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The academic performance of primary school students from rural China:

Distribution and correlates

Hongyan Liu, Hao Xue, Yaojiang Shi, Scott Rozelle,

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# The academic performance of primary school students from rural China

## Distribution and correlates

Hongyan Liu

*School of Economics, Northwest University of Political Science and Law,  
Xi'an, China*

Hao Xue and Yaojiang Shi

*Center for Experimental Economics in Education, Shaanxi Normal University,  
Xi'an, China, and*

Scott Rozelle

*Freeman Spogli Institute of International Studies, Stanford University,  
Stanford, California, USA*

Primary school  
students from  
rural China

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### Abstract

**Purpose** – Low levels of human capital in rural China are rooted in the poor schooling outcomes of elementary school students. The purpose of this paper is to provide insight into the distribution of academic performance in rural China and identify vulnerable groups.

**Design/methodology/approach** – The authors draw on a data set of 25,892 observations constructed from 11 school-level surveys spanning nine provinces and one municipality in China conducted from 2013 to 2015.

**Findings** – The authors find that the distribution of academic performance is uneven across provinces and subgroups. In general, male students, Han, living in richer counties, living with their parents and studying in rural public schools do better academically than female students, non-Han, living in poorer counties, left behind and studying in private migrant schools in cities.

**Research limitations/implications** – Using the results of this study, policymakers should be able to better target investments into rural education focusing on at risk subpopulations.

**Originality/value** – With limited data sources, the research on the academic performance of students in rural China is largely absent. The findings of this study help to fill the gaps in the literature base.

**Keywords** China, Rural areas, Academic performance

**Paper type** Research paper

### Introduction

A critical question that China faces is how to avoid falling into the middle income trap (Eichengreen *et al.*, 2011; Cai and Wang, 2014). The middle income trap refers to the economic stagnation that occurs when the average income level in a country reaches a point where it can no longer sustain transformative economic development (World Bank, 2007). One of the most basic measures that can be taken to avoid the middle income trap is to develop a country's human capital (Zhang *et al.*, 2013; Yilmaz, 2015).

The future of China's economic growth and development relies on raising the level of its human capital (Li, 2016). Current levels of human capital in China are relatively low when compared to levels of upper secondary education attainment in OECD and other BRICS countries. In 2010, only 24 percent of the labor force in China had graduated from upper

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secondary school and less than 10 percent of the labor force had graduated from college (Khor *et al.*, 2016).

How can China increase its human capital? In order to boost the level of its human capital, the nation must focus on the cohorts of youth that are in its education system today. When examining the situation of schooling in urban and rural China, it is clear that the greatest potential for raising human capital is in China's rural areas. In China's cities, the rates of educational attainment at both the upper secondary school and college levels are already high (Zhang *et al.*, 2015).

Our own calculations confirm high rates of educational attainment in urban China. Using the Chinese General Social Survey (Bian and Li, 2012), a nationally representative data set, we found that 96 percent of adolescents in urban China of the appropriate age were enrolled in senior high schools[1]; 70 percent of age-appropriate students entered college in 2013[2]. Similarly, using data from the China Family Panel Studies Xie and Hu (2014), we find that well over 90 percent of adolescents in urban China of the appropriate age were enrolled in senior high schools; 65 percent of age-appropriate students entered college in 2010. China's rate of educational attainment in its urban areas is not far below that of a fully developed country (which implies that there is likely not a lot of room for improvement in urban areas – Khor *et al.*, 2016).

In contrast, human capital levels in rural China are strikingly low. Shi *et al.* (2015) report that only around 23 percent of youth in poor rural areas graduated from academic high school. In a meta-analysis comprised of four studies, results show that up to 30 percent of students in China's poor rural areas drop out of lower secondary school (despite that fact that it is compulsory – Shi *et al.*, 2015).

Why are secondary school outcomes in rural China so poor? Recent literature on human capital in China show that the source of the problem at the secondary school level (and above) is rooted in poor schooling outcomes of children in elementary school (Li, 2016). Liu *et al.* (2016) argued that the academic performance of rural primary students is worse than that of urban primary students. If China wants to be able to rely on investments in human capital to raise its future growth rate, leaders will have no choice but to focus and invest in the present rural education system and in rural elementary schools in particular (Li, 2016).

What is the nature of elementary schooling in rural China today? Why is the level of human capital in China so low? Are there regions of the rural economy that are more developed than others? Are certain subgroups of students at more of a disadvantage than others? If the Chinese government began to aggressively invest in raising rural academic performance, where in the country should they focus their efforts first?

To date, the level of academic performance in rural primary schools across China remains an open question. Until now, with limited data sources, there is little basis for answering the key questions raised in the previous paragraph. Although there are some studies that measure what the distributions of academic performance look like across key subgroups in China, almost all of the studies focus only on a single individual correlate. Yang *et al.* (2015) analyze only the Han minority achievement gap, without looking at factors such as region, gender or boarding status. Gong *et al.* (2014) only focus on the gender difference of academic performance, neglecting factors like regional development level or parental migration status. Wang, Shi, Yue, Luo and Medina (2016) use a relatively large sample but only compares the educational outcomes of boarding and non-boarding students.

Additionally, most of these existing studies do not use recent and representative data. For example, Brown and Park (2002) analyze the relationship between poverty and education with a sample size of only 427. Although this data were collected across six provinces, the sample is too small to be truly representative; furthermore, the data were collected in 1997. Both Zhou *et al.* (2014) and Zhao *et al.* (2014) explored the difference in academic performance between rural left-behind children (LBC) and children living with their parents (CLPs) counterparts by using relatively small samples in two provinces. Lai *et al.* (2014) compare the academic

performance between migrant students and rural students with a relatively small sample of only around 5,000. All of the studies only focus on one individual determinant of academic performance, and all of the data used in these studies is at least five years old, with the exception of the data used in Wang, Shi, Yue, Luo and Medina (2016).

Not only do all these studies not make comparisons among multiple groups at the same time, they are also insufficient to explain how performance varies across several key subgroups that are of interest to today's China, including children in different provinces; different regions (e.g. Northern China vs Southern China); rich counties vs poor counties; Han vs non-Han ethnic minorities; males vs females; students that live at home vs students that board at school; LBC vs children who live with their parents in rural areas; and children that attend private, often unregulated migrant schools (henceforth private migrant schools) vs children that attend rural public schools.

In other words, even if leaders were convinced that investment in rural schooling was necessary to improve the level of human capital in China, they would have little empirical basis on which to rely on in terms of how best to target these investments.

The overall goal of this paper is to describe the distribution of academic performance in rural China today. We will not only describe the overall level of learning outcomes amongst primary school students, but will also seek to measure and compare the levels of academic performance for different key subgroups. The ultimate objective is to build a repository of academic performance for primary school-aged rural children in China. The data will be used to understand the relative levels of learning outcomes across different subgroups. Ultimately, we hope that this can be used as a decision-making tool to help top leaders target their investments and create policies that will be aimed at improving the academic performance of the most vulnerable students in rural China. We also hope that this tool can be used to help determine which subgroups of students need particular special attention.

To meet the above objectives, the rest of the paper will be organized as follows. The next section of the paper describes the data and the sample selection. The following section presents results from two different subsets of schools. Within each subset of schools, we use a single standardized math test to measure student academic performance. This allows us to compare outcomes among students and schools within each sample set. The final section summarizes and draws conclusions.

## Methods

### Data

The data used for this study are aggregated from 11 different school-level surveys that the authors and collaborators conducted in rural areas of nine provinces and one municipality from 2013 to 2015. The total sample includes 25,892 children. Figure 1 shows the location of the nine provinces and one municipality covered by the data set: Qinghai, Gansu, Ningxia, Shaanxi, Sichuan, Guizhou, Jiangxi, Anhui and Jiangsu provinces and Shanghai municipality. For interested readers, more information on the individual data sets is available on the Stanford University's website (<http://reap.fsi.stanford.edu>).

The data for this study come from two different standardized mathematics tests[3]. Both of the standardized tests were carefully designed with the assistance of educators in the local education bureaus of each of our sample areas to ensure coherence with the national curriculum (Boswell *et al.*, 2015; Ma *et al.*, 2014). We call these two test instruments: Test instrument A and Test instrument B. We split our sample into two subsets of schools based on which of the two test instruments was used at each school.

Test instrument A was used for the first subset of schools (henceforth Sample A). The mathematics test was constructed by trained psychometricians. Math test items for the test were first selected from the standardized mathematics curricula for primary school students in China. The validity of the test content was checked by multiple experts. The psychometric properties of



**Figure 1.**  
Our study locations in  
China (nine provinces  
and one municipality)

the test were then validated using data from extensive pilot testing. Test instrument A consists of 30 questions. The students were required to finish the tests in 30 minutes. The exam was carefully proctored to avoid any possibility of cheating. We administered Test instrument A in eight surveys in seven provinces[4] to students in 460 schools (see Table I).

