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COMPENSATING FOR FAMILY DISADVANTAGE: AN ANALYSIS OF THE EFFECTS OF BOARDING SCHOOL ON CHINESE STUDENTS' ACADEMIC ACHIEVEMENT

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Abstract

China implemented a policy to improve education equity through investing in boarding programs of public schools in rural and less-developed areas. However, this policy has not been informed by empirical research in the Chinese context. By using the nationally representative longitudinal data, this study investigates whether and to what extent boarding schools compensate for children's family disadvantages in terms of mathematics and reading achievement. The findings, drawn from multilevel logistic regression and hierarchical models, indicate that students from low-SES families or rural areas tend to board at schools. Boarding students performed better than day students in 8th-grade mathematics tests. Among students with essential needs, those residing at school during the week significantly benefitted in their school performance in both subjects. Overall, it appears that governmental investment in boarding programs can, to some extent, compensate for some family disadvantages.

Keywords: boarding school; academic performance; socioeconomic status; family support; education equity

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Introduction

Family educational resources are unequally allocated among families within countries. In China, students from socioeconomically disadvantaged families are challenged to achieve academic success similar to that of their peers because their parents cannot provide adequate financial and cultural resources (Luo & Zhang, 2017) . Additionally, unbalanced development has led to a great wave of internal migration for better occupational opportunities. At least 69 million Chinese children who have been left with grandparents in the home experience problems as a result of the absence of parental care and support (UNICEF, 2017). The unsupportive family environment may prevent children from fulfilling their potential to get access to top-tier universities and hinder education's function as a "social elevator" (Postiglione et al., 2017; Roksa & Potter, 2011). Attempting to rectify this problem, the General Office of the State Council of China published *Guidance on Strengthening the Construction of Small-scale Rural Schools and Township Boarding Schools* in 2018 to promote education equity. One of the essential measures mentioned is to develop boarding school programs in areas that export a large amount of labor.

In China, "boarding school" is not a synonym for "elite school" or a unique institution in specific areas. It refers to schools that have the necessary facilities to allow students to live at school during the week. A large number of Chinese primary and secondary schools enroll both day students and boarding students. "Boarding on campus" provides a non-coercive option for Chinese rural and urban students who experience a long commute to school and lack of family support. Additionally, the available funding of public schools is related to the student number and local finance. Schools in either less developed or sparsely populated areas are challenging to supply adequate inputs to students.

For filling the quality gaps among schools, the Chinese government implemented the program of rural school consolidation to merge small schools into larger central schools in towns (Liu & Villa, 2020). This program improved the quality of educational resources in central schools. However, students from relatively remote villages might encounter the difficulties of commuting between home and school every day (Guo et al., 2020). In such areas, "boarding school" is a policy tool for concentrating educational resources. According to *the Statistical Bulletin* published by the Ministry of Education China in 2011, 43.4% of middle school students (Grade 7-9) resided at school. For boarding students with financial difficulties, the central government and local governments supply subsidies to cover their expenses at school. To sum up, boarding schools are open to the masses rather than being exclusive to socioeconomically advantaged students in China.

The newly published policy is designed to counteract the influence of an unsupportive family environment by substituting insufficient family inputs for school inputs. The local governments should allow students to board on campus by equipping schools with necessary educational facilities and human resources based on the national standards of constructing and running a school. Township-level boarding schools should be constructed in sparsely populated areas to satisfy local students boarding requirements. Boarding schools in rural areas should have enough teachers, provide teachers with adequate training, and treat them well.

Few studies to date using nationally representative data from within the Chinese context have investigated the characteristics of boarding students and the academic effects of residing on campus. Thus, the research question is whether the new policy on popularising boarding school programs can improve education equity in China. Our study aims to fill this research gap by (1) exploring the attributes of students who tend to benefit from boarding school programs; and (2) examining to what extent boarding schools contribute to

educational success. The findings contribute to the knowledge of whether improving public boarding schools can compensate for students' family disadvantages.

Literature Review

Function of Boarding School

A "boarding school" is an educational institution where students can study and live either for part of or the entire school year, which solves students' difficulties in transportation between home and school (Ainsworth, 2013). In 2001 and 2004, the Chinese government published two policies[2] to reduce rural-urban education inequality, which emphasized using boarding school as a critical strategy to improve the educational quality of rural schools. Since 2004, boarding schools have experienced intensive development in China. Empirical research showed that the boarding school had become the dominant school form in Chinese rural areas and the average age of boarder students was gradually decreasing (Dong, 2013).

Policy-makers in different contexts have tried to use boarding schools to separate children from the influence of their sometimes disadvantaged home situations. The rationale behind this is that boarding schools can reduce the role of family inputs for students whose school performance is held back as a result of their home life (Foliano et al., 2019). For example, the Aboriginal and Torres Strait Islander Study Assistance Scheme (ABSTUDY) in Australia provided boarding school programs to the indigenous students for improving their educational outcomes (Macdonald et al., 2018). The SEED schools in the U.S. are also designed for helping disadvantaged children, no matter their family environments (Curto & Fryer, 2014).

