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Is rented accommodation a good choice for primary school students' academic performance? – Evidence from rural China

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ABSTRACT

Rented accommodation has increased rapidly in the past decade in rural areas since the school consolidation policy was implemented in China at the turn of the 21st century. This paper provides the first impact evaluation of rented accommodation on primary school students' academic performance by employing a double robust estimator with multivalued treatments. Using a unique survey of Grades 4 and 5 students in Shaanxi Province in 2013, we find that 22% of students lived in rented accommodation near their schools. Compared with students living in boarding school or at home, students living in rented accommodation, on average, have higher math test scores, and the positive effect is stronger for boys than girls. These results have important implications for the design of rural school policy.

1. Introduction

School closure or school consolidation in remote rural areas is a common phenomenon when a county is undergoing transformation from an agricultural society to an industrial society. For example, in US, the so-called school consolidation began as early as the mid 1800's and the industrial revolution had accelerated this process (Bard, Gardener, & Wieland, 2006). Rural school consolidation is driven by depopulation, out-migration, and financial savings. Given declining enrolments and limited financial resources in rural areas today, many countries (especially developing countries) still have to deal with challenges associated with rural school consolidations. China is one of them.

Local governments in China lunched a large-scale rural school consolidation program from 2000 to 2012. According to the National Bureau of Statistics of China (National Bureau of Statistics of China, 2001, 2013), the number of total enrolments in rural primary schools has declined by 57.0%, from 85.0 million in 2000 to 36.5 million in 2012. The decline of enrolments in rural primary schools is closely related to demographic changes—a low birth rate alongside increasing migrations from rural to urban areas. Some local governments shut down schools in remote villages and merged them into “central” schools at the township or county level in the late 1990s. This action became national policy in 2001.

The number of rural primary schools nationwide has fallen by 64.8%, from 440,284 in 2000 to 155,008 in 2012. More than half of rural primary schools disappeared during this period and this trend continues. In 2017, the number of rural primary school fell to

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96,052, less than one quarter of that in 2000. Given the longer distances from home to school as a result of school mergers, students from remote villages have to spend more time to travel and face more safety risks on their journeys (Zhao & Barakat, 2015). Schools have become less accessible to students living in remote villages (Chan & Harrell, 2009).

Boarding schools offer a solution for students who live far away from school. According to the Minister of Education of China (cited in Dong (2013)), there were 9.88 million students living in boarding schools in 2011, accounting for 13.5% of total enrolments in rural primary schools. The proportion of rural primary school students in boarding schools is much higher in western regions than in central and eastern regions.

Studies have emerged to investigate the impacts of boarding school on children's physical and psychological well-beings and academic performance. Boarding students have found suffering from poor dormitory and canteen facilities lacking good quality food and daily care (Luo et al., 2009; Wang, Dong, & Mao, 2017). This was partly caused by the lack of well-trained teachers to supervise students' daily life (Yue et al., 2014). Children's physical and psychological well-being, and the cultural rights of ethnic minority students are often ignored by the school authorities, and the boarding school policy in China has increased the urban-rural educational gap (Zhao, 2011). Studies also find that boarding school has negative effects on students' academic performance (Chen et al., 2014; Mo et al., 2012; Wang & Mao, 2018).

Due to the growing concerns about the potential negative effects of school merger on rural students, the State Council suspended the school merger policy nationwide in September 2012. The governments at all levels have significantly increased public spending to improve the living conditions of rural boarding schools, the quality of school teachers, and health and nutritional status of rural children. Meanwhile, a new phenomenon arose in rural areas. More and more families started to rent accommodation near school as an alternative to travelling the long distance from home to school or living in boarding school. However, rented accommodation increases families' housing expenditures (Pang, Long, Dong, & Zeng, 2017), which raises the question of whether rented accommodation is of benefit to students. The negative effects of boarding at schools might be partly offset if students got some physical, academic or psychological benefits from rented rooms.

The key question we are going to address in this paper is that whether rented accommodation is a better choice than boarding at school or living at home in terms of students' academic performance. In order to answer this question, we use a unique dataset collected from a survey, designed specifically to examine students' living arrangements and educational performance. We find that 22% of students in our sample are living in rented accommodation near their schools. Overall, rented accommodation brings students better academic performance than those boarding at school, especially for boys.

The novelty of our paper is four-fold. First, to our knowledge, there is so far no published empirical study that examines the effect of rented accommodation on primary students' academic performance in rural China. Our study provides the first piece of evidence on this topic.

Second, we use a double robust estimator with multivalued treatments to examine the effects of rented accommodation on students' mathematics test scores. Double robust estimators can correct potential self-selection bias and control for important variables involved in both the treatment and outcome models. They are robust to the violation of the conditional independence and overlap assumptions. They are more efficient when the treatment or outcome model is misspecified.

Third, we bring a gender perspective into the analysis. Gender difference in academic performance is a hot topic (Gevrek, Neumeier, & Gevrek, 2018). As suggested by Wang, Zeng, Shi, Luo, and Zhang (2012), boys tend to find transition to boarding school life tougher than girls because traditionally in the home, boys often receive preferential treatments but this is no longer the case in schools. Since the adaptation and learning mechanism between boys and girls may be different and parents may treat boys and girls differently, we examine the gender effects of living arrangement.