Test instrument B was used for the second subset of schools (henceforth Sample B). For questions in Test instrument B, the research team drew on items developed for the Trends in International Mathematics and Science Study. Test instrument B consists of 29 questions. The students were required to finish the test in 25 minutes. We administered Test instrument B in three surveys in four provinces and one municipality[5] to students in 158 schools (see Table I).

#### *Sample selection*

*The selection of Sample A.* The data from the eight survey efforts that were used to create Sample A were all based on random sampling strategies that were identical across studies.

Test instrument type	Subset of schools in Sample A Test instrument A	Subset of Schools in Sample B Test instrument B
Provinces	Qinghai (2015), Guizhou (2015), Jiangxi (2015), Shaanxi (2014, 2015), Gansu (2014, 2015), Sichuan (2015), Ningxia (2015)	Shaanxi (2013), Gansu (2013), Anhui (2014), Jiangsu (2014), Shanghai (2014)
No. of surveys	8	3
No. of sample schools	460	158
No. of sample students	18,888	7,004
Sample selection	Random sampling	Random sampling

**Table I.**  
Summary of Samples  
A and B

First, we obtained a list of all the counties in each of the seven provinces. Second, we randomly selected study counties from those that met our study criteria. Third, using official records, we created a list of all primary schools in the sample counties. Fourth, we used official records and telephone calls to school principals to identify all schools with a set of fixed characteristics (e.g. all schools of a certain size, all schools with boarding facilities, etc.). Fifth, we randomly selected schools and created our sampling frame. Finally, within each group of randomly selected schools we randomly selected students (or classes of students) for inclusion in the studies. The exact sampling strategies are described in the papers from which the source data come from; these papers have been published elsewhere and interested readers are encouraged to refer to those papers for more details (Liu *et al.*, 2016; Boswell *et al.*, 2015; Yi *et al.*, 2015; Loyalka *et al.*, 2016; Wang, Luo, Zhang and Rozelle, 2016; Ma *et al.*, 2014 and Stanford University’s website: <http://reap.fsi.stanford.edu/docs/publications>). Table II describes the provinces, years, grade levels and sample sizes of Sample A. In total, Sample A includes 18,888 children in fourth and fifth grades.

*The selection of Sample B.* The selection process of the schools and students in Sample B were similar to Sample A. In the case of Shaanxi (2013), Gansu (2013) and Anhui (2014), the protocols were identical.

In the cases of Jiangsu (2014) and Shanghai (2014), there were several minor differences. Specifically, the survey that collected the data for a part of Sample B was preceded by a canvas-like survey that identified a set of schools in two suburban areas around central Shanghai in Jiangsu province and in Shanghai municipality’s outlying districts and counties. Unlike urban public schools and rural public schools, there is no official list of private migrant schools in Jiangsu or Shanghai. To make the list, we contacted all educational and research institutes and non-profit organizations in the two study areas that might have contact information for schools that were operating in this way. By using this method, we believe that we were able to establish a representative data set of private migrant schools in Shanghai and Jiangsu. A total of 87 schools were on our list. All private migrant schools in our sampling frame were part of our overall sample.

At each private migrant school, we randomly chose one fifth grade class. All of the students in our chosen class were included in our sample. In total, there were 3,755 migrant students in 87 fifth grade classes in 87 private migrant schools. All students were the children of migrants; there were no children of local urban residents.

Survey No.	Year	Province	Grade	Sample size
1	2015	Sichuan	4	1,452
			5	1,293
2	2015	Guizhou	4	324
			5	332
3	2015	Jiangxi	4	2,698
			5	2,843
4	2014	Gansu, and Shaanxi	4	1,455
			5	1,476
5	2015	Gansu, Ningxia, Qinghai, and Shaanxi	4	1,757
			5	1,902
6	2015	Shaanxi	4	221
			5	373
7	2015	Shaanxi	4	392
			5	365
8	2015	Gansu, and Shaanxi	5	2,005

**Table II.**  
Description of surveys and data sets of Sample A

More than 40 percent of students in our migrant student sample (1,551 of them) originated from Anhui province, and around a quarter of these students (914 of them) originated from three core prefectures in Anhui province: Fuyang, Lu'an and Haozhou. As part of the original study in Shanghai and Jiangsu (see Wang, Luo, Zhang and Rozelle, 2016), we also surveyed students studying in rural public schools in the three core prefectures of Anhui province in order to increase the comparability between migrant and rural students. A summary of the data sets of Sample B from Shaanxi (2013), Gansu (2013), Anhui (2014), Jiangsu (2014) and Shanghai (2014) is detailed in Table III. In total, Sample B includes 7,004 students in the fifth grade.

#### *Data collection and outcome measures*

Our data set can be considered as a pooled data set with different waves of observations of students from elementary rural schools. All of the surveys included in this study followed the uniform data collection protocol. Specifically, the enumerators in all of the survey efforts were undergraduate and graduate students from local universities who were recruited from academic departments relevant to the survey material. All enumerators underwent a comprehensive, multi-day training that lasted two to seven days, depending on the complexity of the survey.

In all survey provinces, we collected data on the basic demographic information of students, including ethnicity, gender, whether or not students were boarding, whether students were living with their parents in rural areas or left behind by migrant parents (when their parents migrate to the cities for work) and whether students were studying in private migrant schools in large cities or rural public schools. We also collected the per capita rural income of each county in 2014 from each province's *Statistical Yearbook*.

In this paper, we use standardized math test scores as the main outcome measure of academic performance. It should be noted that our comparisons are made among students/schools within Samples A and B: we compare test scores between students who were administered the same test. In our analysis, we normalized mathematics scores separately for Samples A and B, creating a normal distribution for each group. Estimated results are, therefore, expressed in standard deviations.

## Results

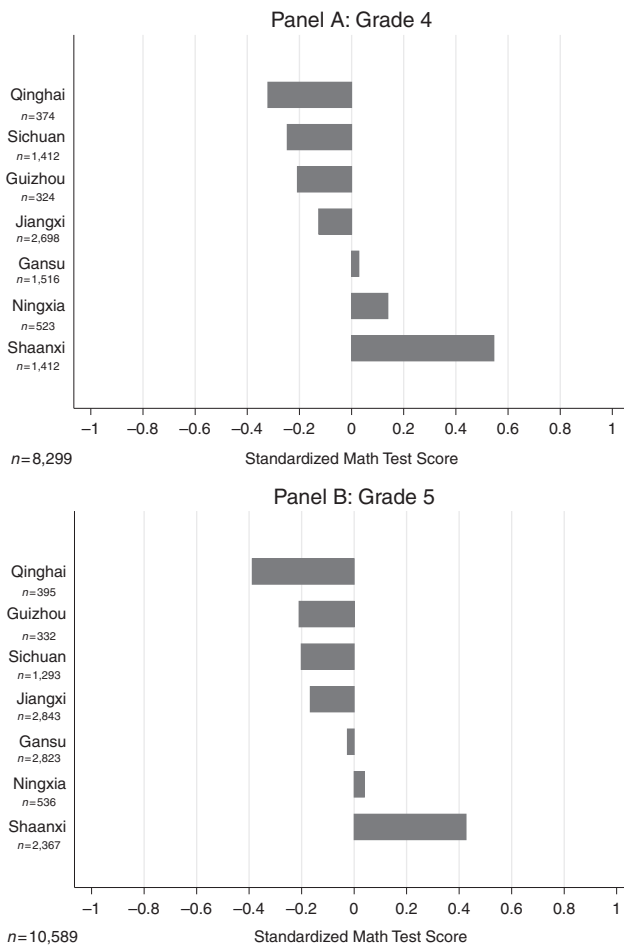
### *Learning outcomes across provinces*

Our findings provide insight into the levels of academic performance of rural elementary students across the country. The distribution of academic performance is unbalanced across the seven provinces within Sample A. Among fourth grade students, the average standardized math test scores are lowest in Qinghai province and highest in Shaanxi province. The gap in standardized scores between students in Qinghai and Shaanxi provinces is around 0.8 standard deviations[6] (Figure 2, Panel A). The distribution of standardized math test scores of fifth grade students across provinces is similar to that of fourth grade students (Figure 2, Panel B).