Facilitating educational success, according to the existing research conducted in various contexts, has shown considerable disparities. Supporters for boarding programs like Curto and Fryer (2014) investigated the data from SEED schools and the District of Columbia Public Schools (DCPS). They found that boarding on campus significantly improved students' mathematics and reading achievement (Curto & Fryer, 2014). Utilizing a more extensive sample based on the data from The Association of Boarding Schools (TABS), Steel and his colleagues (2015) further claimed that boarding students are more likely to graduate from colleges. In the context of China, Liu and Villa (2020) found that boarding on campus improves the academic performance of both left-behind and non-left-behind students. Analyzing the data collected from rural middle schools in Henan province, Yao and Gao (2018) concluded that boarding at school improves students' mathematics achievement. Macdonald et al. (2018) also confirmed the positive effects of boarding at school by studying the case of Australia. Based on a sample of British schools, Foliano and his colleagues (2019) found that boarding students show a higher probability of being in the top decile of achievement in the national standardized exams compared to matched students in grammar schools. Through conducting a qualitative inquiry in boarding schools, Bass (2014) supplied an explanation for such results by indicating that boarding on campus successfully increases students' exposure to social and cultural capital.

However, Mo et al. (2012) and Wang and Mao (2018) made an opposite conclusion by investigating students from Western China. In Australia, Martin et al. (2014) found no significant differences in outcomes between boarding and day students over the course of one academic year. Pfeiffer and Pinquart (2014) found that adolescents at German boarding schools are more often victims of bullying, which was negatively related to students' academic

2 These two policies include: *Decision of the State Council on the Reform and Development of Compulsory Education*, 2001; and *Action Plan for the Revitalization of Education: 2003-2007*, 2004.

achievement (Nakamoto & Schwartz, 2010). In the case of French boarding schools, Behaghel, Chaisemartin, and Gurgand (2017) pointed out that students need time to adapt to their new environment, and only strong students can benefit from boarding schools.

A possible explanation for the mixed findings is that the family characteristics of boarding students may vary across educational systems. Boarding on campus can, to some extent, block the influence from both a supportive and unsupportive home environment (Bass, 2014). If boarding students are more vulnerable to risk-factors at the family level, they should benefit from boarding on campus (Bass, 2014; Weng et al., 2018). Boarding schools may help to eliminate any negative academic effects in a specific context where families fail to provide academic support and proper nurturing, a result of their socioeconomic situation. Otherwise, the results may be insignificant or even negative.

Limitations of prior studies

The gaps in knowledge of boarding schools and boarding students have led to the debate over whether and to what extent boarding on campus should be viewed as a useful policy tool to improve educational resources of family-disadvantaged students. Specifically, although the functions of boarding school have been discussed in previous studies, research studies on their significant academic effect have yet to be established. This ambiguity can be attributed to two reasons. On the one hand, it is challenging to obtain clean estimates of the effect of boarding at school because of the omitted variables. For example, boarding students and day students may differ substantially in their family environment. Most previous studies noticed that boarding students are more likely to be left-behind students (Liu & Villa, 2020; Wang & Mao, 2018). However, the lack of family support rather than parental migration should be the direct reason why students may benefit from boarding at school. Students whose parents are too busy to take care of them or unable to support their studies are also in a disadvantaged position to achieve educational success. Models without controlling such family factors may bias the estimation results of the boarding effect.

On the other hand, prior studies focusing on boarding students rarely use nationally representative data. It not only led to different conclusions depending on various data sources but also determined that the results could not be generalized to the student population in a specific country. For example, Mo et al. (2012) and Wang and Mao (2018) estimated the negative effects of boarding on campus by analyzing the data from students in Western China. By contrast, Curto and Freyer (2014) made an opposite conclusion by investigating the SEED schools located in Washington, D.C. and Baltimore. Guo et al. (2020) also confirmed the positive effects on eighth-grade students by investigating the data collected from eight provinces in China.

Another substantive limitation is that previous studies did not supply accurate estimation of the predictors on Chinese students' access to boarding schools. Boarding school programs in other contexts, like the SEED schools, are for financially disadvantaged urban students and select them by lottery. In contrast, most Chinese secondary schools supply boarding options without a selection mechanism. Students and their parents can autonomously decide whether to board on campus, given their specific needs. In such a context, a study investigating the predictors of residing at school is necessary because the results concern the particular group that benefits from governmental investment in boarding programs.

Given the limitations of the previous studies on Chinese boarding schools and boarding students, the current study aims to answer the following research questions:

1. What are the characteristics of boarding students and non-boarding students in China?
2. Which specific factors, including the socioeconomic status of the family, the community, and residential area (urban or rural), predict students' participation in boarding programs?
3. Whether and to what extent can boarding on campus affect students' academic achievement in China?

Data and Method

Data and Analytic Sample

We analyzed data from a longitudinal sample of middle school students participating in the China Education Panel Survey (CEPS), which is administered by the National Survey Research Center at Renmin University of China (NSCR). This database is designed to investigate the influence of family, school, and community on individuals' educational outcomes. The CEPS adopted a three-stage sampling method to recruit a nationally representative sample of middle school students in 2014. Primary Sampling Unit (PSU) consists of 28 county-level units that were sampled based on the regional average educational level and the migrant population. Secondary Sampling Unit (SSU) consists of 112 schools sampled from the PSU. Two classes for Grade 7 and Grade 9 were sampled from the SSU as a Third Sampling Unit (TSU). Observations in those classes are the basic units of this database.

