Premature Boarding and Human Capital Accumulation for Rural Pupils:
Evidence from School Consolidations*

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Abstract: *From 2001 to 2012, many local governments in China closed down village teaching sites for primary school students in the first and second grades, consolidating them into larger township schools more distant from village students' homes. School closure and consolidation are particularly striking in China's central and western regions, where swathes of rural labor migrated to cities for jobs. As a result, numerous primary school pupils are forced to study at boarding schools in the first and second grades, which is considered as too early for pupils to live without parental care. This paper employs survey data from 137 township schools with boarding qualifications collected by a project team consisting of researchers from the China Institute for Educational Finance Research (CIEFR) of Peking University, the Institute of Population and Labor Economics of the Chinese Academy of Social Sciences (IPLE-CASS) and the Capital University of Economics and Business (CUEB). By matching the home-school distance with village teaching site information as the proxy variable for the school consolidation policy, this paper evaluates the policy's impact on the likelyhood of premature boarding for primary school pupils, as well as the impact on their human capital accumulation. Our study finds that the creation of teaching sites makes it less likely for primary school pupils to board at school. Premature boarding impedes children's human capital accumulation, and the harmful effect is particularly striking for children lacking pastoral teachers, raised by grandparents and from families above average income levels, as well as girls.*

Keywords: *school consolidation, primary school students, premature boarding, instrumental variable, human capital*

JEL Classification Codes: A21, I25

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1. Introduction

Primary education is the cornerstone of rural education in China. Yet the quality and accessibility of primary schools are uneven across regions with varying fiscal resources. As the

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population of rural school-age children started to shrink after 2000, rural schools struggled to recruit sufficient students and use fiscal funds efficiently under the "one village, one school" layout. Moreover, educational reform[1] has saddled county-level governments with the responsibility to finance primary education. In the countryside of China's central and western regions, local governments in fiscal red ink took the lead in closing teaching sites[2] - small primary schools usually for pupils in the first and second grades - to raise efficiency (Ding, Zheng, 2015). With the closure of village teaching sites, resources were pooled in township schools where teaching quality is expected to be higher. However, villages in central and western regions are often scattered in mountainous areas with poor access to transportation, forcing students to board at school before the third grade.

Yet the inadequate facilities and pastoral care at boarding schools are a far cry from meeting the needs of premature boarding pupils, taking a toll on their human capital accumulation. If a social group is unable to improve their human capital in health and education, poverty will become inevitable and inescapable (Cai, 2017). Childhood experience will influence lifelong human capital accumulation (Heckman, 2008). Without a proper grasp of basic knowledge and learning methods at primary school, a child is more likely to flounder in later stages of education.

Since 2012, the central government has prohibited the closedown of teaching sites at various localities. Yet fiscal pressures still prodded local governments into encouraging premature students to attend boarding schools or acquiescing such a practice. The closedown of teaching sites offers an experiment window: Before 2001, the "one village, one school" system dominated rural primary education in China. The period between 2001 and 2012 saw widespread closures of rural teaching sites, though the number of closed teaching sites varies considerably across regions. By unraveling differences in the layout of township schools, this paper examines the intensity of school closure and its implications for boarding pupils' academic performance and psychological health.

Based on the survey data on rural boarding schools in China's central and western regions, this paper investigates the availability of schools in the proximity of rural students' homes, the likelihood for premature students to attend boarding schools, and the human capital impact of sending premature students to boarding schools. Also, the heterogeneity of such impact is examined from the perspectives of the availability of pastoral teachers, guardians, household income and gender.

2. Research Background and Hypotheses

2.1 Background

2.1.1 Closedown and consolidation of rural primary schools

In the 1990s, the Chinese government vowed to basically universalize nine-year compulsory education by 2000. Yet the tax-sharing reform of 1994 left local governments with fewer financial muscle and a funding gap for rural compulsory education. In 1995, the then State Education Commission and the Ministry of Finance launched the "Compulsory Education Project for Poor Regions" under the principle of "optimizing educational resource allocation and school layout" to ensure efficient use of funds. From 1995 to 2000, such adjustment in the layout of rural compulsory education was characterized by the closure and consolidation of teaching sites into centralized schools (Zhao, 2019). Figure 1 suggests a decline in the number of small rural

[1] See the *Decisions of the State Council on the Reform and Development of Elementary Education* (Guo Fa [2001] No.21), http://old.moe.gov.cn/publicfiles/business/htmlfiles/moe/moe_16/200105/132.html. This document calls for establishing a "county-dominated system where responsibilities are shared among various levels of local government under the leadership of the State Council."

[2] In 2001, the National Elementary Education Work Conference called for launching a nationwide adjustment in the layout of rural schools, known as the "merger and consolidation of rural primary schools."