We further divide our sample provinces into two groups based on geographic regions in order to analyze the differences in academic performance between Northern and Southern

Survey No.	Year	Province	Grade	Migrant or rural students?	Sample size	No. of students originating from the three core prefectures of Anhui
1	2013	Gansu	5	Rural	876	0
	2013	Shannxi	5	Rural	857	0
2	2014	Anhui	5	Rural	1,516	1,516
	2014	Jiangsu	5	Migrant	1,072	188
3	2014	Shanghai	5	Migrant	2,683	726

**Table III.**  
Description of surveys  
and data sets of  
Sample B



Primary school  
students from  
rural China

**Note:** For fourth and fifth grades, the differences of standardized math test scores between students in Qinghai and Shaanxi are 0.87 ( $p=0.00$ ) and 0.81 ( $p=0.00$ ), respectively

**Source:** Authors' data from Sample A

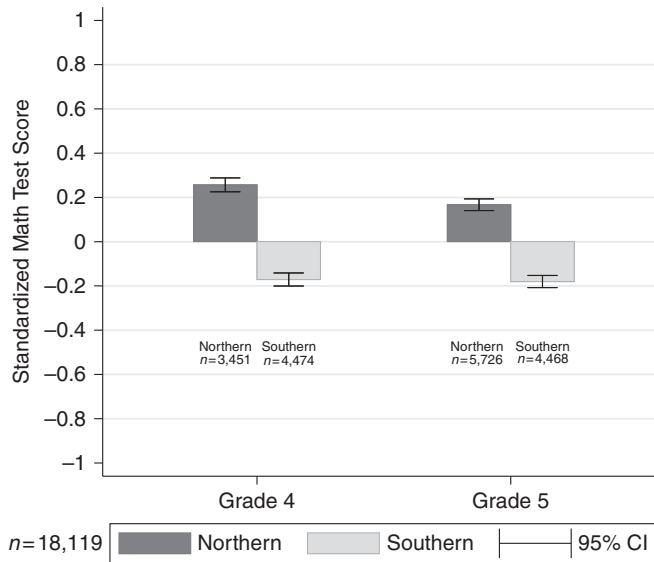
**Figure 2.**  
The distribution of  
standardized math  
test scores across  
provinces

China. Gansu, Ningxia and Shaanxi provinces belong to the Northern region; Sichuan, Guizhou and Jiangxi provinces belong to the Southern region[7]. In comparing the average standardized math test scores between Northern and Southern China, we find that students in Northern China perform significantly better than those in Southern China (Figure 3)[8]. The overall gap in standardized math test scores between the two regions is around 0.4 standard deviations[9]. For both fourth and fifth grade students, the gaps of standardized scores between Northern and Southern China are significant at the 1 percent level (Figure 3).

#### *Learning outcomes in rich and poor counties*

Using data from the respective *Statistical Yearbooks* of each sample province[10], we ranked 67 counties from lowest to highest per capita rural net income and divided them into two





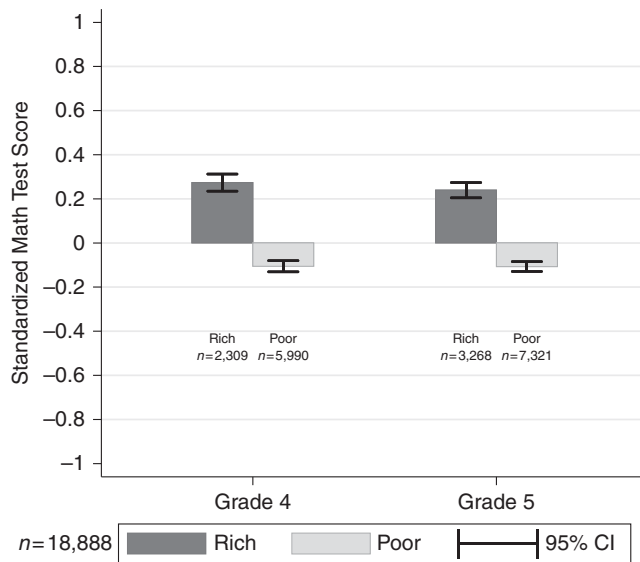
**Figure 3.** The differences in standardized math test scores between students in Northern and Southern regions with 95% confidence interval (CI)

**Notes:** In this analysis, Southern region refers to three provinces: Guizhou, Jiangxi, and Sichuan; Northern region also only refers to three provinces: Gansu, Ningxia and Shaanxi. We do not include Qinghai province in this analysis as it belongs to one of the westernmost provinces; generally people do not include it into either the Southern region or the Northern region of China. For fourth and fifth grades, the differences of standardized math test scores between students in Northern and Southern China are 0.43 ( $p=0.00$ ) and 0.35 ( $p=0.00$ ), respectively

**Source:** Authors' data from Sample A

equally sized groups: a (relatively) rich group (34 counties) and a (relatively) poor group (33 counties). For fourth grade students in the rich group, the average standardized math test scores are about 0.3 standard deviations above the mean, whereas fourth grade students in the poor group score on average around 0.1 standard deviations below the mean (Figure 4). For fourth grade students, the overall gap between students in rich counties and students in poor counties is 0.4 standard deviations; this gap is statistically significant from 0 at the 1 percent level of significance (Figure 4). The difference in academic performance between the rich and the poor groups suggests that there is a correlation between socioeconomic conditions and academic performance. The gap for fifth grade students between the rich and the poor is slightly smaller, but it is still more than 0.3 standard deviations. This gap is also significantly different from 0 at the 1 percent level of significance.

Figure 5 plots the associations between county per capita rural net income and the average county-level standardized math test scores. From Figure 5, we can see that average county-level standardized math test scores rises steadily as county per capita rural net income increases. In Table IV, we report the results of regression analysis in which we seek to measure the correlation between income and learning outcomes. According to our analysis (and similar to the findings in Figure 5), the first row of Table IV shows a positive correlation between income and learning outcomes. This is true at the county level (Columns 1 and 2), at the individual level without controlling for other individual characteristics



**Note:** For fourth and fifth grades, the differences of standardized math test scores between students in rich and poor counties are 0.38 ( $p=0.00$ ) and 0.35 ( $p=0.00$ ), respectively

**Source:** Authors' data from Sample A and *Statistical Yearbook of Shaanxi, Gansu, Ningxia, Qinghai, Jiangxi, Sichuan and Guizhou Province* (2013)

Primary school  
students from  
rural China

**Figure 4.**  
The differences in  
standardized math  
test scores between  
students in rich and  
poor counties with  
95% confidence  
interval (CI)

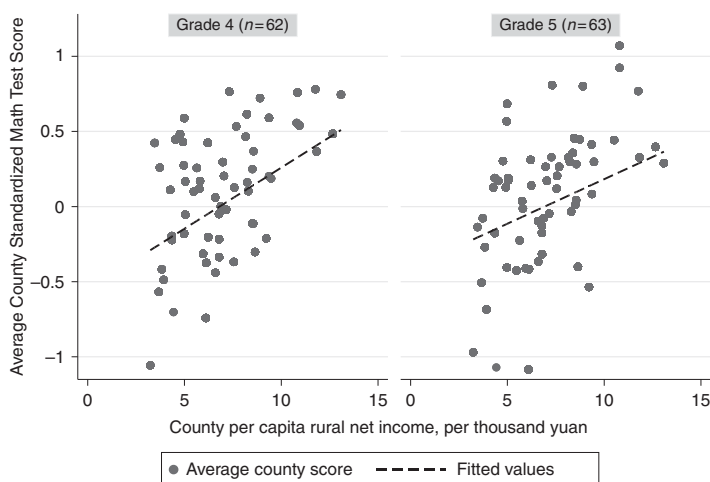
(Columns 3 and 4) and at the individual level while controlling for other individual characteristics (Columns 5 and 6). A complete listing of average county-level standardized math test scores and county per capita rural net income are shown in Table A1.

#### *Learning outcomes of Han and non-Han ethnic minority students*

Our data suggest that the gap in educational achievement between Han and non-Han ethnic minority students in both fourth and fifth grades is wide. For fourth and fifth grades, the differences of standardized math test scores between Han and non-Han ethnic minority students are 0.51 and 0.46, respectively (Figure 6)[11]. The difference of scores between non-Han ethnic minority and Han students for both fourth and fifth graders is significant at the 1 percent level. Detailed differences of standardized scores between Han and non-Han ethnic minority students in each sample province are shown in Figure A1.

#### *Learning outcomes of male and female students*

When aggregating across our entire sample, the results show that the standardized math test scores of male students are higher than those of female students – although the size of the gap is relatively small (Figure 7). In the case of fourth grade students, the difference of standardized math test scores between male and female students is 0.12 standard deviations; for fifth grade students, the difference is 0.09 standard deviations. Although both of the differences observed are small in magnitude, in the case of both fourth and fifth grade students, the gap is statistically significant at the 1 percent level. The detailed differences of standardized scores between male and female students in each sample province are shown in Figure A2.



