scores on questions measuring “literary experience,” rather than scores on those questions measuring the ability of students to “acquire and use information”. Specifically, we find that male and female students perform significantly different in “acquiring and using information” only in the fifth grade, while female students perform better than male students in “literary experience” in every grade (all significant at the 1% level – Rows 5 to 12, Column 5). In other words, it appears that it is primarily increased exposure to reading materials that improves the reading achievement of female students relative to that of male students. These findings provide support for previous research that found gender differentials in reading

Table 7. Comparison of standardised test reading scores between female and male students in Shaanxi, Guizhou, and Jiangxi provinces ^a.

	Female Student		Male Student		Difference Male – Female
	Mean	SD	Mean	SD	
	(1)	(2)	(3)	(4)	(5)
Overall standardised reading score					
1. Grade 3	0.04	0.99	–0.03	1.01	–0.07 (0.05)
2. Grade 4	0.06	1.00	–0.05	1.00	–0.11*** (0.03)
3. Grade 5	0.05	0.98	–0.04	1.01	–0.09*** (0.02)
4. Grade 6	0.09	0.99	–0.09	1.00	–0.18*** (0.03)
Standardised reading score of acquiring and using information					
5. Grade 3	–0.02	1.00	0.02	1.00	–0.03 (0.05)
6. Grade 4	0.01	1.01	–0.01	0.99	–0.03 (0.03)
7. Grade 5	0.05	0.95	–0.05	1.04	–0.10*** (0.02)
8. Grade 6	0.00	1.04	0.00	0.96	0.00 (0.03)
Standardised reading score of literary experience					
9. Grade 3	0.12	0.96	–0.10	1.02	–0.22*** (0.05)
10. Grade 4	0.07	1.00	–0.06	1.00	–0.14*** (0.03)
11. Grade 5	0.04	1.00	–0.03	1.00	–0.07*** (0.02)
12. Grade 6	0.12	0.97	–0.11	1.01	–0.22*** (0.03)

Source: Authors' own data

Note: Robust standard errors clustered at the class level are presented in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

^aThe reading test scores were standardised in each grade across the three sample provinces to a mean of 0 and a standard deviation of 1.

achievement appear to be related to exposure to reading material (Chiu and Catherine 2006; Clark and Rumbold 2006; Kirsch et al. 2003). For example, using data from 43 countries, Chiu and Catherine (2006) found that female students outperformed male students on a measure of reading achievement, and that “reading for enjoyment” (i.e. reading for literary experience) accounted for 42% of the gender effect on reading achievement.

Conclusion

This paper describes the reading achievement of primary school students in rural areas of three regions in China. Our data show that, although gaps in reading achievement exist between students from our three different sample provinces, all sample students exhibit low levels of reading achievement. Specifically, we find that sample students from Shaanxi province performed significantly better in our measure of reading achievement (scores on a standardised reading exam) than students from either Guizhou and Jiangxi provinces. Also, using data collected from the PIRLS test, we found that our sample students from rural China ranked last in reading skills among a sample of students from the other 44 countries/regions. When we compare the outcomes of students in our three sample provinces separately, students from Jiangxi and Guizhou still ranked behind all countries/regions that participated in the test, while students from Shaanxi performed better than only five other countries/regions.

Although we cannot totally exclude influences of cultural and language on student reading performance, we believe it cannot result in the low reading achievement of rural Chinese students and the significant differences of reading achievement across the three provinces in rural China. In the PIRLS reading tests in 2011, the reading assessment instruments were

translated into 48 languages and only 16 countries used the English version of the reading tests (Mullis, Martin, and Gonzalez 2004). Chinese Taipei and Hong Kong adopted the Chinese version of reading tests and were in the top in the PIRLS reading tests. Considering the multiple languages used and the cases of Chinese Taipei and Hong Kong, we believe that Chinese culture and orthography cannot result in the low reading achievement of rural Chinese students. Additionally, although students from Shaanxi, Guizhou, and Jiangxi provinces may have different local languages and culture, all sample students in the school class had the same type of official reading, Chinese books, and test exams in Chinese version. Therefore, we believe our reading tests are appropriate for all sample students and the differences of local culture and language could not result in the significant differences of student reading achievement across the three provinces.

