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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 that 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 took part in the Progress in International Reading Literacy Study reading tests, our sample students from rural China ranked last. Our regression analysis documented that strong correlations between reading achievement and math performance exist among the sample students in rural China. Additionally, we find that male students, students with rural hukou, boarding students, and students from relatively poor families are more susceptible to having worse reading outcomes. Overall, our findings indicate that the government should develop more effective policies to support reading skill development in China, especially in rural areas.

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Keywords: reading achievement, academic performance, rural China

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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 & Rumbold, 2006; Cox & Guthrie, 2001; National Reading Panel, 2000; Slavin, Lake, Chambers, Cheung, & Davis, 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 (Jordan, Hanich, & Kaplan, 2003; Rutherford-Becker & Vanderwood, 2009; Thurber, Shinn, & Smolkowski, 2002). It is also believed that delays in reading development at an early age will negatively impact the education of students over the long term (Good, Simmons, & Kame'enui, 2001; Slavin et al., 2009; Whitehurst & Lonigan, 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 & 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.

Given the importance of reading skill development for long-term outcomes, many developed countries have begun to place greater emphasis on reading and established programs to improve student reading skills, with the ultimate goal of improving schooling outcomes (Good, Simmons, & Kame'enui, 2001; Kim, 2006; Kim & Quinn, 2013; Slavin et al., 2009; Whitehurst & Lonigan, 2001). 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; Moloi & 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 (Moloi & 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 & Mullis, 2013). Other similar studies show essentially the same dynamic in many developing countries (Grantham-McGregor et al., 2007; Martin & Mullis, 2013), such as Turkey (Duru & Koklu, 2011) and Ghana (Owusu-Acheaw & 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, Liu, Zhang, Shi, & Rozelle, 2013; Zhang, Yi, Luo, Liu, & Rozelle, 2013). Specifically, it has been found that rural students consistently perform worse than urban students in core academic subjects, such as math and science (Kleiman-Weiner et al., 2013; Lai et al., 2009; Li, Loyalka, Rozelle, Wu, & Xie, 2015; Qian & Smyth, 2008). These gaps are concerning because about 68% of students at the compulsory schooling level live in rural areas of the country (Educational Statistics Yearbook 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, 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., 2017). 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, 2006; Kim & Quinn, 2013).

In fact, education officials in China appear to be beginning to recognize 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., 2017; Liu, 2015). Other studies have presented evidence that teachers and educators in rural areas do not recognize 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, Loyalka, Rozelle & Wu, 2017), over-crowded (Wang & Lewin, 2016), and staffed with less capable teachers/educators than urban schools (Guo, Guo, Beckett, Li, & Guo, 2013; Wang & Li, 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 programs and activities in China have been effective and whether there should be further efforts to implement them more fully.

The objective of this study is to quantify and examine the reading achievement of students from rural areas in different regions of China. To achieve this goal, we first describe and compare the reading achievement of rural students across three provinces in different parts of China—Northwest China; Southwest China and Southeast China. Next, we compare the reading achievement levels of our sample students to those of students in other countries/regions. The reason for doing this is to put into perspective how the best (and less good) readers in our sample are doing in international terms. Then, we examine the relationship between reading achievement levels and academic performance among our sample students. Admittedly, in this study, it is only possible to provide correlations between reading achievement and math performance. Finally, we examine whether levels of reading achievement vary among different subgroups of students, paying particular attention to gender differences in reading achievement.

The rest of this paper is organized 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, 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–China Educational Statistics Yearbook, 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. 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. 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 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, we also collected data on whether or not students board at school as well as elicited information on a number of household assets of the sample students that were used to construct a wealth index. In Dataset 2, we also collected information on the household registration (hukou) status of sample children in order to distinguish children that were registered in urban areas (n=1,095) and rural areas (n=4,805). 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 standardized reading test, a 30-minute standardized math 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 (Caygill & Chamberlain, 2004; Cheung et al., 2009; Mullis, Martin, & 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).