**Figure 5.**

The correlation between county per capita rural net income and the average county standardized math test scores in fourth and fifth grades in China

**Note:**  $n$  refers to the number of counties

**Source:** Authors' data from Sample A and Statistical Yearbook of Shaanxi (*Statistical Bureau of Shaanxi Province, 2015*), Gansu (*Statistical Bureau of Gansu Province, 2015*), Ningxia (*Statistical Bureau of Ningxia Province 2015*), Qinghai (*Statistical Bureau of Qinghai Province, 2015*), Jiangxi (*Statistical Bureau of Jiangxi Province, 2015*), Sichuan (*Statistical Bureau of Sichuan Province, 2015*) and Guizhou Province (*Statistical Bureau of Guizhou Province, 2015*), 2015

#### *Learning outcomes of boarding and non-boarding students*

There are no significant differences in learning outcomes between students that live in school (boarding students) and students that live at home (non-boarding students) (Figure 8). Among fourth grade students, the point estimate of the academic performance of non-boarding students is only slightly higher than that of boarding students. The gap is only 0.04 and the  $p$ -value is large (0.08). Among fifth grade students, boarding students do only slightly better than non-boarding students. Again, the absolute value of the gap is only 0.04 and the  $p$ -value is also large (0.07). The differences of standardized scores between boarding and non-boarding students in each sample province are additionally shown in Figure A3.

#### *Learning outcomes of left behind children (LBCs) and children living with their parents (CLPs)*

We use data from Sample A to analyze the differences in academic performance between LBCs and CLPs (Table V). According to our data, 24 percent of children are LBCs, or living in households in which both parents are working and living outside of the households[12]. Children in these households live with either their paternal grandparents or other relatives. Nearly half of the children in our sample (49 percent) are CLPs, or children who live with both of their parents.

When comparing the academic performance between LBCs and CLPs, our data show that the standardized math test scores of LBCs are modestly lower than those for CLPs (Figure 9). In the case of fourth grade students, the standardized math test scores of LBCs are 0.08 standard deviations lower than those of CLPs. Although this gap is narrow, the difference is significant at the 1 percent level (Figure 9). For fifth grade students, the gap in standardized math test scores between CLPs and LBCs is slightly wider – 0.15 standard

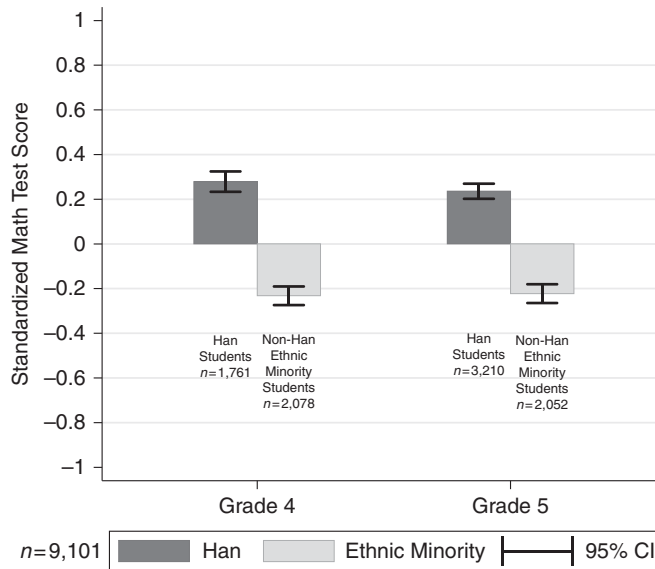
Standardized math test score	County average score	County average score	Student score	Student score	Student score	Student score
	Grade 4 (1)	Grade 5 (2)	Grade 4 (3)	Grade 5 (4)	Grade 4 (5)	Grade 5 (6)
County per capita rural net income (per thousand yuan)	0.114*** (0.024)	0.124*** (0.024)	0.074*** (0.018)	0.029** (0.013)	0.314*** (0.049)	0.076*** (0.019)
Age of students (month)					-0.004*** (0.001)	-0.015*** (0.001)
Gender (1 = male; 0 = female)					0.078** (0.031)	0.068*** (0.026)
Boarding (1 = yes; 0 = no)					-0.147*** (0.040)	-0.070** (0.032)
Ethnic minority (1 = yes; 0 = no)					-0.400*** (0.061)	-0.383*** (0.050)
Project fixed effects			Yes	Yes	Yes	Yes
Prefecture fixed effects			Yes	Yes	Yes	Yes
Observations	62	63	8,299	10,589	3,387	4,898
Adjusted $R^2$	0.22	0.26	0.09	0.08	0.17	0.17

Notes: Standard errors are reported in parentheses. \*\*\* \*\* \* Indicate significance at the 5 and 1 percent levels, respectively

Source: Authors' data from Sample A and *Statistical Yearbook of Shaanxi, Gansu, Ningxia, Qinghai, Jiangxi, Sichuan and Guizhou Province (2013)*

Primary school  
students from  
rural China

**Table IV.**  
Correlation between  
student standardized  
math test scores and  
selected student  
characteristics



**Figure 6.** The differences in standardized math test scores between Han and non-Han ethnic minority students with 95% confidence interval (CI)

**Notes:** There are in total 9,787 missing values on ethnicity in our sample. The surveys conducted in Guizhou (2015) and Jiangxi (2015), the survey conducted in Gansu and Shaanxi (2014) and the survey conducted in Gansu and Shaanxi (2015) did not collect information on ethnicity. For fourth and fifth grades, the differences of standardized math test scores between Han and non-Han ethnic minority students are 0.51 ( $p=0.00$ ) and 0.46 ( $p=0.00$ ), respectively

**Source:** Authors' data from Sample A

deviations, with LBCs also performing at lower levels than CLPs. The difference for fifth graders also is significant at the 1 percent level. Figure A4 shows the detailed differences of standardized math test scores between LBCs and CLPs in each sample province.

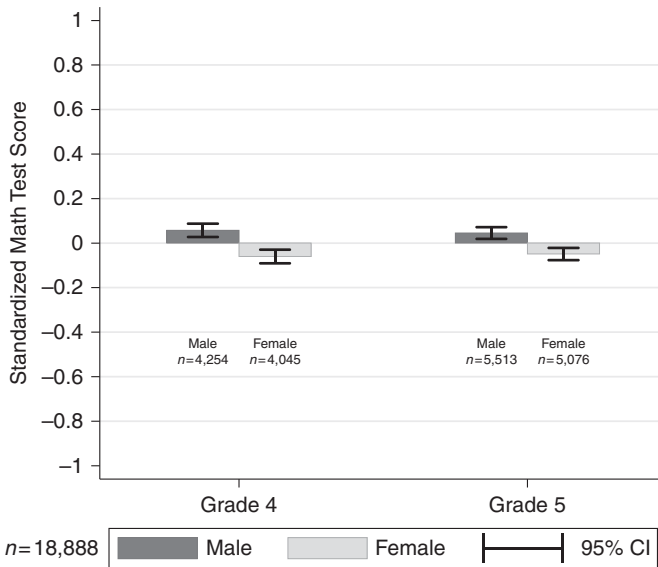
#### *Learning outcomes of migrant and rural students*

We use data from students in Sample B to compare standardized math test scores between migrant and rural students in fifth grade[13] ( $n = 7,004$ ). We find that the standardized math test scores of students in private migrant schools in large cities are significantly lower than the scores of students in public schools in rural areas (Figure 10). In fact, the gap is the widest observed when compared to any of the other comparisons we make (see results up to this point). Specifically, the gap in standardized math test scores between students from private migrant schools and students from public rural schools is more than 1 standard deviation and is statistically significant at the 1 percent level (Figure 10, and Rows 1–2, Columns 1–2 of Table VI).

In order to produce an even more precise comparison, we compare the standardized math test scores between migrant students originating from the three core prefectures of Anhui province with rural students from the same three prefectures. The results are similar with our previous comparison between all migrants and all rural students.

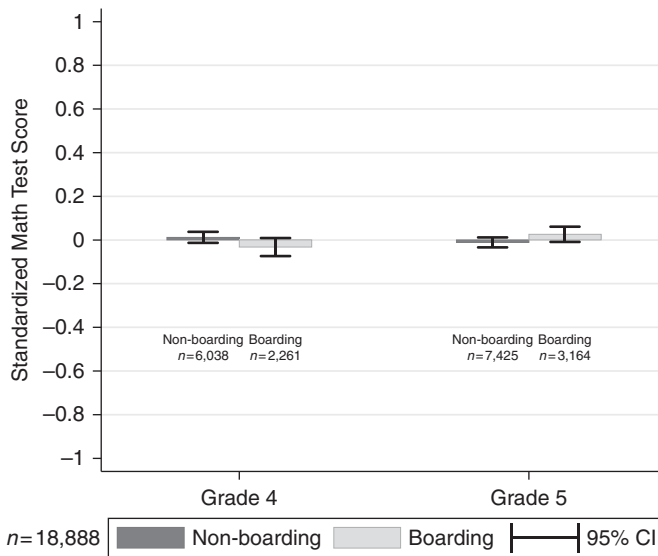
Students originating from the three core prefectures and studying in migrant schools have significantly lower scores than students studying in rural schools of the three core prefectures (Rows 1-2, Columns 3–4 of Table VI). In other words, students originating from

Primary school students from rural China



**Note:** For fourth and fifth grades, the differences of standardized math test scores between male and female students are 0.12 ( $p=0.00$ ) and 0.09 ( $p=0.00$ ), respectively  
**Source:** Authors' data from Sample A