Our results also provide evidence suggesting that low levels of reading achievement are related to poor academic performance in other subject areas. For example, our analysis found strong positive correlations between reading achievement and performance on a standardised maths examination. Therefore, these findings suggest that if the educational systems in rural areas of China do not begin to improve the reading achievement of rural students, the general academic performance of students will suffer. Ultimately, this situation could aggravate the severe educational inequality between urban and rural areas in China.

To determine whether there are certain groups of students who are particularly susceptible to developing poor reading skills, we evaluated whether differences in reading achievement varied based on student gender, household registration, boarding status, and socioeconomic status. From this heterogeneous analysis, we found that male students, students with rural hukou, boarding students, and students from relatively poor families scored significantly worse than their peers on our measure of reading achievement.

Our findings contribute towards the existing literature on student reading achievement in several ways. First, although previous research explored student reading achievement in China, few studies have identified the reading achievement of students in rural China. To our knowledge, this is the first large-scale study that presents evidence documenting the low levels of student reading achievement in rural China. Second, unlike most studies conducted on reading in rural China, our quantitative data provide empirical support for the positive impact of reading achievement on the academic performance among primary school students in rural China. Finally, this study also improves understanding of student reading achievement among different subgroups of primary school students in rural China, often neglected by previous literature. From the heterogeneous analysis, we found male students, students with rural hukou, boarding students, and students from relatively poor families to be susceptible to poor reading skills.

Our study has import implications for educational policymakers. While we cannot identify the specific sources of low levels of reading achievement among students in rural China, our results suggest that recent government efforts towards improving reading skills across China may be ill-suited for addressing the specific challenges of primary school students in rural areas (GMW.cn 2015; People.cn 2015). Not only do we find evidence of low levels of reading achievement, but our results also suggest that deficient reading skills could hinder the performance of students in other subject areas. Approximately 70 percentage of primary school children are from rural areas (National Bureau of Statistics of China 2016). These children constitute the majority of China's future workforce. Faced with reading challenges, if these

children do not perform well academically, they may not meet the demands of the future labour market, which, in turn, is central to China's future social stability and sustainable economic development. These findings suggest that the government should develop more effective policies and enhance its efforts to support reading skill development in China, especially in rural areas.

One possible route the government could take is to develop reading programmes in schools that increase students' exposure to books and teach reading skills. As aforementioned, many developed countries have begun establishing reading programmes to improve reading skills. Limited by reading resources, reading programmes have also been found to be effective in other developing countries, such as Rwanda and the Philippines (Abeberese, Kumler, and Linden 2013; Friedlander and Goldenberg 2016; Lonigan and Shanahan 2009; Slavin et al. 2009). Most of these reading programmes focused on either providing reading resources or delivering reading teaching instructions, or both. There is even evidence that reading programmes can potentially improve reading achievement in rural areas of China, as shown in recent research determining a correlation between certain well-designed programmes and reading achievement among samples of rural children (Gao et al. 2018; Wang et al. 2015; Yi et al. 2018). For example, a study conducted in rural areas of the Guizhou province found that appropriate reading books combined with instructions from well-trained teachers had a positive impact on the student reading achievement and academic performance (Gao et al. 2018). If the Chinese government does choose to implement these reading programmes, it would also be particularly important to focus on those subgroups of children which are more susceptible to worse reading outcomes (e.g. male students, students with rural hukou, boarding students, and students from relatively poor families). By focusing more on the reading achievement of rural students, we believe that the Chinese government can improve general educational outcomes and begin narrowing the educational achievement gap between rural and urban areas of China.

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Table A1. Comparison of standardised reading test scores of students with urban hukou and students with rural hukou in Shaanxi province.