Similarly, a standardized math 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 standardized math 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 standardized reading tests and half of the students in this sample were selected to complete the standardized math tests. In Dataset 2, students were randomly selected to take either the standardized reading test or the standardized math test. In total, our sample includes 19,853 students who completed the standardized reading test and 12,301 students who completed the standardized math test (Table 1). In 9,011 cases, the students took both the reading and math tests. For most analyses, we normalized reading and math 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 math performance. Our basic OLS analysis regressed our measure of reading achievement on the outcome variable of math achievement. The model used is as follows:

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

where the dependent variable y_{ijc} indicates the standardized math test score of student i in school j and class c; R_{ijc} represents the standardized 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 math 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:

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

In equation (2), y_{ijc} represents the standardized 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, 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 standardized reading test. Specifically, the average standardized 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 standardized 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 standardized 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 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, & 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 standardized reading test score of students with urban hukou is significantly higher than that of students with rural hukou (Appendix Table 1).

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 2). 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, 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 3). 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 standardized 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 standardized 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 1 & 2).

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, our full sample of children from rural China (i.e., from all three sample provinces) ranked last when compared to other countries/regions that participated in the PIRLS assessment (Figure 1).

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 2, 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 Math Performance

Following the literature base demonstrating that reading skills have substantial impacts on overall academic performance (Clark & Rumbold, 2006; Cox & Guthrie, 2001; National Reading Panel, 2000; Slavin et al., 2009), we examined the correlation between standardized reading and math test scores among students in our sample. To do so, we first compared the relative levels of math performance among students in our three sample provinces, and the results of this analysis are displayed in Table 4. We found that patterns in math 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 standardized math scores were similar for sample students from Guizhou and Jiangxi provinces (Column 9).

Given that the differences in math performance between our sample provinces mirror the differences in reading achievement, we examined whether reading achievement and math 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 math performance. Specifically, we find that, when controlling for observable characteristics, a one standard deviation increase in standardized reading test scores is correlated with a 0.62 SD increase in standardized math test scores (significant at 1% level). As has been expressed in the literature (Rutherford-Becker & Vanderwood, 2009; Thurber, Shinn, & Smolkowski, 2002; Jordan, Hanich, & 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 math problems more easily.

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 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, Martin, Foy, & Drucker, 2012; Smith, Smith, Gilmore, & Jameson, 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, & Lochner, 2005; Davis-Kean, 2005; Greenwald, Hedges & 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 household asset values lower than the median have an average level of reading achievement 0.14 SD lower than that of students from households with higher household asset values (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, & Bryant, 1998; Davis-Kean, 2005). Therefore, boarding students may perform worse on our measure of reading achievement because they lack the individualized 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 (Dahl & Lochner, 2005; Davis-Kean, 2005). 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 achievement appear to be related to exposure to reading material (Chiu & McBride-Chang, 2006; Clark & Rumbold, 2006; Kirsch et al., 2003). For example, using data from 43 countries, Chiu & McBride-Chang (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 standardized 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.

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 standardized math 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.

While we cannot identify the specific sources of the low levels of reading achievement found among students in rural China, our results suggest that recent government efforts to improve reading skills across China may be ill-suited for addressing the specific challenges facing 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. 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 programs in schools that increase student exposure to books and teach reading skills. These types of programs have been found to be effective in other countries, such as Rwanda and the Philippines (Abeberese, Kumler, & Linden, 2014; Friedlander & Goldenberg, 2016; Lonigan & Shanahan, 2009; Slavin et al., 2009). There is even evidence that these programs offer the potential to improve reading achievement in rural areas of China, as recent research that determined a correlation between certain well-designed programs and reading achievement among samples of rural children (Gao et al., 2017; Wang et al., 2015). If the Chinese government does choose to implement these sorts of reading programs, it would also be particularly important to focus on subgroups of children that 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 attention on the reading achievement of rural students, we believe that the Chinese government can improve general educational outcomes and begin to narrow the educational achievement gap between rural and urban areas of China.