**Figure 7.** The differences of standardized math test scores between male and female students with 95% confidence interval (CI)



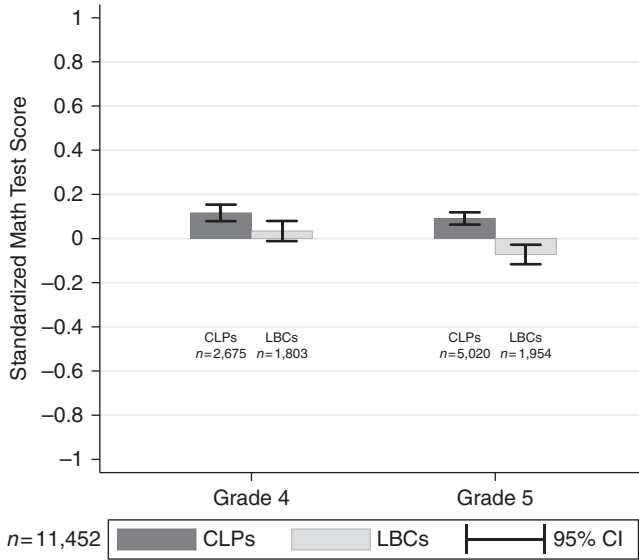
**Note:** For fourth and fifth grades, the differences of standardized math test scores between non-boarding and boarding students are 0.04 ( $p=0.08$ ) and  $-0.04$  ( $p=0.07$ ), respectively  
**Source:** Authors' data from Sample A

**Figure 8.** The differences of standardized math test scores between boarding and non-boarding students with 95% confidence interval (CI)

	Observations	Percentage
Total sample	15,600	100
Children living with both parents (CLPs)	7,695	49
<i>Patterns of migration</i>		
Only father migrates	3,250	21
Only mother migrates	898	6
Both parents migrate (LBCs)	3,757	24

**Table V.**  
Family type by migration status

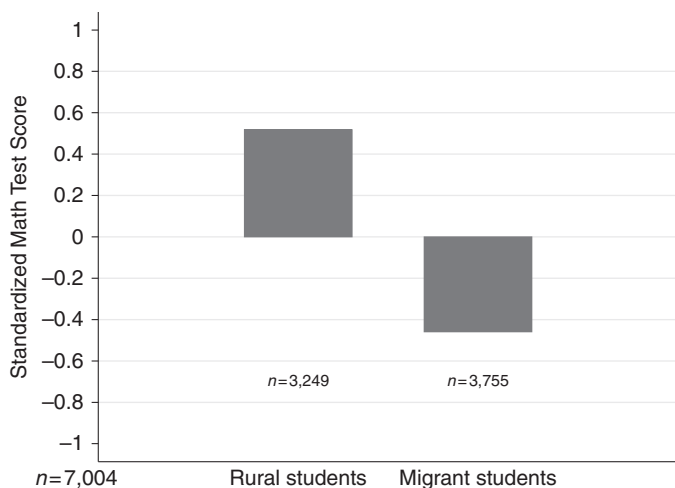
**Notes:** There are in total 3,288 missing values on migration status in our sample. There are 543 missing values in the surveys conducted in Jiangxi (2015) and Guizhou (2015); the survey conducted in Sichuan (2015) did not collect information on migration status  
**Source:** Authors' data from Sample A



**Figure 9.**  
The differences in students' standardized math test scores between CLPs and LBCs

**Notes:** There are in total 3,288 missing values on migration status in our sample. There are 543 missing values in the surveys conducted in Jiangxi (2015) and Guizhou (2015); the survey conducted in Sichuan (2015) did not collect information on migration status. For fourth and fifth grades, the differences of standardized math test scores between CLPs and LBCs are 0.08 ( $p=0.00$ ) and 0.16 ( $p=0.00$ ), respectively  
**Source:** Authors' data from Sample A

these core prefectures who leave with their parents that migrate for work to large cities have worse educational outcomes than students from these core prefectures than who did not leave. The gap between migrant and rural students is 1.11 standard deviations. Most significantly, this gap is even wider than the gap observed between students in Northern and Southern China: between rural students in the worst performing province (Qinghai) and the best performing province (Shaanxi – see Figure 2). This clearly indicates that one of the most vulnerable groups of students in China are students attending private migrant schools in China's large cities.



**Note:** The difference of standardized math test scores between rural students and migrant students is 0.98 ( $p=0.00$ )

**Source:** Authors' data from Sample B

Primary school students from rural China

**Figure 10.** The differences in students' standardized math test scores between migrant and rural students

	All migrant students and all rural students		Migrant students originating from the three core prefectures of Anhui Province and rural students in the same prefectures	
Standardized math test score	(1)	(2)	(3)	(4)
School type (1 = private migrant schools; 0 = rural public schools)	-0.977*** (0.021)	-1.127*** (0.033)	-1.105*** (0.039)	-1.266*** (0.050)
Age of students (month)		-0.002*** (0.000)		-0.236*** (0.020)
Gender (1 = male; 0 = female)		0.029 (0.021)		0.080** (0.037)
Boarding (1 = yes; 0 = no)		0.148*** (0.046)		0.124 (0.223)
Mother migrated (1 = yes; 0 = no)		-0.052* (0.031)		0.039 (0.051)
Father migrated (1 = yes; 0 = no)		-0.018 (0.030)		-0.058 (0.037)
Observations	7,004	6,957	2,430	2,428
Adjusted $R^2$	0.23	0.24	0.25	0.29

**Notes:** Standard errors are reported in parentheses. \*, \*\*, \*\*\* indicate significance at the 10, 5 and 1 percent levels, respectively

**Source:** Authors' data from Sample B

**Table VI.** Correlation between students standardized math test scores and school type

## Discussion and conclusion

Our study seeks to provide insight into the distribution of academic performance in rural China today and build a repository of academic performance for primary school-age rural children. Specifically, we describe the overall level of academic performance across the country and among subgroups of students in elementary school (fourth and fifth grade classes).

We find that the distribution of academic performance is uneven across provinces, regions and subgroups. Academically, rural elementary students in Shaanxi province perform the best while students in Qinghai province perform the worst. We also find that



fourth and fifth graders in the Northern region perform significantly better than students in the Southern region.

Our results also compare the academic performance of students that are in different subgroups of students. The goal of this analysis is to provide insights into the levels of academic performance within and between potentially vulnerable groups. In general, male students, Han, living in richer counties, living with their parents and studying in rural public schools perform better academically (in math) than female students, non-Han, living in poorer counties, left behind by their parents (when their parents migrate to cities for work) and studying in private migrant schools in large cities. Notably, differences in standardized test scores between boarding and non-boarding students are small. Perhaps most significantly, our results show that students attending private migrant schools in large cities in China are among the most vulnerable students in our sample.

Because of the study's much broader scope (and larger sample size), our results can be used to assess the validity of a number of previous studies. For instance, our results which compare learning outcomes in richer and poorer counties are consistent with the findings of Shi *et al.* (2015) who report that socioeconomic conditions are related with student academic achievement, documenting the poor performance in education of students in their study areas in poor rural China. In this way, our research fills an important gap in mapping the relative levels of learning outcomes in rural areas. Poor outcomes in learning are related to poverty.

In comparing Han and non-Han ethnic minority students, our results can also validate those reported in studies by Yang *et al.* (2015) and Lu *et al.* (2016). In a smaller sample (300 schools), Yang *et al.* (2015) found that non-Han ethnic minority students performed worse than Han students in Math and Chinese. While only examining 14,761 students, Lu *et al.* (2016) also found that non-Han ethnic minority students are significantly more likely to drop out of primary schools than Han students. Our study demonstrates that the results of these smaller studies can also be generalized over a larger part of rural China.

In terms of the learning outcomes of LBCs (vs CLPs), there have been numerous studies that have reported on the academic performance of this group (Bai, Zhang, Liu, Shi, Mo and Rozelle, 2016; Bai, Neubauer, Ru, Shi, Kenny and Rozelle, 2016; Hu and Li, 2009; Ye *et al.*, 2006; Chen, 2009). However, as we discussed above, some studies found that LBCs performed worse academically than CLPs; others reported that there were no significant differences between LBCs and CLPs. In this study, using more observations than almost all previous studies combined, we find that indeed (in general) the academic performance of LBCs is worse than CLPs. Hence, the present study provides a more rigorous and comprehensive analysis of LBCs in fourth and fifth grades across the country and can be considered a more definitive set of findings.

This study has a number of strengths. First, our aggregated Samples A and B comprise a total of 11 school-level surveys spanning nine provinces and one municipality in China. The data set ( $n = 25,892$ ) used in this study, comprised of both Samples A and B, is much larger than that used in any previous study. This gives our research a high degree of statistical power and considerable external validity. Second, all of the observations within each subset of data were collected using a common sampling strategy by a single research team. The data collection instrument within Samples A and B was standardized, as was the enumeration process. This allows us to compare outcomes among students and schools within each sample set, as we compare test scores between students who were administered the exact same exact test.