The sample size of the baseline data is 10,279 in seventh grade and 9,208 in ninth grade. The follow-up survey was employed in 2015. There are 830 students who participated in seventh grade in the baseline survey and who were not followed in the newly published dataset due to school transfer and/or drop out. Additionally, the second wave data have not yet published the baseline ninth grade dataset. Therefore, a total of 9,432 observations has benchmark data in the CEPS.

This study analyzed the second wave data of the CEPS with the analytical sample of the eighth-grade students who participated in both surveys. Considering that participants' prior knowledge may affect their performance, we controlled students' baseline academic performance in the investigation process for an accurate estimation. Missing values existed in the survey sample. After checking the missing patterns of all variables used in our models, we found that different variables are responsible for the missing cases. Notably, 308 cases are missing eighth-grade mathematics and Chinese tests. Another 110 cases were missing seventh-grade mathematics and Chinese scores. This is possible because those students did not participate in those tests for specific reasons, such as being absent or sick. After applying the list-wise deletion, the final analytic sample consisted of 7,272 observations.

Measures

Academic Performance

The CEPS supply students' test scores were reported by schools in both datasets. In the Chinese educational system, the *National Curriculum Standards of Compulsory Education* specifically regulates the knowledge and skills a student should acquire from first through ninth grade. Although the textbooks used in the provinces can be different, they are legally required to be compiled based on the *National Curriculum Standards*. To ensure consistency of education quality throughout China, the Ministry of Education further published an announcement (360A26-05-2011-0007-1) in 2011 to demand that the academic proficiency tests in the stage of compulsory education should be set strictly according to the *National*

Curriculum Standards. Therefore, the difficulty level of tests in middle schools should be similar across regions of China. Students' academic achievement thus is comparable in this database. This study used students' mathematics and reading test scores to indicate their school performance, which were the outcome variables in the HLM models.

Boarding Status

The CEPS survey includes a question of whether the students were boarding on campus from Monday to Thursday. Based on students' answers, we generated a dichotomous variable of boarding status. The value of boarding status was "1" when the students claimed that they resided on campus during school days. Boarding status was the outcome variable in the multilevel logistic models.

In China, students and their family members can choose whether to board at school based on their needs. Although rural students may have higher demands on boarding at school due to parental migration, disadvantaged students also exist in urban areas. For example, some urban parents may be too busy to be a part of their children's education, or do not have the academic knowledge to facilitate their children's studies. Urban students from those families also lack family emotional support. Therefore, this study investigates the effect of boarding at school for both rural and urban students.

Socioeconomic Status (SES)

Family socioeconomic status is made up of several components, such as income, education, and occupation (Duncan et al., 1972). Generating a composite SES indicator by different components can avoid conflicting stories about relationships to the dependent variable (National Center for Education Statistics, 2012). As such, we performed Principal Component Analysis (PCA) on the correlation matrix to generate a variable representing family SES. The component details are listed in the Appendix.

Parental educational involvement at home

Parents reported whether students need academic support from the family and how often they had supported children's schoolwork at home that past week. Five categories are included in this ordinal variable. The first is "no need, no support". The second is "need, but no support". The third is "supplying support for 1-2 days". The fourth is "supplying support for 3-4 days". The fifth is "supplying support every day".

School Disciplinary Climate

School administrators reported the frequency of students' misbehaviors at school. The disciplinary climate is essential to be kept as constant in estimation models because it directly relates to boarding students' living and studying environment. We employed PCA to generate a composite variable to indicate whether the disciplinary climate was relatively poor in a school.

Moreover, we also controlled a series of variables indicating students' demographic characteristics and school factors. The details of those variables are shown in the Appendix.

Analytic Procedures

This study undertook four analytical steps to investigate the research questions. We first computed descriptive statistics and examined how student characteristics differed between boarding and day student groups by using a T-test. Then, we employed multilevel logistic regression to examine whether students' family characteristics, including SES,

community environment, and residential area, predicted their participation in boarding programs. For isolating unmeasured effects on the estimated predictive relations, we statistically controlled the confounders consisting of students' personal characteristics as well as school factors. We re-estimated the predictive strength by adding more family and school variables, like migrant status and teachers' education level, into the logistic regression models. Those variables did not make significant changes to the estimated relations and were excluded from the final models.

Third, considering the nested structure of the analytic sample, we estimated multilevel regressions by using the boarding status, family characteristics, and extensive covariate adjustment to predict the students' mathematics and Chinese reading achievement in the eighth grade. This step depicted an overall picture of the extent to which students' boarding status was related to their mathematics and reading performance in Grade 8. Given that our hierarchical linear models (HLM) controlled for students' previous academic achievement (Grade 7), these regressions generated value-added estimates for the included factors. Moreover, we applied robustness checks by calculating the sandwich estimator to ensure that our results were plausible and robust.