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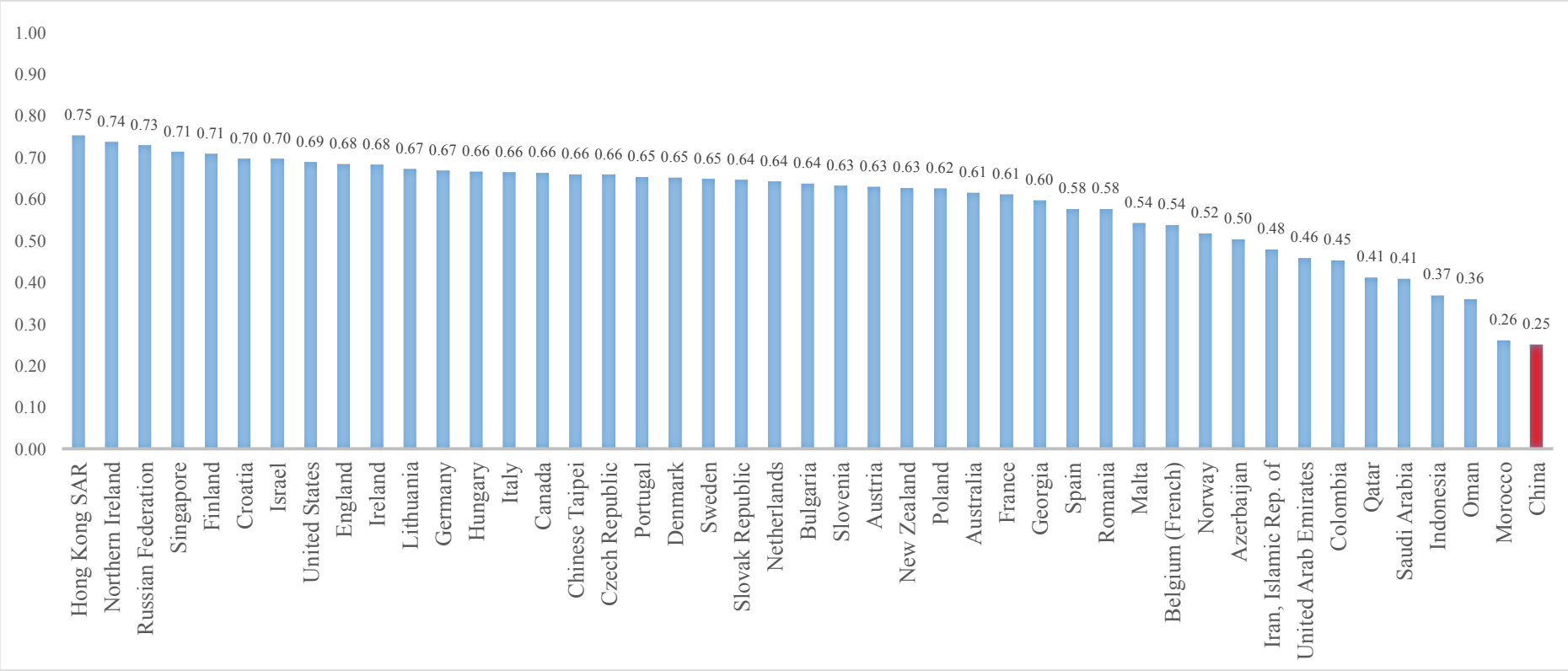

Figure 1: Reading test scores of students in our full rural Chinese sample compared to those of students from other countries/regions

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.