Our study also has several limitations. First, our survey only collected information on fourth and fifth grade students, limiting us to conclusions for this age group. Second, while large in size, and covering a large part of rural China, this is not a nationally representative sample. To the extent that national survey efforts, such as those conducted by Peking University's China Family and Population Survey, can collect higher quality measures of academic performance, the results presented in this paper can be improved upon. Third, we do not compare children's

non-cognitive abilities (such as student anxiety, self-esteem and self-efficacy) between subgroups, as this information was not collected in many of these survey efforts.

From a policy perspective, our results point to wide gaps that exist among different parts of China's primary school system. The current distribution of academic performance is uneven across different groups of children. If the Chinese Government wants to raise levels of human capital particularly in rural areas, it will need to more comprehensively raise outcomes for all children. Awareness of uneven learning outcomes across vulnerable groups of children is the first step.

One of our study's strongest finding is the gap that we measured in academic performance between children in private migrant schools and children in rural public schools. Both our results and the existing literature show that there exists a huge and widening gap in the achievement levels of children who receive primary school education in private, urban migrant schools and students who attend rural public schools. We cannot conclude that the difference of academic performance between two groups of children is completely attributable to the differences between schools. This outcome may, for instance, be related to the individual and family background characteristics of students. It also is likely related to the poor quality of migrant schools. Nevertheless, the difference in academic performance between two groups is notably large, and it is therefore worth focusing on students who study in private migrant schools. Additionally, as millions of laborers continue to migrate to cities to work, their children will join the ranks of these vulnerable students, and may face conditions similar to those of the children in our sample.

Another potential policy direction would be to focus on the education of China's ethnic minority students. There are large and widespread differences between Han and non-Han ethnic minority students. Although, as the results of our decomposition indicate, this is partly linked to poverty, there may be approaches to narrow the gap between minority and non-minority students that a poverty alleviation focus might overlook, such as teaching in the mother tongue of the students (at least in primary school) and the provision of higher quality teachers. More studies are needed to explore the factors that influence the academic performance gap between Han and non-Han minority students, as well as effective ways to narrow this gap.

While the above serve as two direct examples of action, our results should not be construed to mean that students who perform better academically in our analyzed subgroups are absolutely more advantaged across China. In fact, if we were to compare students in the advantaged rural subgroups with their counterparts in urban school districts (i.e. urban students attending urban public schools), it is possible that all children in rural China would be found to be vulnerable and require extra resources. Having data for urban schools and the academic performance of urban students is also critical. Given that the future of China's economic growth and development will have to rely primarily on increases in human capital, we believe that our research provides an important empirical basis for future decision-making in targeted, rural education investments.

## Notes

1. We use the term "senior high school" to refer to all upper secondary education programs including both academic and vocational high schools.
2. Our calculations are based on entrance ages to senior high schools and colleges as defined in Wu and Zhang (2010).
3. There are two reasons that we use mathematics scores to measure student academic performance in this study. First, student performance in mathematics is considered a foundational ability necessary for a student to continue in school (because mathematics learning is so cumulative, Cattell, 1987). Second, mathematics performance, as compared to language performance, is particularly easy and objective to measure.

4. Shaanxi (2014, 2015), Gansu (2014, 2015), Ningxia (2015), Sichuan (2015), Qinghai (2015), Guizhou (2015) and Jiangxi (2015).
5. Shaanxi (2013), Gansu (2013), Anhui (2014), Jiangsu (2014) and Shanghai (2014).
6. In the field of education, a difference in test scores of 0.2 standard deviations is typically considered relatively large (equivalent to additional learning that might occur over a period of six months to a full school year (Kremer, 2003; Levitt *et al.*, 2016).
7. We exclude Qinghai province in our regional analysis, as it is one of China's westernmost provinces. Generally, Qinghai is not included in either the Northern or Southern region of China.
8. Figure 2 also shows that students in each of the three southern provinces perform worse than those in Northern provinces.
9. In total, 20 percent of the difference in math scores between northern and southern fourth students can be explained by the differences in individual characteristics (county per capita rural net income, student age, gender, boarding status). Among those characteristics, county per capita rural net income is the most important factor in explaining the difference in scores between northern and southern students (The total difference is 0.43 SD. Per capita income can explain 0.08 SD of that difference).
10. We obtain the county per capita rural net income in 2012 from the 2013 *Statistical Yearbook* of each sample province: Shaanxi, Gansu, Ningxia, Qinghai, Jiangxi, Sichuan and Guizhou provinces.
11. Less than 20 percent of the difference in math scores between Han and non-Han ethnic minority fourth students can be explained by the differences in individual characteristics (county per capita rural net income, student age, gender, boarding status). Among those characteristics, county per capita rural net income is also the most important factor in explaining the difference in scores between Han and non-Han ethnic minority students. (The total difference is 0.51 SD. Per capita income can explain 0.07 SD of that difference).
12. The parents of LBCs have worked and lived outside their households for the majority of the most recent school semester. However, our data do not allow us to specify how far away the parents live.
13. Here, "migrant students" refer to students that attend private migrant schools in large cities; "rural students" refer to those that attend rural public schools.

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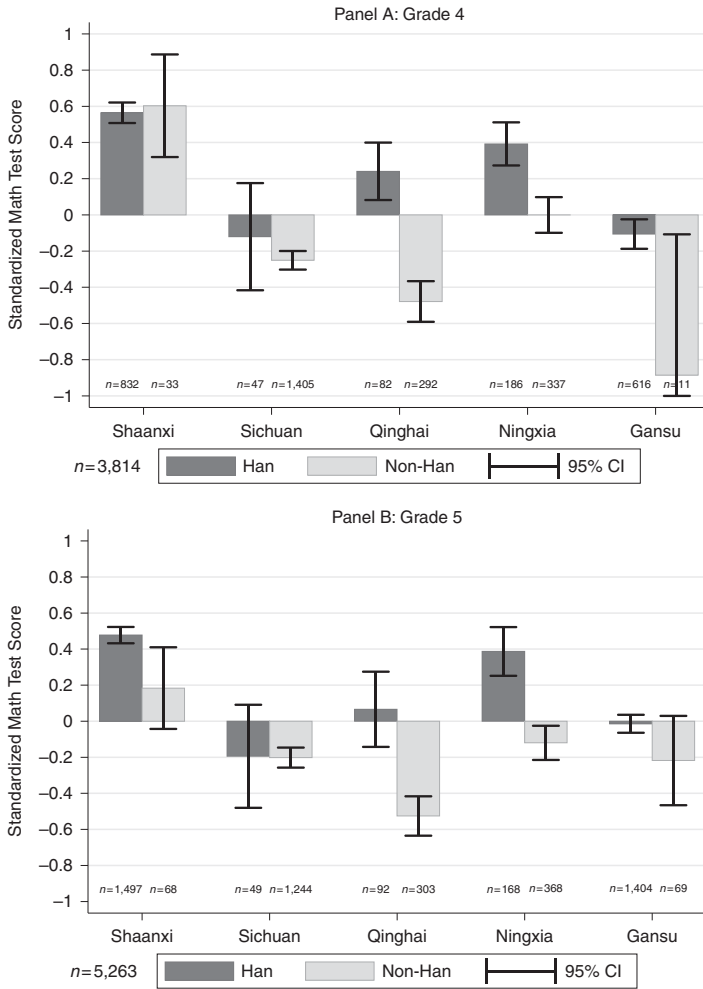
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### Further reading

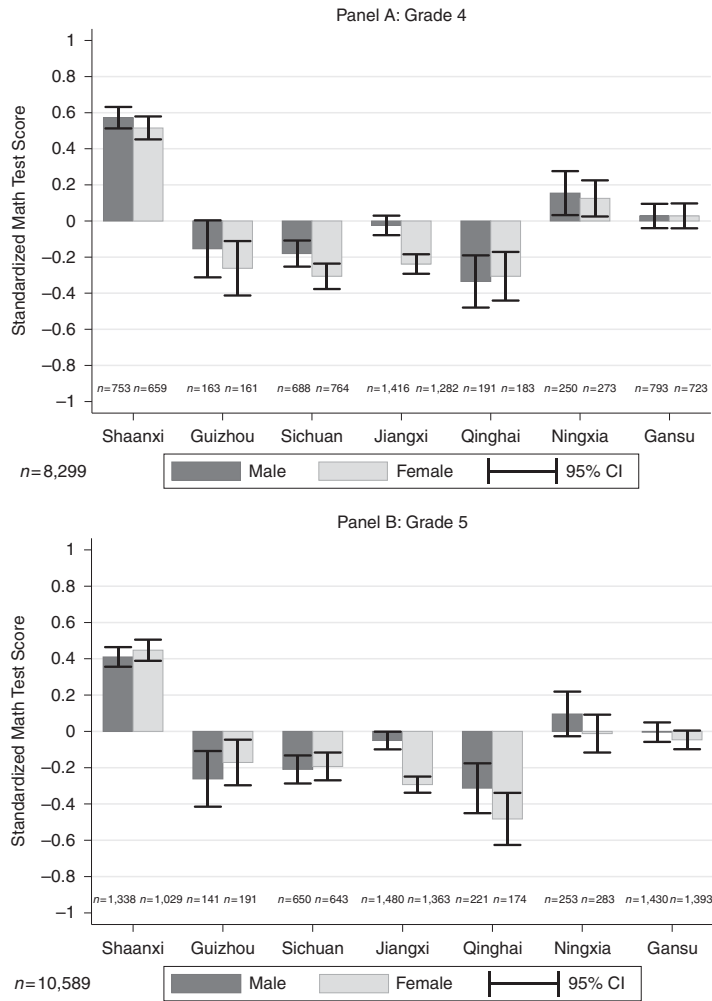
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**Figure A1.** The differences in standardized math test scores between Han and non-Han students in each selected province with 95% confidence interval (CI)