Fourth, our results have strong policy implications. Children living in remote villages are still lack of school accessibility in both rural China and other developing countries. Our study suggests that rented accommodation might offer another way to avoid the negative effects of boarding at school, especially for boys.

The remainder of the paper is organized as follows. Section 2 presents the data and its descriptions. Section 3 describes the method. Section 4 presents the empirical results and discusses potential advantages of rented accommodation over boarding schools and living at home. The last section concludes this study and discusses limitations and possible policy implications.

2. Data and descriptive statistics

2.1. Data

Our data came from a survey of 7673 Grades 4 and 5 students in 131 primary schools at the township level in Yulin Prefecture, Shaanxi Province. Two waves of surveys were conducted during the autumn semester 2012 and spring semester 2013. The surveys were conducted by a team of scholars from Shaanxi Normal University, Stanford University, Chinese Academy of Sciences, and Renmin University of China. We use the math score from the second wave survey because some specific living arrangement questions were not included in the first wave. Time-invariant variables are derived from the first wave survey.

Yulin Prefecture has 12 counties and the survey was carried out in 11 of these (one was omitted because of its small population). We obtained a list of all primary schools from each county's bureau of education, then selected schools at township level with more than 50 students in Grades 4–5. We randomly selected one school from each township in the 11 counties. If there were two or more classes in each grade, we randomly chose only one. This gave us a sample of 131 schools in total. The descriptive statistics of main school characteristics are presented in Table A.1 in the Appendix.

The questionnaire collected information on students and their families in the sample. The information includes students' age, gender, grade, living arrangements, time and mode of transportation from home to school, their parents' age, education, migration

Table 1
Living arrangements (%).

	Girls	Boys	Total
Home	35.54	34.70	35.10
School	41.16	44.22	42.77
Rent	23.31	21.07	22.13
Total	100	100	100

status, household size, and household assets. We used a standardised math examination to test students' achievement. The questions were developed by the Trends in International Mathematics and Science Study (TIMSS) testing service. Questionnaires for math teachers and headteachers produced data on teachers (age, gender, educational level). Information about schools (number of students and teachers, facilities, location) was obtained through questionnaires for school principals.

2.2. Descriptive statistics

2.2.1. Living arrangements

Table 1 presents the distribution of students over three types of living arrangement: living at home, boarding at school, and living in rented accommodation. 35% of students lived at home, 43% were boarding, and 22% were in rented accommodation near school.

Living arrangements differed little between boys and girls. The percentages of girls living at home and in rented accommodation are slightly larger than those of boys, whereas the percentage of girls boarding at school is marginally smaller than that of boys.

2.2.2. Travel time from home at village to school

The travel time from home at village to school is the longest among students living in rented accommodation. Students in rented accommodation take more than 1 h from their homes to school. Students living at home only need to spend 13 min from home to school. The time for students boarding at school is in the middle, nearly 34 min (see Table 2).

2.2.3. Math test scores

As Table 3 shows, students living in rented accommodation have the highest average standardised test scores in mathematics and boarding school students the lowest. This comparative pattern is observed for all students as whole as well as for boys and girls separately.

3. Methodology

A main challenge for estimating the impact of living arrangements on students' math test scores is the potential self-selection bias as the decision of living arrangements may be affected by the factors that also influence a student's academic performance. For instance, parents may choose rented accommodation over boarding school if they feel that their children need greater parents' supervision. We do not apply conventional panel estimation due to the data limitation. Instead, we estimate the effects of living arrangements on students' math test scores using the inverse probability weighted regression adjustment (IPWRA) estimator with multivalued treatments, which addresses selection bias by controlling for the observables. This is a plausible approach, given that our data provide rich information on the characteristics of students, parents, teachers, and schools. We will check the robustness of the estimates using the augmented inverse-probability weighting (AIPW) and instrumental variable (IV) estimation.

The IPWRA estimator is derived in Wooldridge (2007) and discussed at length in Wooldridge (2010). The IPWRA estimator enjoys a so-called “double robust” property because it combines the regression adjustment (RA) and the inverse probability weighting (IPW) estimators (Abadie & Cattaneo, 2018; Derya Uysal, 2015; Słoczyński & Wooldridge, 2018; StataCorp, 2015; Wooldridge, 2010). The RA estimator runs separate regression for each treatment level and use averages of predicted outcomes from each regression. An RA estimator depends on the correctly specified outcome model. The IPW estimator derives the inverse probability from the treatment model and uses the weighted means of the observed outcome variable. The IPW estimator needs the correctly specified treatment model. For the IPWRA estimator, we still need to model the outcome and the treatment but we are only required to specify one of the two models correctly. This is the main advantage of the IPWRA estimator.

Table 2
Travel time from home to school (minutes).

	Girls		Boys		Total	
	Mean	SD	Mean	SD	Mean	SD
Home	12.58	9.15	12.73	9.92	12.66	9.56
School	33.96	28.14	35.12	28.97	34.59	28.60
Rent	42.80	33.55	43.18	35.42	42.99	34.49
Total	28.43	27.70	29.05	28.64	28.76	28.20

Table 3
Description of math scores.