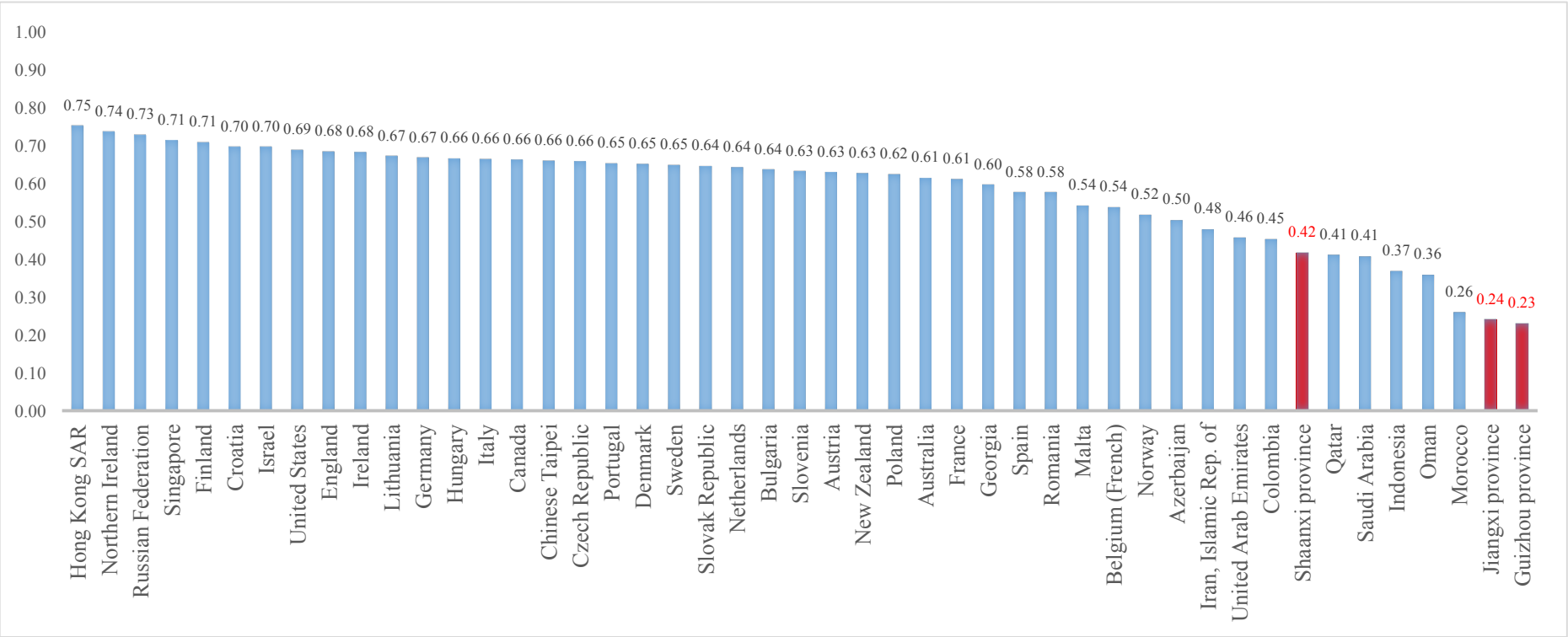

Figure 2: Reading test scores of students in our subsamples from Shaanxi, Guizhou and Jiangxi provinces compared to those of students from other countries/regions

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.

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 Math 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.

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. Family asset (1=lower than median)	0.67	0.47	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. Family asset (1=lower than median)	0.70	0.46	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. Family asset (1=lower than median)	0.66	0.47	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.

Table 3: Comparison of standardized 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 standardized 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)
					Standardized 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)
					Standardized 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 standardized 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 4: Comparison of standardized math 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 math test scores are standardized 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 standardized reading and math test scores among students from Guizhou and Jiangxi provinces

Dependent variable	Standardized math test score	
	(1)	(2)
1. Standardized reading test score	0.61***	0.62***
	(0.01)	(0.01)
2. Gender (1=male)		Yes
3. Student lives at school (1=yes)		Yes
4. Family asset (1=lower than median) [a]		Yes
5. Age (year)		Yes
6. Grade		Yes
7. Constant	-0.06***	-0.04
	(0.02)	(0.14)
8. Observations	9,011	9,011
9. R-squared	0.348	0.369

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 math exam. In Shaanxi, students completed either the standardized reading test or the standardized math test. Therefore, we use the sample of students who took both the reading and math exams in Guizhou (1,769) and Jiangxi (7,242) provinces.

[a] The "family asset" variable is based on the summed value of a set of assets, such as electric appliances and vehicles. The variable equals 1 if the family asset value is lower than the median value, and equals 0 otherwise.

Table 6: The relative performance on the standardized reading test of students with different characteristics from Shaanxi, Guizhou, and Jiangxi Provinces [a]

Dependent variable	Standardized reading test score	
	Shaanxi Sample	Guizhou and Jiangxi Sample
	(1)	(2)
1. Gender (1=male)	-0.15***	-0.11***
	(0.03)	(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. Family assets (1=lower than median) [b]		-0.14***
		(0.02)
5. Age (years)	Yes	Yes
6. Grade	Yes	Yes
7. Constant	1.41***	0.32**
	(0.30)	(0.14)
8. Observations	2,610	17,243
9. R-squared	0.119	0.015

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.

[b] The "family asset" variable is based on the summed value of a set of assets, such as electric appliances and vehicles. The variable equals 1 if the family asset value is lower than the median value, and equals 0 otherwise.

Table 7: Comparison of standardized 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 standardized 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)
			Standardized 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)
			Standardized 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

[a] The reading test scores were standardized in each grade across the three sample provinces to a mean of 0 and a standard deviation of 1.

Appendix 1: Comparison of standardized 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 standardized 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.

Appendix 2: Comparison of standardized 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 standardized 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)
					Standardized 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)
					Standardized 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.

Appendix 3: 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	SD	Mean	SD	Mean	SD			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
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