**Notes:** There are in total 9,787 missing values on ethnicity in our sample. The surveys conducted in Guizhou (2015) and Jiangxi (2015), the survey conducted in Gansu and Shaanxi (2014), and the survey conducted in Gansu and Shaanxi (2015) did not collect information on ethnicity

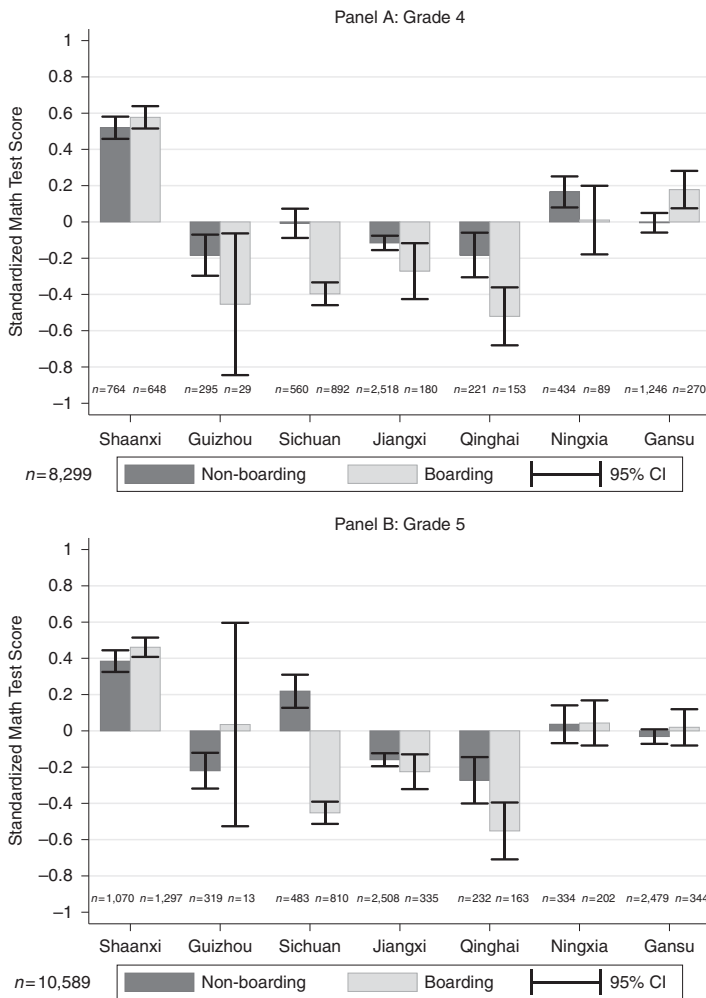
**Source:** Authors' data from Sample A



**Figure A2.** The differences in standardized math test scores between male and female students in each selected province with 95% confidence interval (CI)

Source: Authors' data from Sample A

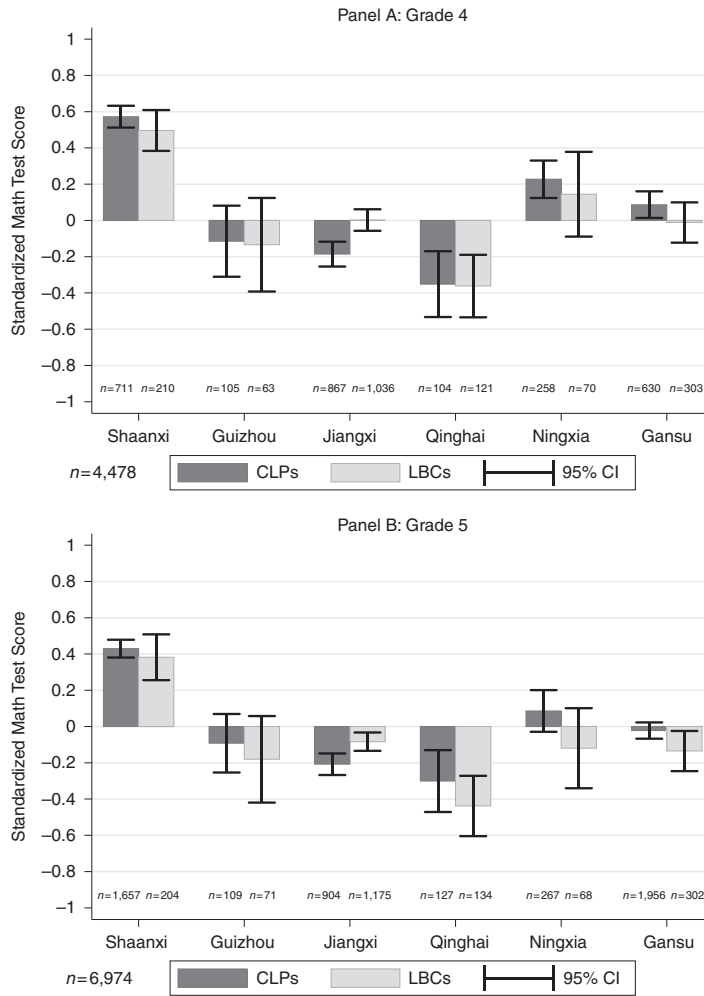
Primary school students from rural China



Source: Authors' data from Sample A

**Figure A3.**  
The differences in students' standardized math test scores based on students' boarding status in each selected province with 95% confidence interval (CI)





**Figure A4.** The differences in standardized math test scores between CLPs and LBCs in each selected province with 95% confidence interval (CI)

**Notes:** There are in total 3,288 missing values on migration status in our sample. There are 543 missing values in the surveys conducted in Jiangxi (2015) and Guizhou (2015); the survey conducted in Sichuan (2015) did not collect information on migration status