	Math score		Standardised math score	
	Mean	SD	Mean	SD
Girls				
Home	17.82	5.48	0.06	1.00
School	17.49	5.42	−0.02	0.97
Rent	18.11	5.45	0.12	0.98
Total	17.75	5.46	0.04	0.98
Boys				
Home	17.62	5.60	0.04	1.01
School	17.13	5.69	−0.09	1.03
Rent	18.02	5.31	0.10	0.95
Total	17.49	5.59	−0.00	1.01
All				
Home	17.72	5.54	0.05	1.01
School	17.29	5.57	−0.06	1.00
Rent	18.06	5.38	0.11	0.96
Total	17.61	5.53	0.02	1.00

The IPWRA estimator needs three assumptions: the conditional mean independence assumption, the overlap assumption and the independent and identically distributed (IID)sampling assumption. So the IPWRA estimator still may have risks, for example, unbalanced covariates between the treatment groups, or unstable inverse probability weights or misspecified models for both the outcome model and the treatment model (Kreif, Grieve, Radice, & Sekhon, 2013). Results from Glynn and Quinn (2010) and Derya Uysal (2015) show that the IPWRA estimator outperforms regression adjustment and PSM estimator when either the outcome model or the treatment model is misspecified, or when the inverse propensity is unstable. Kreif et al. (2013) and Qin, Zhang, and Leung (2017) found the IPWRA estimator also do better when both outcome model and treatment model are misspecified.

The estimation procedure is described below. Suppose Y is the math score, T is the living arrangement, and Y_{ti} is the math score for student i with the living arrangement t. Then function $F(Y)$ would be the outcome model and $F(T)$ would be the treatment model. Let T_0 to be the control group, then we have:

1 If all students choose the living arrangement t, their average math score can be defined as $Y_t = E(Y_t)$.
2 If all students choose the living arrangements t instead of 0, the change of their average math score can be defined as $ATE_t = E(Y_t - Y_0)$. This is known as the average treatment effect (ATE).
3 For students with the living arrangement $\hat{t}$,if they choose the living arrangement $\tilde{t}$ instead of 0, the change of their average math score can be defined as $ATT_{\tilde{t},\hat{t}} = E\{(Y_{\tilde{t}} - Y_0) \mid t = \hat{t}\}$. This is known as the average treatment on the treated (ATT).

We use the IPWRA estimator to get Y_t, ATE_t and $ATT_{\tilde{t},\hat{t}}$ by the following steps: firstly, using multinomial logit model, it estimates the parameters of the treatment model $F(T)$ and calculates inverse probability weights. Secondly, using the inverse probability from the first step as weights, it estimates separate weighted regression models $F(Y_t)$ of the outcome variable for each treatment level and computes the treatment-specific predicted outcomes for each subject. Thirdly, it obtains the averages of the treatment-specific predicted outcomes (Y_t) from the second step. The contrasts of these means for different groups provide the estimates of ATE_t and $ATT_{\tilde{t},\hat{t}}$. The models are estimated by using the Stata command *teffects ipwra*. To get the correct standard errors, we use the bootstrap methods with 1000 replications.

For the model of living arrangements, we controlled for student characteristics (gender, age, numbers of siblings, school transfer), family characteristics (father's age and education, mother's age and education, household economic level), class characteristics (class size), school characteristics (number of students, distance to county town), and county dummies. We also controlled for the travel time and transportation methods from home village to school and these variables are expected to influence living arrangement decisions but not students' school performance when living arrangements are controlled for. In this sense, these variables act as IVs for living arrangements in the model.

For the model of math test scores, we controlled for student characteristics (gender, age, repeated one grade, numbers of siblings, school transfer), family characteristics (father's age and education, mother's age and education, household economic level), class characteristics (class size, teacher's gender, age and education), school characteristics (number of students, student-teacher ratio, reading room, distance to county town), and county dummies.

It is noteworthy that in both models we control for whether a student was transferred from other school and if transferred, what type of school the student was transferred from. School transfer is mostly driven by the school merger program. It may also affect students' academic performance as transferred students may have difficulties adapting new environment and establishing new relationship with teachers and classmates. This variable is a proxy for teachers' quality in that teachers for students transferred from a teaching point school may not be as good as those for students transferred from a school near the county center (Han, 2013).

The description of the variables is shown in Appendix Tables A.1–A.3.

Table 4
Marginal effects from multinomial logit model for all students.

	Home	School	Rent
Time from home to school (minutes)	−0.0093***	0.0047***	0.0046***
Transport: basic group = on foot			
Bicycle, motorcycle	−0.2776***	0.2108***	0.0668***
Vehicle and others	−0.3741***	0.2405***	0.1337***
Type of school transfer: basic group = no transfer			
Teaching point	−0.1221***	0.1506***	−0.0285
Village school	−0.0927***	0.1324***	−0.0398**
Township school	−0.0669***	0.1363***	−0.0694***
Other school	−0.0583***	0.1105***	−0.0522***
N	7673	7673	7673

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4. Results of multivariate analysis

In this section we present first the IPWRA estimates and then the augmented inverse-probability weighting (AIPW) and IV estimates to check the robustness of the IPWRA estimates.