Fourth, we further focused on those students receiving limited parental support for schoolwork and re-estimated the full models in the third step. Given boarding students stay on campus from Monday to Friday, their parents have at most two days to tutor their studies. We generated three analytic subgroups by using the ordinal variable "parental educational involvement at home". The first subgroup consisted of students who need family support but received none. The second subgroup referred to students having limited family support. In addition to observations in the first subgroup, the second subgroup included students who received family support for at most two days in a week. The third subgroup referred to students who received family support at least three days a week. This group provides a comparison to the first two groups.

Results

RQ.1 What are the characteristics of boarding students and non-boarding students in China?

Table 1 displays descriptive statistics of the full analytic sample as well as statistics for boarding and non-boarding students. Approximately 30% of eighth-grade students were boarding students. Among the day school students, 22% lived in rural areas. 73.8% of boarding students were from rural areas. Females accounted for about fifty percent of all students. The average parental expectation was to let their children complete tertiary education.

According to the T-test results displayed in Table 1, day students showed significantly higher mathematics performance than did their boarding peers in seventh grade. No significant differences were found in the other tests. The non-boarding group demonstrated significantly higher SES and parental expectations than did the boarding group. The neighbors of day students had a higher socioeconomic status on average. Significantly more boarding students were from rural areas. Furthermore, day students showed advantages in factors representing school quality. Day students enjoyed significantly better educational facilities and more affluent human resources than did boarding students on average. Schools attended by day students offered more chances for direct teacher-parent communication. Those schools generally ranked above the boarding schools on educational quality. Their campus climates were also more supportive than those of boarding schools.

Table 1.
Descriptive Statistics of Student, Family, and School Characteristics

	All Students			Non-boarding Students			Boarding Students			T-test	
Variable	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean Diff	t
Mathematics (8th-Grade)	64.32	25.83	7272	64.50	25.62	5091	63.91	26.32	2181	0.587	0.888
Mathematics (7th-Grade)	68.62	23.27	7272	69.14	23.11	5091	67.39	23.61	2181	1.748	2.937**
Chinese Reading (8th-Grade)	69.20	14.74	7272	69.01	14.73	5091	69.67	14.76	2181	-0.660	-1.75
Chinese Reading (7th-Grade)	71.84	13.41	7272	71.67	13.69	5091	72.25	12.75	2181	-0.578	-1.683
SES	0.025	1.469	7272	0.368	1.438	5091	-0.776	1.204	2181	1.144	32.598***
Family economic status	2.948	0.605	7272	3.022	0.581	5091	2.775	0.627	2181	0.247	16.209***
Highest occupation level	2.367	1.241	7272	2.575	1.291	5091	1.883	0.956	2181	0.692	22.522***
Highest education level	2.755	1.203	7272	2.983	1.261	5091	2.222	0.842	2181	0.761	25.829***
Family possesions (standardized)	0.008	0.994	7272	0.207	0.873	5091	-0.459	1.098	2181	0.666	27.502***
Attitude on learning	3.343	0.943	7272	3.366	0.961	5091	3.291	0.898	2181	0.075	3.111**
Parental expectation	4.876	1.162	7272	4.958	1.126	5091	4.684	1.220	2181	0.274	9.26***
Social class of community	1.776	0.455	7272	1.831	0.425	5091	1.648	0.497	2181	0.182	15.915***
Living in a rural area	0.373	0.484	7272	0.216	0.411	5091	0.738	0.440	2181	-0.522	-48.579***
Frequent parents quarrel	1.903	0.296	7272	1.908	0.289	5091	1.892	0.310	2181	0.016	2.092*
Frequent criticisms from teachers	1.840	0.888	7272	1.846	0.890	5091	1.826	0.885	2181	0.021	0.907
Gender	0.513	0.500	7272	0.515	0.500	5091	0.507	0.500	2181	0.008	0.655
School educational facilities	-0.068	1.944	7272	0.164	1.923	5091	-0.610	1.884	2181	0.775	15.84***
Ratio of teacher to student	0.092	0.040	7272	0.093	0.040	5091	0.090	0.039	2181	0.003	3.366**
Frequency of parent-teacher meeting	2.549	0.620	7272	2.673	0.555	5091	2.259	0.664	2181	0.414	27.44***
Rank of school in the local district	4.048	0.853	7272	4.094	0.839	5091	3.942	0.877	2181	0.152	6.992***
Disciplinary climate at school	0.046	1.681	7272	-0.0677	1.659	5091	0.311	1.701	2181	-0.378	-8.842***
School location	1.721	0.844	7272	1.701	0.855	5091	1.767	0.818	2181	1.721	-3.037**

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

RQ.2 Which specific factors, including the socioeconomic status of the family, the community, and residential area (urban or rural), predict students' participation in boarding programs?

Table 2 presents the coefficients and average marginal effects of multilevel logistics models. Model 1 predicted students' choice of boarding on campus using only variables indicating the family environment. Model 2 added students' personal characteristics, including attitude on learning and gender. Model 3 further added indicators for school characteristics concerning educational resources, school rank, and campus climate.