	Students with Urban Hukou		Students with Rural Hukou		Difference Urban – Rural
	Mean	SD	Mean	SD	
	(1)	(2)	(3)	(4)	(5)
Overall standardised reading score					
1. Total	1.15	0.96	0.47	0.98	0.68*** (0.12)
2. Grade 3	0.65	0.99	0.21	0.95	0.44** (0.18)
3. Grade 4	0.90	0.84	0.53	0.91	0.37* (0.18)
4. Grade 5	1.62	0.81	0.65	1.03	0.97*** (0.14)
5. Grade 6	1.24	0.91	0.49	0.97	0.74** (0.29)

Source: Authors' own data

Note: 1. Robust standard errors clustered at the class level are presented in parentheses,

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

2. We use the sample of students who took reading tests in Shaanxi province. Among this sample, there are 484 sample students with urban hukou and 2,126 sample students with rural hukou

Table A2. Comparison of standardised reading test scores of only students with rural hukou from Shaanxi, Guizhou, and Jiangxi provinces.

	Shaanxi Sample		Guizhou Sample		Jiangxi Sample		Difference Shaanxi - Guizhou ^a	Difference Shaanxi - Jiangxi ^a	Difference Guizhou - Jiangxi ^a
	Mean	SD	Mean	SD	Mean	SD			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Overall standardised reading score									
1. Total	0.47	0.98	0.05	0.99	-0.12	0.96	0.43*** (0.08)	0.59*** (0.05)	0.16** (0.07)
2. Grade 3	0.21	0.95	-0.24	0.96	-	-	0.45*** (0.13)	-	-
3. Grade 4	0.53	0.91	0.05	0.98	-0.08	0.99	0.47*** (0.15)	0.66*** (0.09)	0.13 (0.12)
4. Grade 5	0.65	1.03	0.37	0.98	-0.15	0.93	0.28 (0.18)	0.80*** (0.12)	0.52*** (0.14)
5. Grade 6	0.49	0.97	0.04	0.95	-0.12	0.97	0.45*** (0.14)	0.62*** (0.07)	0.16 (0.13)
Standardised reading score of acquiring and using information									
6. Grade 3	0.24	1.00	-0.26	0.91	-	-	0.50*** (0.15)	-	-
7. Grade 4	0.46	0.95	0.08	1.08	-0.07	0.98	0.38** (0.16)	0.53*** (0.09)	0.15 (0.14)
8. Grade 5	0.51	0.83	0.45	0.88	-0.12	0.99	0.07 (0.10)	0.64*** (0.07)	0.57*** (0.08)
9. Grade 6	0.61	1.15	0.00	1.01	-0.13	0.89	0.61*** (0.17)	0.74*** (0.09)	0.13 (0.14)
Standardised reading score of literary experience									
10. Grade 3	0.08	0.93	-0.13	1.03	-	-	0.21** (0.11)	-	-
11. Grade 4	0.52	0.90	0.03	0.94	-0.08	1.00	0.49*** (0.13)	0.59*** (0.07)	0.11 (0.11)
12. Grade 5	0.60	1.12	0.28	1.03	-0.13	0.91	0.33 (0.20)	0.73*** (0.13)	0.41*** (0.15)
13. Grade 6	0.35	0.91	0.05	0.93	-0.09	1.01	0.30*** (0.12)	0.44*** (0.06)	0.15 (0.11)

Source: Authors' own data

Note: We excluded students with urban hukou in Shaanxi province and compared students with rural hukou in Shaanxi to sample students in Guizhou and Jiangxi.

^a Robust standard errors clustered at the class level are presented in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.



Table A3. Comparison of the average raw reading test scores of students from Shaanxi, Guizhou, and Jiangxi provinces.

	Shaanxi Sample		Guizhou Sample		Jiangxi Sample		Difference Shaanxi - Guizhou ^a	Difference Shaanxi - Jiangxi ^a	Difference Guizhou - Jiangxi ^a
	Mean (1)	SD (2)	Mean (3)	SD (4)	Mean (5)	SD (6)			
1. Grade 3	25.25	9.94	19.83	9.72	—	—	5.41*** (1.48)	—	—
2. Grade 4	28.38	8.54	23.39	9.23	22.15	9.26	4.99*** (1.43)	6.23*** (0.87)	1.24 (1.17)
3. Grade 5	27.51	7.90	23.72	7.28	19.90	6.85	3.79** (1.51)	7.62*** (1.15)	3.82*** (1.00)
4. Grade 6	25.56	7.80	21.04	7.45	19.75	7.59	4.52*** (1.32)	5.80*** (0.90)	1.28 (1.02)

Source: Authors' own data

Note: Robust standard errors clustered at the class level are presented in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$