4.1. Multinomial logit model for living arrangements

Results of multinomial logit regression for all students, boys and girls are presented in Appendix Tables A.4–A.6 respectively. In order to explore the effects of different elements on students' living arrangements, we calculate the marginal effects of each variable on living arrangements. Since we are particularly interested in the impact of school merging on students' living arrangement, we present the marginal effects of variables relating to the school merger policy in Table 4.

The estimate of travel time from home at village to school is negative for students living at home and positive for those boarding at school or in rented accommodation. With a travel time of ten more minutes from home to school, the probability of students living at home decreased 0.093; the probability of students boarding at school increased 0.047; the probability of students rented accommodation increased 0.046. These estimates are highly significant.

The effects of transportations models are also both statistically and practically significant. The probability of boarding at school for students who went to school by bicycle and motorcycle was 0.211 more than that for students who went to school on foot. The probability of boarding at school for students who went to school by vehicle and others is 0.241 more than that for students who went to school on foot. The probability of renting accommodation for students who went to school by bicycle and motorcycle was 0.067 more than that for students who went to school on foot. The probability of boarding at school for students who went school by vehicle and others was 0.134 more than that for students who went to school on foot. So compared to students who went to school on foot, students who went by bicycle, motorcycle, vehicle, and others, were less likely to live at home, but more likely to board at school or live in rented accommodation.

As to types of school transfer, compared with students who have never transferred, students who have transferred schools are less likely to live at home and more likely to board at school, as might be expected. Since school transfer is a consequence of the school merger policy, decisions to board at school is largely related to the school merger policy. Those transferring from teaching points were most affected by the school merger policy. The probability of boarding at school for those who transferred from teaching points is 0.151 higher than those who had not transferred.

The effect of school transfer on rented accommodation is tricky. Students who transferred were less likely live in rented accommodation than students who did not transfer. The reason is that many students may have started to rent accommodations when they began first grade and remained at the one school, hence they would report they had never transferred. This group of students may be affected much more by the school merger policy than other students. As shown in Table 4, the predicted probabilities of rented accommodation among different types of school transfer are ranging from 0.026 to 0.069. Table 5 also shows the differences of the percentage of students rented accommodation among different types of school transfer is small, ranging from 1.78 to 3.32 percentage point.

The direction and attitude of the effects of time and transportation from home to school on living arrangements are similar between boys and girls, as shown in Table 6.

Table 5
Type of schools transfer from (%).

	No transfer	Teaching point	Village school	Township school	Other school
Home	47.3	14.8	20.9	26.8	33.5
School	30.8	61.7	56.2	53.0	43.8
Rent	22.0	23.5	22.9	20.2	22.7
Total	100	100	100	100	100

Table 6
Marginal effects from multinomial logit model for boys and girls.

	Boys			Girls		
	Home	School	Rent	Home	School	Rent
Time from home to school (minutes)	−0.0090***	0.0047***	0.0043***	−0.0097***	0.0047***	0.0050***
Transport: basic group = on foot						
Bicycle, motorcycle	−0.2089***	0.1643***	0.0445**	−0.2311***	0.1808***	0.0503**
Vehicle and others	−0.3161***	0.2092***	0.1069***	−0.3142***	0.2075***	0.1067***
Type of school transfer: basic group = no transfer						
Teaching point	−0.1178***	0.1493***	−0.0315	−0.1202***	0.1380***	−0.0178
Village school	−0.0882***	0.1567***	−0.0685***	−0.0889***	0.0982***	−0.0094
Township school	−0.0605***	0.1361***	−0.0756***	−0.0600***	0.1251***	−0.0651***
Other school	−0.0445***	0.1060***	−0.0615***	−0.0652***	0.1060***	−0.0407**
N	4043	4043	4043	3630	3630	3630

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2. The effects of living arrangements on math score: IPWRA

In order to compare math score for students in each type of living arrangements, we run outcome models using the IPWRA estimator.[1] We provide the predicted math score in Table 7 and compare them in Table 8.

Table 7 shows that students in rented accommodation have the highest predicted standardised math scores regardless of gender. For boys, those who boarding at school have the lowest predicted standardised math score. For girls, those who living at home have the lowest predicted standardised math score.

Table 8 reports the ATE of living arrangements on the standardised math score and give the difference in predicted scores between two groups. For all samples, there is no statistically significant difference of the predicted standardised math score if they change one type of living arrangement to another. For boys, if all boys change their living arrangement from boarding at school to rented accommodation, their standardised math score would increase 0.1668. For girls, if all girls change their living arrangement from living at home to boarding at school or rented accommodation, their standardised math score would increase 0.1166 or 0.1265, respectively.

We are mostly interested in the ATT of living arrangements on the standardised math score, as shown in Table 9. For students living at home or boarding at school, their standardised math score would not change too much if they choose living at home or rented accommodations instead of boarding at school. For students living at rented recommendations, their standardised math score would drop 0.1625 or 0.0876 if they turn to living at home or boarding at school.