The results of Model 1 show that family SES and living in a rural area significantly predicted the probability of participation in boarding programs. Specifically, holding the other family indicators as constant, a one-unit increase in family SES was associated with a 1.4% decrease in the probability of residing at school. Living in a rural area predicted a 7% increase in the probability of boarding on campus. Model 2 presents that statistically controlling for personal characteristics did not widely change the predictive relation between family factors and participation in boarding programs. Notably, male students were associated with a 2.4% decrease in the probability of boarding on campus. Model 3 includes school variables as additional controls. The results show that school resources and campus climate had little effect on the likelihood of students' boarding choice. By controlling school-level covariates, for each one-unit increase in family SES, the probability of boarding at school decreased on average by 1.6%, which is significant at the .01 level. Living in a rural area significantly increased the probability of residing at school at the .001 level. The predictive strength of the social class of community is similar to those reported in Model 1 and Model 2. Female students still had a higher probability of participation in boarding programs than did their male peers. Overall, having high SES, living in an urban area, and being a male student predicted a remote probability of residing at school, respectively.

For checking the robustness, we added other covariates, including students' migrant status (being a migrant student or left-behind student) and available academic support from parents to the estimation models. Both variables are not significantly associated with students' participation in boarding programs. The estimated results are quite similar to the ones we reported. As such, we excluded them from the final models.

RQ.3 Whether and to what extent can boarding on campus affect students' academic achievement in China?

Table 3 displayed the results of hierarchical linear models used to estimate the effect of boarding on campus on students' academic achievement. Clustered standard errors are shown in parentheses. Eighth-grade students' mathematics performance was the dependent variable of Model 1-3. Their Chinese reading performance was the dependent variable of Model 4-6. Interclass correlation (ICC) was calculated for each model to test whether the usage of the hierarchical models was necessary. The results justify our modeling of school variance by suggesting that schools played an essential role in differing students' academic performance.

Model 1 and 4 used only a dummy variable indicating students' boarding status as predictors after dealing with the shared variance in the data nested within schools. Model 2 and 5 added individual-level covariates to isolate the unexpected effects. Model 3 and 6 further controlled variables representing school characteristics to see whether the magnitude of boarding on campus was above and beyond the effect of the multilevel controls.

Table 2.
Multilevel Logistic Models: Coefficients and Average Marginal Effects (AME) for Boarding at School

	Model 1		Model 2		Model 3	
	Coefficient	AME	Coefficient	AME	Coefficient	AME
Family predictors:						
SES	-0.202***	-0.014*	-0.190***	-0.013*	-0.183***	-0.016**
	(0.050)	(0.006)	(0.051)	(0.006)	(0.051)	(0.005)
Parental expectation	0.0385	0.003	0.0431	0.003	0.0429	0.004
	(0.041)	(0.003)	(0.043)	(0.003)	(0.043)	(0.004)
Social class of community	-0.231*	-0.016	-0.236*	-0.016	-0.232*	-0.020*
	(0.106)	(0.009)	(0.107)	(0.009)	(0.107)	(0.010)
Frequent parents quarrel	-0.115	-0.008	-0.0846	-0.006	-0.0843	-0.007
	(0.158)	(0.011)	(0.158)	(0.011)	(0.158)	(0.013)
Living in a rural area (1=yes)	1.120***	0.077**	1.131***	0.078**	1.120***	0.095***
	(0.132)	(0.027)	(0.133)	(0.027)	(0.132)	(0.020)
Personal predictors:						
Attitude on learning			-0.116*	-0.008	-0.115*	-0.010
			(0.058)	0.005	(0.058)	(0.005)
Gender (1=male)			-0.350***	-0.024*	-0.350***	-0.030**
			(0.101)	0.011	(0.101)	(0.010)
School predictors:						
Educational facilities					-0.342	-0.029
					(0.214)	(0.018)
Ratio of teacher to student					-15.05	-1.280
					(9.135)	(0.827)

	Model 1		Model 2		Model 3	
	Coefficient	AME	Coefficient	AME	Coefficient	AME
Rank of school in the local district					-0.278	-0.024
					(0.482)	(0.040)
Disciplinary climate at school					0.304	0.026
					(0.253)	(0.022)
School located in:		(East China is the reference group)				
Middle China					1.873	0.206
					(1.048)	(0.139)
West China					-0.153	-0.010
					(1.040)	(0.070)
Constant	-2.696***		-2.214***		-0.0366	
	(0.590)		(0.609)		(2.411)	
Between-school variance	14.495***		14.679***		13.168 ***	
	(2.836)		(2.871)		(2.531)	
N	7272		7272		7272	

Exponentiated coefficients; Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

The results of Model 1 show that students' boarding status did not have a significant relationship with mathematics achievement. Model 2 statistically controlled for students' personal and family characteristics and found that boarding on campus was positively and significantly associated with students' mathematics performance. After adding all demographic and school features in the estimation model, Model 3 presents the consistent results with Model 2. Specifically, boarding students achieved 1.62 points higher in eighth-grade mathematics tests than did otherwise similar non-boarding students. Among the covariates, students' previous mathematics performance, attitude on learning, and parental expectation had strong and positive predictive strength on their eighth-grade mathematics test scores. Their mathematics test scores were negatively associated with frequent adverse criticisms from teachers.

By contrast, the relations between boarding on campus and Chinese reading achievement exhibited in Model 4-6 show different results. Model 4 suggests that students boarding on campus achieved 1.59 points higher than did day students without controlling any covariates. While progressively holding multilevel characteristics as constant, the results presented by Model 2 and Model 3 indicate that there were no significant academic effects attributable to boarding on campus.