**Source:** Authors' data from Sample A

Grade	Province	Prefecture	County	Average county standardized math test score	County per capita rural net income (per thousand yuan)	Primary school students from rural China
Grade 4	Gansu	Dingxi	Zhang	-0.70	3.47	
Grade 4	Gansu	Dingxi	Min	-0.22	3.38	
Grade 4	Gansu	Dingxi	Tongwei	-0.20	3.37	
Grade 4	Gansu	Dingxi	Linzhao	0.43	3.84	
Grade 4	Gansu	Dingxi	Weiyuan	0.45	3.52	
Grade 4	Gansu	Dingxi	Longxi	0.59	3.92	
Grade 4	Gansu	Longnan	Tanchang	-1.06	2.50	
Grade 4	Gansu	Longnan	Xihe	-0.57	2.86	
Grade 4	Gansu	Longnan	Li	-0.49	3.00	
Grade 4	Gansu	Longnan	Wudu	-0.42	2.96	
Grade 4	Gansu	Longnan	Hui	0.26	4.39	
Grade 4	Gansu	Longnan	Kang	0.26	2.89	
Grade 4	Gansu	Longnan	Wen	0.42	2.68	
Grade 4	Gansu	Tianshui	Wushan	-0.18	3.83	
Grade 4	Gansu	Tianshui	Qinan	-0.05	3.91	
Grade 4	Gansu	Tianshui	Qinzhou	0.10	4.25	
Grade 4	Gansu	Tianshui	Zhangjiachuan	0.11	3.34	
Grade 4	Gansu	Tianshui	Gangu	0.17	3.93	
Grade 4	Gansu	Tianshui	Maiji	0.27	3.83	
Grade 4	Gansu	Tianshui	Qingshui	0.48	3.71	
Grade 4	Guizhou	Zunyi	Suiyang	-0.30	6.77	
Grade 4	Guizhou	Zunyi	Zhengan	-0.22	4.33	
Grade 4	Guizhou	Zunyi	Daozhen	-0.05	4.14	
Grade 4	Jiangxi	Ganzhou	Huichang	-0.34	4.28	
Grade 4	Jiangxi	Ganzhou	Ruijin	-0.02	5.18	
Grade 4	Jiangxi	Ganzhou	Yudu	0.00	4.43	
Grade 4	Ningxia	Guyuan	Jingyuan	0.17	4.31	
Grade 4	Ningxia	Guyuan	Longde	0.43	4.67	
Grade 4	Ningxia	Wuzhong	Tongxin	-0.37	4.53	
Grade 4	Ningxia	Wuzhong	Yanchi	0.30	4.79	
Grade 4	Ningxia	Zhongwei	Haiyuan	0.12	4.23	
Grade 4	Qinghai	Haidong	Xunhua	-0.74	4.66	
Grade 4	Qinghai	Haidong	Hualong	-0.44	5.09	
Grade 4	Qinghai	Haidong	Huzhu	-0.37	5.85	
Grade 4	Qinghai	Haidong	Minhe	0.06	5.03	
Grade 4	Shaanxi	Ankang	Hanbin	0.13	5.92	
Grade 4	Shaanxi	Ankang	Shiquan	0.53	5.95	
Grade 4	Shaanxi	Ankang	Ningshan	0.76	5.63	
Grade 4	Shaanxi	Baoji	Linyou	0.25	6.70	
Grade 4	Shaanxi	Baoji	Long	0.37	6.74	
Grade 4	Shaanxi	Baoji	Feng	0.78	9.06	
Grade 4	Shaanxi	Hanzhong	Mian	-0.11	6.64	
Grade 4	Shaanxi	Hanzhong	Chenggu	0.19	7.31	
Grade 4	Shaanxi	Hanzhong	Nanzhen	0.20	7.23	
Grade 4	Shaanxi	Hanzhong	Zhenba	0.20	5.47	
Grade 4	Shaanxi	Hanzhong	Lueyang	1.22	5.65	
Grade 4	Shaanxi	Weinan	Huayin	0.16	6.40	
Grade 4	Shaanxi	Xianyang	Changwu	-0.11	6.62	
Grade 4	Shaanxi	Xianyang	Xingping	0.54	8.44	
Grade 4	Shaanxi	Xianyang	Liquan	0.56	8.38	
Grade 4	Shaanxi	Xianyang	Sanyuan	0.76	8.38	
Grade 4	Shaanxi	Yulin	Zizhou	0.10	6.58	

*(continued)*

**Table A1.**  
A complete list of average county standardized math test scores in Grades 4 and 5 and county per capita rural net income in China

Grade	Province	Prefecture	County	Average county standardized math test score	County per capita rural net income (per thousand yuan)
Grade 4	Shaanxi	Yulin	Dingbian	0.37	9.49
Grade 4	Shaanxi	Yulin	Jia	0.47	6.41
Grade 4	Shaanxi	Yulin	Yuyang	0.48	10.00
Grade 4	Shaanxi	Yulin	Hengshan	0.59	7.86
Grade 4	Shaanxi	Yulin	Suide	0.61	6.63
Grade 4	Shaanxi	Yulin	Mizhi	0.72	7.51
Grade 4	Shaanxi	Yulin	Jingbian	0.75	11.41
Grade 4	Sichuan	Abazhou	Ruoergai	-0.21	6.00
Grade 4	Sichuan	Ganzizhou	Yajiang	-0.20	4.57
Grade 4	Sichuan	Liangshanzhou	Muli	-0.31	4.09
Grade 5	Gansu	Dingxi	Zhang	-1.07	3.47
Grade 5	Gansu	Dingxi	Min	-0.18	3.38
Grade 5	Gansu	Dingxi	Linzhao	0.13	3.84
Grade 5	Gansu	Dingxi	Weiyuan	0.17	3.52
Grade 5	Gansu	Dingxi	Tongwei	0.19	3.37
Grade 5	Gansu	Dingxi	Longxi	0.68	3.92
Grade 5	Gansu	Longnan	Tanchang	-0.97	2.50
Grade 5	Gansu	Longnan	Li	-0.68	3.00
Grade 5	Gansu	Longnan	Xihe	-0.51	2.86
Grade 5	Gansu	Longnan	Wudu	-0.27	2.96
Grade 5	Gansu	Longnan	Hui	-0.23	4.39
Grade 5	Gansu	Longnan	Wen	-0.14	2.68
Grade 5	Gansu	Longnan	Kang	-0.08	2.89
Grade 5	Gansu	Tianshui	Qinzhou	-0.42	4.25
Grade 5	Gansu	Tianshui	Wushan	-0.41	3.83
Grade 5	Gansu	Tianshui	Zhangjiachuan	0.13	3.34
Grade 5	Gansu	Tianshui	Gangu	0.18	3.93
Grade 5	Gansu	Tianshui	Qinan	0.19	3.91
Grade 5	Gansu	Tianshui	Qingshui	0.30	3.71
Grade 5	Gansu	Tianshui	Maiji	0.57	3.83
Grade 5	Guizhou	Zunyi	Suiyang	-0.40	6.77
Grade 5	Guizhou	Zunyi	Daozhen	-0.17	4.14
Grade 5	Guizhou	Zunyi	Zhengan	-0.13	4.33
Grade 5	Jiangxi	Ganzhou	Huichang	-0.32	4.28
Grade 5	Jiangxi	Ganzhou	Yudu	-0.08	4.43
Grade 5	Jiangxi	Ganzhou	Ruijin	-0.05	5.18
Grade 5	Ningxia	Guyuan	Jingyuan	-0.01	4.31
Grade 5	Ningxia	Guyuan	Longde	0.31	4.67
Grade 5	Ningxia	Wuzhong	Tongxin	-0.42	4.53
Grade 5	Ningxia	Wuzhong	Yanchi	0.27	4.79
Grade 5	Ningxia	Zhongwei	Haiyuan	0.04	4.23
Grade 5	Qinghai	Haidong	Xunhua	-1.08	4.66
Grade 5	Qinghai	Haidong	Hualong	-0.37	5.09
Grade 5	Qinghai	Haidong	Minhe	-0.10	5.03
Grade 5	Qinghai	Haidong	Huzhu	0.12	5.85
Grade 5	Shaanxi	Ankang	Hanbin	0.20	5.92
Grade 5	Shaanxi	Ankang	Shiquan	0.27	5.95
Grade 5	Shaanxi	Ankang	Ningshan	0.81	5.63
Grade 5	Shaanxi	Baoji	Linyou	0.01	6.70
Grade 5	Shaanxi	Baoji	Long	0.28	6.74
Grade 5	Shaanxi	Baoji	Feng	0.77	9.06
Grade 5	Shaanxi	Hanzhong	Mian	0.04	6.64

Table A1.

(continued)

Grade	Province	Prefecture	County	Average county standardized math test score	County per capita rural net income (per thousand yuan)	Primary school students from rural China
Grade 5	Shaanxi	Hanzhong	Nanzhen	0.08	7.23	
Grade 5	Shaanxi	Hanzhong	Zhenba	0.17	5.47	
Grade 5	Shaanxi	Hanzhong	Chenggu	0.30	7.31	
Grade 5	Shaanxi	Hanzhong	Lueyang	0.33	5.65	
Grade 5	Shaanxi	Weinan	Tongguan	0.36	6.39	
Grade 5	Shaanxi	Xianyang	Wugong	0.44	8.17	
Grade 5	Shaanxi	Xianyang	Xunyi	0.45	6.66	
Grade 5	Shaanxi	Xianyang	Chunhua	0.45	6.57	
Grade 5	Shaanxi	Xianyang	Liquan	0.92	8.38	
Grade 5	Shaanxi	Xianyang	Jingyang	1.07	8.38	
Grade 5	Shaanxi	Yulin	Zizhou	-0.03	6.58	
Grade 5	Shaanxi	Yulin	Jingbian	0.29	11.41	
Grade 5	Shaanxi	Yulin	Suide	0.30	6.63	
Grade 5	Shaanxi	Yulin	Dingbian	0.33	9.49	
Grade 5	Shaanxi	Yulin	Jia	0.33	6.41	
Grade 5	Shaanxi	Yulin	Yuyang	0.40	10.00	
Grade 5	Shaanxi	Yulin	Hengshan	0.41	7.86	
Grade 5	Shaanxi	Yulin	Mizhi	0.80	7.51	
Grade 5	Sichuan	Abazhou	Ruoergai	-0.54	6.00	
Grade 5	Sichuan	Ganzizhou	Yajiang	0.14	4.57	
Grade 5	Sichuan	Liangshanzhou	Muli	-0.41	4.09	

**Source:** Authors' data from Sample A and *Statistical Yearbook of Shaanxi, Gansu, Ningxia, Qinghai, Jiangxi, Sichuan and Guizhou Province (2013)*

**Table AI.**

### Corresponding author

Yaojiang Shi can be contacted at: shiyaojiang7@gmail.com

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