For boys living at home, they would have 0.2426 decline of standardised math score if they choose to boarding at school instead of to living at home. For boys boarding at school, their standardised math score would increase 0.1536 if they turn to rented accommodations. For boys rented accommodations, their standardised math score would drop 0.2498 or 0.1377 if they choose to live at home or to board at school.

For girls living at home, their standardised math score would not change too much if they choose boarding at school or rented accommodations instead of living at home. For girls boarding at school, their standardised math score would decrease 0.1942 if they turn to living at home. For girls rented accommodations, their standardised math score would decrease 0.1148 if they turn to living at home.

4.3. Robustness tests

4.3.1. The augmented inverse-probability weighting (AIPW)estimator

The augmented inverse-probability weighting (AIPW) estimator is also a double robust estimator.[2] The estimator computes inverse probability weights from the treatment model using multinomial logit model. But unlike IPWRA estimator, the weights are used to compute the weighted means of the treatment-specific predicted outcome from separate outcome models that do not use weights (see Cattaneo (2010); Cattaneo, Drukker, and Holland (2013)). Comparing the relative efficiency of the IPWRA estimator and the AIPW estimator with multivalued treatments allows more robust results, so for this reason we use the AIPW estimator as a robustness test.

Comparing Tables 7 and 10, both the AIPW and the IPWRA estimators show that students who rented accommodation have the highest predicated standardised math score for both boys and girls. Unlike the results from the IPWRA estimator, the AIPW estimator indicates that boys who living at home have the lowest predicated standardised math score. For girls, both the AIPW and IPWRA report that girls who living at home have the lowest predicated standardised math score.

[1] Variables in IPWRA and AIPW are the same as in previous multinomial logit and OLS model (Appendix Table A.7).

[2] We use the official *Stata* command *teffects aipw* in Stata 14.2 to imply the AIPW estimator. Standard errors are calculated by using the bootstrap method with 1000 replications.

Table 7
The predicted standardised math score.

	All	Boys	Girls
Home	−0.0367	−0.0394	−0.0745
School	−0.0467	−0.1367	0.0421
Rent	0.0288	0.0301	0.0520

Table 8
ATE of living arrangements on the standardised math score.

	All		Boys		Girls	
	ATE	SE	ATE	SE	ATE	SE
School VS Home	−0.0100	0.0480	−0.0973	0.0620	0.1166**	0.0555
Rent Vs Home	0.0655	0.0528	0.0695	0.0718	0.1265*	0.0705
Rent VS School	0.0754	0.0485	0.1668**	0.0700	0.0099	0.0688

Note: SE in the second column are calculated by 1000 bootstrap replications.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 9
ATT of living arrangements on math score.

	All	Boys	Girls
Home			
From home to school	−0.0939	−0.2426***	0.0534
From home to rent	−0.0675	−0.0099	−0.0485
School			
From school to home	−0.0334	0.0161	−0.1942**
From school to rent	0.0715	0.1536*	0.0241
Rent			
From rent to home	−0.1625 ***	−0.2498***	−0.1148*
From rent to school	−0.0876**	−0.1377**	−0.0427

Note: SE are calculated by using the bootstrap method with 1000 replications.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Comparing Tables 9 and 11, both the IPWRA and AIPW estimators indicate that if boys change their living arrangement from boarding at school to rented accommodation, their math score would be increased. The IPWRA and AIPW estimators also show that if girls change their living arrangement from living at home to boarding at school or to rented accommodation, their math scores would be increased.

4.3.2. IV models

We are going to use the traditional external IV method as another robustness check. To implement the IV method, we divide the living arrangements from three groups into two groups: rented accommodation, and non-rented accommodation. So we have a binary endogenous regressor which indicates whether the living arrangement is rented accommodation. We use the time and transportation from home at village to school as two instruments for rented accommodation. These two instruments measure the distance from home village to school. The distance from home village to school,as a geographical variable, is supposed to be directly related to the living arrangements, but to be external to the academic performance. We have controlled the same variables used in IPWRA models, including student characteristics, family characteristics, class characteristics, school characteristics, and region dummies, as explained in the methodology part. Moreover, we have controlled school fixed effects in IV models. The tests presented in Table 12 shows that the instruments are not weak. The three IV models confirm that rented accommodation can improve students' academic performance.

Table 10
The predicted standardised math score: AIPW.

	All	Boys	Girls
Home	−0.0972	−0.2669	−0.1644
School	−0.0611 9	−0.1464	0.0319
Rent	0.0329	0.0139	0.0819

Table 11
ATE of living arrangements on math score: AIPW.