Further, we re-estimated the full models of students with essential needs for residing at school on weekdays. The results are shown in Table 4. Model 1-3 investigated the relationships between boarding status and eighth-grade mathematics achievement by analyzing the subgroups of students who had none, limited, and strong family support, respectively. Model 4-6 estimated the effects on Chinese reading achievement.

The results suggest that boarding at school was consistently and positively associated with the academic performance of eighth-grade students who received no family support. However, boarding students with limited family support present significant advantages in mathematics tests only, but not Chinese reading tests, compared to their counterparts. Boarding at school showed no significant effects on the test performance of students with strong academic support from parents. Notably, in case that the missing data caused heteroscedasticity, we applied a robustness check for models reported in Table 3 and Table 4 by calculating the robust estimator of variance. The significance levels of the coefficients estimated by this method are quite similar to our main analysis. It indicates that our results are not biased by the missing observations.

Discussion

We used hierarchical linear models to examine the predictors of students' choice of boarding at school and its effect on academic achievement by utilizing nationally representative data, the China Education Panel Survey (CEPS). We consistently observed that low family socioeconomic status and living in a rural area increased eighth-grade students' likelihood of boarding at school. Moreover, our findings indicate that boarding students performed better than day students in eighth-grade mathematics tests, but not on Chinese reading tests, after isolating the effects of individual and school factors. Among students with essential needs, such as parental absence or lack of family support, boarding on campus significantly benefits their school performance in both subjects. These findings indicate that governmental investment in raising the quality of public boarding schools may, to some extent, compensate for students' family disadvantages.

Table 3.
HLM Analysis of Boarding Effects on 8th-grade Students' Mathematics and Chinese Reading Performance

	(1) Mathematics	(2) Mathematics	(3) Mathematics	(4) Chinese	(5) Chinese	(6) Chinese
Boarding students	1.741	1.549*	1.620*	1.590*	0.391	0.453
(1=yes)	(1.234)	(0.685)	(0.699)	(0.681)	(0.470)	(0.469)
Test scores		0.754***	0.753***		0.624***	0.623***
(7th-grade)		(0.025)	(0.025)		(0.024)	(0.024)
SES		-0.126	-0.138		-0.0573	-0.0699
		(0.179)	(0.180)		(0.126)	(0.125)
Attitude on learning		3.153***	3.154***		1.564***	1.565***
		(0.310)	(0.310)		(0.162)	(0.162)
Parental expectation		2.152***	2.150***		1.249***	1.248***
		(0.246)	(0.247)		(0.151)	(0.151)
Social class of community		-0.942*	-0.952*		-0.293	-0.301
		(0.406)	(0.405)		(0.247)	(0.247)
Living in a rural area		0.298	0.317		-0.573	-0.553
(1=yes)		(0.581)	(0.589)		(0.318)	(0.319)
Frequent parents quarrel		0.177	0.169		-0.0582	-0.0644
		(0.529)	(0.530)		(0.301)	(0.302)
Frequent criticisms		-1.055***	-1.058***		-0.474***	-0.477***
		(0.200)	(0.199)		(0.122)	(0.122)
Gender		-1.008**	-1.004**		-2.205***	-2.207***
(1=male)		(0.327)	(0.327)		(0.243)	(0.243)

School-level predictors:						
Educational facilities			-0.207			0.206
			(0.590)			(0.379)
Ratio of teacher to student			9.520			14.83
			(21.41)			(14.67)
Frequency of parent-teacher meeting			1.322			-0.158
			(1.653)			(1.018)
Rank of school in the local district			1.551			1.826*
			(1.067)			(0.828)
Disciplinary climate at school			-0.574			-0.613
			(0.541)			(0.332)
School located in:			(East China is the reference group)			
Middle China			1.259			-0.710
			(2.782)			(2.127)
West China			-1.660			-1.916
			(2.495)			(1.473)
Constant	63.15***	-5.246*	-15.42*	68.33***	15.85***	8.292
	(1.407)	(2.360)	(6.820)	(0.983)	(2.050)	(4.797)
Between-school variance	184.6***	76.72***	72.27***	85.81***	38.30***	33.85***
	(12.13)	(5.820)	(5.384)	(7.541)	(2.792)	(2.725)
Within-student variance	485.1***	197.0***	197.0***	138.4***	65.09***	65.09***
	(11.29)	(6.853)	(6.848)	(5.576)	(3.199)	(3.197)
Interclass correlation	0.276	0.280	0.268	0.383	0.370	0.342
N	7272	7272	7272	7272	7272	7272

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.
HLM Analysis of Boarding Effects on Students with Essential Needs