	All		Boys		Girls	
	ATE	SE	ATE	SE	ATE	SE
School VS Home	0.0361	0.1473	0.1205	0.3008	0.1963*	0.1027
Rent VS Home	0.1301	0.1520	0.2808	0.2977	0.2463**	0.1171
Rent VS School	0.0940*	0.0512	0.1603**	0.0727	0.0500	0.0782

Note: SE in the second column are calculated by using the bootstrap method with 1000 replications.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

4.4. The advantages of rented accommodation

From the field interview, we attribute the advantages of rented accommodation for students' academic performance to close parental supervision and high motivations for both students and parents. (See Table 13)

First, students in rented accommodation are more likely to be with parents and to get parents' close care and supervision daily, compared with students boarding at school. Since parental separation has negative effects on students' academic performance (Liu, Yu, & Zheng, 2018; Zhang, Behrman, Fan, Wei, & Zhang, 2014) and mental health (Chang et al., 2019; Lei, Liu, & Hill, 2018), parental care and supervision gives more advantages to students in rented accommodation than students boarding at school. Parents of students in rented accommodation tend to have more time available to provide supervision and care than parents of students living at home. Being away from the home villages, parents of students in rented accommodation are unable to work on their farmland as parents of students living at home can do. Job opportunities at the township level are largely unavailable. Thus, students in rented accommodation can get more parental supervision and care than their peers living in school or at home, and parental supervision and care are essential to students' cognitive development (Ruhm, 2008). With more time available, parents of students in rented accommodation can also communicate more with teachers and other parents, which is also helpful for students' academic performance (Siebert, Wei, Wong, & Zhou, 2018; Young, 2020; Zong, Zhang, & Yao, 2018).

Second, since rented accommodation costs more than living at home or boarding at home, students in rented accommodation are under greater pressure to have a good school performance than their peers living at home or boarding at school. And their parents are also more motivated to provide the needed supervision and care to ensure their children to succeed in school. Parental supervision and care are particularly important for boys, given that boys living in rented accommodation have higher math scores than boys in boarding school. Interestingly, girls in boarding school overperform girls living at home, which suggests that the former have more time studying (instead of helping mother do housework) than the latter.

5. Discussion and conclusions

School closures may be driven by justifiable considerations, but they tend to affect communities, households and students differently (Caven, 2018). In China, rented accommodation is caused by the less accessibility to school for students living in remote villages. In this paper we have attempted to understand the impact of rented accommodation on primary students' academic performance as measured by math test scores. Using students survey data from Yulin, Shaanxi Province in China, the results shows that

Table 12
Results from IV models.

	All	Boys	Girls
Second stage			
Rented accommodation	0.2094**	0.2051*	0.2166*
First stage			
Time from home to school	0.0037 ***	0.0035***	0.0041***
Transport: basic group = on foot			
Bicycle, motorcycle	0.0965***	0.0937***	0.0954***
Vehicle and others	0.1682 ***	0.1694***	0.1665***
P-value of endogeneity test	0.0193	0.1703	0.0405
P-value of Hansen J statistic	0.5474	0.7280	0.0998
KP rk Wald F statistic	269.6	128.3	140.0
Stock-Yogo weak ID test critical values			
5% maximal IV relative bias	13.91	13.91	13.91
10% maximal IV size	22.30	22.30	22.30
Centered R^2	0.1614	0.1743	0.1764
N	7673	4043	3630

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.
We use *Stata* command *ivreg2* to implement the IV model and its tests.

Table 13
Parental presence and students' living arrangements (%).

	Home	School	Rent	Total
Father at home	62.70	66.24	49.47	61.29
Mother at home	90.55	85.83	91.40	88.72
Parental presence status				
No parent out	59.56	62.49	47.82	58.22
Father out only	31.08	23.40	43.64	30.57
Mother out only	3.30	3.84	1.94	3.23
Both parents out	6.05	10.27	6.60	7.98

43% of grade four and five students are boarding at school and 22% of them live in rented accommodation near school. Boarding at school results from the need to travel long distances from home to school because of the unavailability or low quality of schools near the students' home villages. Renting accommodation is also related a way to solve the problem of distance and travel times.

We find that students in rented accommodation, both boys and girls, have higher math test scores than students boarding at home or living at home. Differing from previous studies by Mo et al. (2012) and Chen et al. (2014), we find that boarding school can improve academic performance for girls, but not for boys. Our results also find negative effects of living at home on girls' academic performance in mathematics.

Our results show that the school merger policy has led to more students living in boarding school and rented accommodation. We conclude that rented accommodation would improve students' academic performance in mathematics and boarding at school would weak boys' academic performance in mathematics. Since the government replies on boarding schools to solve the negative effects of the school merger policy, we suggest that the government need to consider the option of supporting rented accommodation by providing low-rent housing near school for rural students or subsidies for rented accommodation. These measure would lower the costs of rented accommodation, reducing economic burden of rural families. Most importantly, more concerted efforts are needed to ensure the provision of parental care and supervision for primary school children.

We should be cautious in interpreting our results. We rely on primary school students survey data from only one province in China. The living arrangement and environment may differ in other parts of China or other countries.

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Appendix

Table A.1
Descriptions of student and family characteristics.