	(1)	(2)	(3)	(4)	(5)	(6)
	Mathematics (None support)	Mathematics (Limited support)	Mathematics (Strong support)	Chinese (None support)	Chinese (Limited support)	Chinese (Strong support)
Boarding students (1=yes)	3.858**	2.320*	0.410	1.744*	0.789	-0.974
	(1.305)	(1.089)	(1.361)	(0.888)	(0.656)	(0.685)
Test scores (7th-grade)	0.745***	0.743***	0.732***	0.632***	0.629***	0.639***
	(0.031)	(0.028)	(0.032)	(0.033)	(0.026)	(0.029)
SES	-0.180	-0.0333	0.0384	-0.266	-0.138	-0.110
	(0.388)	(0.235)	(0.276)	(0.206)	(0.154)	(0.185)
Attitude on learning	2.817***	3.122***	3.561***	1.136***	1.365***	1.455***
	(0.462)	(0.325)	(0.380)	(0.254)	(0.162)	(0.180)
Parental expectation	2.037***	2.097***	2.342***	1.397***	1.380***	1.512***
	(0.363)	(0.321)	(0.547)	(0.182)	(0.179)	(0.314)
Social class of community	-1.747*	-1.253*	-0.216	0.293	0.269	0.0262
	(0.734)	(0.618)	(0.781)	(0.410)	(0.353)	(0.482)
Living in a rural area (1=yes)	-0.307	0.650	1.660	-0.874	-0.145	0.852
	(1.031)	(0.843)	(1.117)	(0.634)	(0.399)	(0.569)
Frequent parents quarrel	-0.158	-0.279	-0.175	-0.0698	-0.597	-0.962
	(0.964)	(0.875)	(1.162)	(0.646)	(0.489)	(0.648)
Frequent criticisms	-1.055*	-1.081***	-0.816*	-0.386	-0.476**	-0.495*
	(0.431)	(0.314)	(0.380)	(0.218)	(0.173)	(0.222)
Gender (1=male)	-0.676	-1.296**	-1.234	-2.399***	-2.249***	-1.934***
	(0.675)	(0.463)	(0.630)	(0.383)	(0.303)	(0.383)

School-level predictors:						
Educational facilities	-0.0297	-0.0983	-0.0150	0.0280	0.200	0.341
	(0.648)	(0.564)	(0.425)	(0.388)	(0.378)	(0.362)
Ratio of teacher to student	19.93	15.10	23.85	18.76	19.71	20.85
	(24.29)	(21.31)	(21.55)	(13.89)	(13.56)	(14.50)
Parent-teacher meeting	1.187	1.486	1.772	-0.127	-0.317	-0.711
	(1.754)	(1.615)	(1.499)	(1.102)	(1.025)	(1.050)
Rank of school in local district	2.146	1.769	1.360	1.462	1.822*	2.024*
	(1.170)	(1.074)	(1.145)	(0.877)	(0.854)	(0.891)
Disciplinary climate	-0.975	-0.859	-0.931*	-0.814*	-0.770*	-0.522
	(0.565)	(0.541)	(0.463)	(0.357)	(0.320)	(0.330)
School located in:			(East China is the reference group)			
Middle China	1.778	1.174	2.227	-0.721	-0.569	0.237
	(2.932)	(2.701)	(2.454)	(2.117)	(2.118)	(2.190)
West China	-0.996	-1.464	-0.778	-1.427	-1.334	-1.263
	(2.499)	(2.367)	(2.199)	(1.513)	(1.458)	(1.491)
Constant	-15.48*	-15.32*	-20.39**	7.424	7.281	7.159
	(7.502)	(6.692)	(7.424)	(4.991)	(4.949)	(5.621)
Between-school variance	71.57***	65.58***	54.06***	33.11***	33.29***	32.42***
	(6.417)	(5.139)	(3.948)	(2.811)	(2.690)	(2.762)
Within-student variance	219.3***	210.8***	192.1***	68.61***	63.97***	57.74***
	(9.957)	(7.717)	(7.251)	(3.734)	(3.027)	(3.073)
N	1941	3758	2264	1941	3758	2264

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

A plausible explanation for the findings is that teachers can supply under-supported students with better academic assistance than that provided by their families, which partly remedies the deficiency in the current Chinese educational system. Chinese public schools in the stage of compulsory education (Grades 1-9) have adopted the principle of nearby enrollment. It requires that students have to attend the school closest to the address registered in their Hukou, the Chinese household registration system. This principle theoretically ensures students' equity in access to high-quality education. However, some families can assist their children by investing in a residence located in high-performing school districts and scheduling structured extracurricular activities after school. That facilitates those children to outperform their counterparts with little parental educational support and involvement. If disadvantaged students choose to board at school, well-educated teachers can give them timely academic guidance and guarantee their implementation of a relatively rigorous timetable, which mitigates the adverse effects of family disadvantages.

Educational inequality also exists between Chinese rural and urban areas, which is reflected in the fact that rural students perform less well than their urban counterparts in school and are less likely to enroll in top-tier universities (Postiglione et al., 2017). This could be attributed to the fact that rural parents may migrate to large urban areas for working opportunities or be undereducated. It directly reduces family support received by rural students. Under such circumstances, rural students can derive academic assistance from boarding programs to fulfill their academic potential.

Notably, the results confirmed gender differences in the probability of boarding on campus. Girls are more likely to reside at school. A possible explanation is that parents may tend to believe that the girls can behave well at school on weekdays. Female students are more self-disciplined than their male counterparts (Duckworth & Seligman, 2006). This factor may assist girls to take the most advantage of boarding on campus and avoid the adverse impact of temporary parental absence.