	Home	School	Rent	Total	P-value
Time from home to school (minutes)	12.66	34.59	42.99	28.76	0.000
Transport					0.000
On foot	75.60	26.60	28.62	44.25	
Bicycle, motorcycle	12.48	32.88	25.80	24.15	
Vehicle and others	11.92	40.52	45.58	31.60	
Type of school transfer (%)					0.000
No transfer	64.61	34.52	47.59	47.97	
Teaching point	6.76	23.03	16.96	15.98	
Village school	5.16	11.37	8.95	8.65	
Township school	10.77	17.46	12.84	14.09	
Other school	12.70	13.62	13.66	13.31	
Male (%)	52.10	54.48	50.18	52.69	0.012
Age	11.23	11.52	11.30	11.37	0.000
Grade Five (%)	47.57	55.18	46.47	50.58	0.000
Grade Fou (%)r	52.43	44.82	53.53	49.42	0.000
Repeated one grade (%)	26.03	34.28	29.03	30.22	0.000
Number of Young siblings	0.57	0.52	0.64	0.56	0.000
Have old siblings (%)	45.60	55.15	45.88	49.75	0.000
Household size	4.35	4.55	4.40	4.45	0.000
Father's age	38.25	39.34	38.42	38.75	0.000

(*continued on next page*)

Table A.1 (*continued*)

	Home	School	Rent	Total	P-value
Mother's age	36.13	36.70	36.12	36.37	0.000
Father's education (%)					0.000
Illiteracy	5.87	9.60	7.54	7.83	
Primary school	33.79	42.26	38.22	38.39	
Middle school	43.56	36.53	41.87	40.18	
High school and above	16.78	11.61	12.37	13.59	
Mother's education (%)					0.000
Illiteracy	16.97	25.87	22.20	21.93	
Primary school	39.14	42.08	43.17	41.29	
Middle school	30.04	22.91	26.33	26.17	
High school and above	13.85	9.14	8.30	10.61	
House values (%)					0.000
Less than 5000 yuan	33.35	29.77	48.23	35.11	
5000–10,000 yuan	18.86	25.35	21.55	22.23	
10,000–50,000 yuan	20.31	22.33	17.61	20.58	
50,000–100,000 yuan	27.48	22.55	12.60	22.08	

Note: P-value is calculated from joint Walt test or Chi-squared test.

Table A.2
Descriptions of class, school and region characteristics.

	Home	School	Rent	Total	P-value
Math teacher is male (%)	42.85	45.40	44.64	44.34	0.137
Math teacher's age	32.31	31.28	33.24	32.08	0.000
Math teacher has bachelor degree (%)	55.96	62.10	52.59	57.84	0.000
Class size	39.86	37.16	41.46	39.06	0.000
Number of students in school	516.15	414.04	530.35	475.61	0.000
Student-teacher ratio	13.05	11.58	13.22	12.20	0.000
Having reading room (%)	76.09	69.07	72.79	72.36	0.000
Distance from school to county town	34.49	41.62	34.42	37.53	0.000
Development level of county (%)					0.000
Rich county	22.80	10.79	22.85	17.67	
Middle county	34.01	50.91	28.86	40.10	
Poor county	43.19	38.30	48.29	42.23	
N	2693	3282	1698	7673	

Note: P-value is calculated from Walt test or Chi-squared test.
School related variables have different values from those in Table A.3 because of different units of analysis.

Table A.3
Characteristics of sample schools ($N = 131$).

	Min	Max	Mean	SD
Number of sample students	17	116	58.6	21.2
Number of total students	54	1334	411.6	292.0
Number of total teachers	9	145	35.7	21.6
Student-teacher ratio	4.1	23.9	11.6	4.6
Having reading room (yes = 1)	0	1	0.73	0.44
Distance to county town (km)	1	105	37.5	23

Note: School related variables have different values from those in Table A.2 because of different units of analysis.

Table A.4
Marginal effects from multinomial logit model for all students.

	Living at home	Boarding at school	Rented accommodation
Time from home to school (minutes)	−0.0093***	0.0047***	0.0046***
Transport: on foot			
Bicycle, motorcycle	−0.2776***	0.2108***	0.0668***
Vehicle and others	−0.3741***	0.2405***	0.1337***

(*continued on next page*)

Table A.4 (*continued*)

	Living at home	Boarding at school	Rented accommodation
Type of school transfer: no transfer			
Teaching point	−0.1221***	0.1506***	−0.0285
Village school	−0.0927***	0.1324***	−0.0398**
Township school	−0.0669***	0.1363***	−0.0694***
Other school	−0.0583***	0.1105***	−0.0522***
Male	0.0060	−0.0088	0.0029
Age	−0.0249***	0.0537***	−0.0288***
Number of Young siblings	0.0093	−0.0482***	0.0390***
Household size	−0.0027	0.0288***	−0.0261***
Father's age	−0.0016	0.0055***	−0.0039**
Mother's age	0.0017	−0.0024	0.0006
Father's education: middle school or above	0.0159*	−0.0272**	0.0113
Mother's education: middle school or above	0.0145*	0.0073	−0.0218**
House values:less than 5000 yuan			
5000–10,000 yuan	0.0046	0.0673***	−0.0718***
10,000–50,000 yuan	0.0272**	0.0551***	−0.0823***
50,000–100,000 yuan	0.0709***	0.0689***	−0.1398***
Number of students of school	0.0000	−0.0001**	0.0001**
Distance from school to county town	−0.0571***	0.1032***	−0.0461***
Economic development of counties: middle			
Rich county	0.1440***	−0.3051***	0.1611***
Poor county	0.0200	−0.1157***	0.0957***
N	7673	7673	7673

Note: Cluster stand error at school level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5
Marginal effects from multinomial logit model for boys.

	Living at home	Boarding at school	Rented accommodation
Time from home to school (minutes)	−0.0090***	0.0047***	0.0043***
Transport: on foot			
Bicycle, motorcycle	−0.2089***	0.1643***	0.0445**
Vehicle and others	−0.3161***	0.2092***	0.1069***
Type of school transfer: no transfer			
Teaching point	−0.1178***	0.1493***	−0.0315
Village school	−0.0882***	0.1567***	−0.0685***
Township school	−0.0605***	0.1361***	−0.0756***
Other school	−0.0445***	0.1060***	−0.0615***
Age	−0.0308***	0.0572***	−0.0265***
Number of young siblings	−0.0014	−0.0254*	0.0269**
Household size	0.0049	0.0263***	−0.0313***
Father's age	−0.0030	0.0083***	−0.0053**
Mother's age	0.0029	−0.0048**	0.0019
Father's education: middle school or above	−0.0001	−0.0152	0.0154
Mother's education: middle school or above	0.0224*	0.0006	−0.0230*
House values:less than 5000 yuan			
5000–10,000 yuan	0.0041	0.0566***	−0.0607***
10,000–50,000 yuan	0.0236	0.0273	−0.0509***
50,000–100,000 yuan	0.0607***	0.0719***	−0.1326***
Number of students of school	0.0000	−0.0001*	0.0001*
Distance from school to county town	−0.0618***	0.1158***	−0.0540***
Economic development of counties: middle			
Rich county	0.1550***	−0.3284***	0.1733***
Poor county	0.0152	−0.1194***	0.1041***
N	4043	4043	4043

Note: Cluster stand error at school level.

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table A.6
Marginal effects from multinomial logit model for girls.

	Living at home	Boarding at school	Rented accommodation
Time from home to school (minutes)	−0.0097***	0.0047***	0.0050***
Transport: on foot			
Bicycle, motorcycle	−0.2311***	0.1808***	0.0503**
Vehicle and others	−0.3142***	0.2075***	0.1067***
Type of school transfer: no transfer			
Teaching point	−0.1202***	0.1380***	−0.0178
Village school	−0.0889***	0.0982***	−0.0094
Township school_before	−0.0600***	0.1251***	−0.0651***
Other school_before	−0.0652***	0.1060***	−0.0407**
Age	−0.0187**	0.0503***	−0.0316***
Number of young siblings	0.0164*	−0.0631***	0.0467***
Household size	−0.0117*	0.0330***	−0.0214***
Father's age	0.0005	0.0023	−0.0028
Mother's age	−0.0002	0.0008	−0.0006
Father's education: middle school or above	0.0343***	−0.0403***	0.0059
Mother's education: middle school or above	0.0064	0.0135	−0.0199
House values:less than 5000 yuan			
5000–10,000 yuan	0.0016	0.0677***	−0.0692***
10,000–50,000 yuan	0.0263	0.0773***	−0.1035***
50,000–100,000 yuan	0.0859***	0.0663***	−0.1522***
Number of students of school	−0.0000	−0.0001**	0.0001***
Distance from school to county town	−0.0517***	0.0892***	−0.0374***
Economic development of counties: middle			
Rich county	0.1355***	−0.2931***	0.1576***
Poor county	0.0117	−0.1042***	0.0925***
N	3630	3630	3630

Note: Cluster stand error at school level.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.7
OLS model for standardised math score.

	All	Boys	Girls
Living arrangement: rented accommodation			
Living at home	−0.0705**	−0.0692	−0.0761*
Boarding at school	−0.0477	−0.0814*	−0.0094
Male	−0.0267		
Age	−0.1744***	−0.1908***	−0.1529***
Repeated one grade	−0.0963***	−0.1012***	−0.0899**
Have old siblings	0.0252	0.0758**	−0.0183
Type of school transfer: no transfer			
Teaching point	0.0254	0.0705	−0.0246
Village school	−0.0029	0.0014	−0.0086
Township school	0.0023	0.0004	0.0005
Other school	−0.0303	0.0288	−0.0832*
Father's age	−0.0072**	−0.0085*	−0.0059
Mother's age	0.0088**	0.0105**	0.0057
Father's education: middle school or above	0.1103***	0.1075***	0.1116***
Mother's education: middle school or above	0.0786***	0.0950***	0.0627*
House values:less than 5000 yuan			
5000–10,000 yuan	0.0389	0.0427	0.0392
10,000–50,000 yuan	0.0911***	0.0944**	0.0795*
50,000–100,000 yuan	0.0511	0.0583	0.0434
Math teacher is male	−0.1547***	−0.1300***	−0.1821***
Math teacher's age	0.0017	−0.0007	0.0044
Math teacher has bachelor degree	−0.0290	−0.0798**	0.0244
Class size	−0.0022*	−0.0022	−0.0018
Number of students in school	0.0000	−0.0001	0.0001
Student-teacher ratio	0.0145***	0.0159***	0.0133**
Having reading room	−0.0934***	−0.0545	−0.1307***

(*continued on next page*)

Table A.7 (*continued*)

	All	Boys	Girls
Distance from school to county town	−0.0355***	−0.0439**	−0.0254
County dummies controlled			
R^2	0.0873	0.0938	0.0888
N	7673	4043	3630

Note: Robust stand error are caculated.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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