However, boarding on campus does not benefit children's development equally. Boarding at school on weekdays separates students from their families at a very early stage, which leaves them to deal with many social and emotional issues (Behaghel et al., 2017). Schools are rarely able to provide differentiated support based on students' needs. Thus, the positive effect of boarding on campus should be on condition that the support acquired from boarding programs is hard to be replaced. Otherwise, if boarding programs fail to substitute school inputs for family inputs appropriately, they may have less or even no effect on students' performance. Our findings partially support this assumption by suggesting that students who had an essential need for academic support but received none from families derive higher returns from boarding at school.

This study has several limitations. First, the longitudinal data from the CEPS are currently available only from seventh to eighth grade, and class-level data is not accessible in Grade 8. Thus, on the one hand, we cannot apply more complex statistical models (i.e., difference-in-difference) to investigate the academic effect of boarding on campus. On the other hand, the results may suffer from omitted variable bias if other factors are not fully controlled. For instance, the observed assistance from class tutors may moderate the effect of boarding on campus because class tutors keep in the closest contact with students during weekdays. Second, although the test scores are comparable in the CEPS datasets, they are not drawn from a national assessment. This situation prevents us from making causal inferences in this study. Instead, we confirm that family disadvantages predict students' participation in boarding programs, and there is a positive association between boarding on campus and academic performance of students who need academic support after school.

Therefore, whether boarding on campus causally decreases students' family disadvantages is still unclear and needs more advanced statistical techniques applied in future research.

The current study contributes to the existing knowledge about the function and benefits of boarding school programs and provides a basis for decisions for policy-makers and educators. First of all, our findings suggest that boarding on campus is a valuable way to mitigate the adverse effects of family disadvantages. Although criticized for engendering parental absence, boarding on campus is an option rather than a mandatory requirement in the Chinese educational system. Parents usually choose a boarding program after balancing the drawbacks against their ability of providing an academically supportive environment. Additionally, parental care is not entirely absent in boarding schools because students can regularly visit their families for weekends and vacations. Therefore, boarding on campus has the potential to adequately compensate for students' family disadvantages and avoid potential negative impacts in the context of China.

Furthermore, our findings suggest that the functions of boarding on campus differ across social contexts. Previous research rarely investigated its function of bridging family gaps because, on the one hand, boarding schools have historically been used as tools for reinforcing power relationships and cultural identities (Graham, 2012). On the other hand, boarding schools are not regular institutions in many educational systems, which are only open to specific groups of children. For example, SEED schools exist in several states of the U.S. and serve disadvantaged students. On the opposite end, a boarding school in England, Christ's Hospital, admits talented pupils. By contrast, Chinese students may choose boarding programs based on their initial needs rather than social strata or qualification, which effectively counteracts the influence of the unsupportive environment on their achievement. The Chinese educational system, characterized by high-stakes tests, assumes a higher likelihood of attending prestigious post-secondary institutions for high-achievers at school. Therefore, the context of China highlights the fact that boarding on campus can be utilized as a mechanism to battle social inequality.

Finally, the implementation of *the Guidance on Strengthening the Construction of Small-scale Rural Schools and Township Boarding Schools* can improve education equity in rural and less-developed areas. However, children from disadvantaged families also reside in urban areas, where residential facilities are not equipped in each school. In the next step, the government may want to consider investing in residential infrastructures of urban schools, especially those with limited family support, to provide a chance for disadvantaged students to compete for academic success at school equally.

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Appendix

Predictors Used in the Models

Variable	Description
Personal and Family Level	
Boarding status	Reported by students in the CEPS
SES	PCA components: ● Family economic status ● Highest education level (based on ISCED-97) ● Highest occupation level (based on ISCO-2008) ● Home possessions (house type, separate toilet, toilet type, and tap water)
Parental educational expectations	Reported by parents or guardians in the CEPS and recategorized based on ISCED-97
Attitudes on learning	Indicating students' internal motivation in studying. Reported by parents or guardians in the CEPS.
Social class of the community	An ordinal variable containing 3 levels. "3" is the highest. Reported by parents or guardians in the CEPS.
Living in a rural area	Reported students in the CEPS.
Frequent parents quarrel	An ordinal variable. Reported students in the CEPS.
Frequent adverse criticisms from teachers	An ordinal variable. Reported by parents or guardians in the CEPS.
Gender (1=Male)	Reported students in the CEPS.
Parental educational involvement at home	An ordinal variable indicating how often parents help children with schoolwork in the past week.
School Level	
Educational Facilities	PCA components: ● Lab ● Computer lab ● Library ● Music classroom ● Activity room ● Psychological consultation room
Ratio of teacher to student	Generated by the function: # of teachers / # of students

Frequency of parent-teacher meeting	Reported by school administrators in the CEPS.
Rank of school in the local district	An ordinal variable containing 5 levels. "5" is the best. Reported by school administrators in the CEPS.
Disciplinary climate	PCA components: ● Playing Truant ● Fighting at School ● Vandalism ● Drinking at School
School location	A categorical variable indicating geographical location in China. "1" is for East China, "2" is for Middle China, and "3" is for West China. Reported by school administrators in the CEPS.