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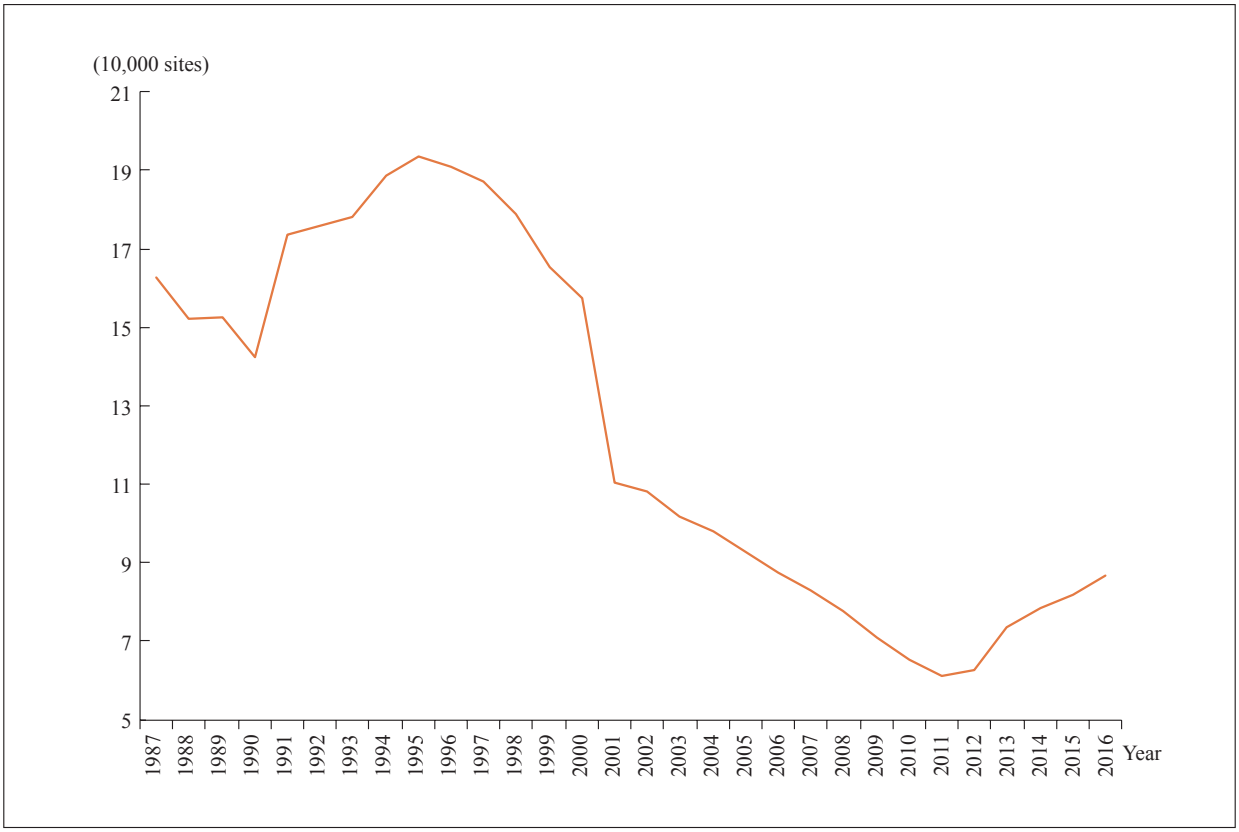

Figure 1: Number of Rural Teaching Sites (1987-2013)

Source: *China Education Statistical Yearbook (1988-2015)*, compiled by the Development and Planning Department of the Ministry of Education, Beijing: the People's Press.

schools since 1995.

In 2001, China's central government launched the rural tax-for-fee reform[3] and abolished the practice of educational fundraising. Since then, county governments have been saddled with administering and financing rural compulsory education. Meanwhile, localities across China started to close and consolidate rural primary schools. As shown in Figure 1, the number of teaching sites plummeted between 2000 and 2001 and continued to fall steadily from 2002 to 2011, putting an end to the "one village, one school" principle.

The local movements closing and consolidating schools over the 2001-2012 period triggered a social backlash that prompted the central government to step in. During this period, the construction of boarding schools failed to keep pace with the closure of teaching sites, and long distance to schools led to a rise in dropout rates among rural school-age children in central and western regions. In 2012, the State Council enacted the *Opinions on Regulating the Layout Adjustment of Rural Compulsory Schools*[4], which prohibits the closedown of rural compulsory education schools - unless absolutely necessary - to

[3] See *Circular of the State Council on Improving the Pilot Programs of Rural Tax-for-Fee Reform* (Guo Fa Ban [2001] No.5) http://www.gov.cn/zhengce/content/2016-09/18/content_5109014.htm. This directive states that "rural tax-for-fee reform entails the reform of the rural compulsory education system to abolish educational fundraising from township governments and local farmers, transfer the responsibilities of running rural compulsory education to county-level governments, and incorporate educational spending into county-level fiscal budget".

[4] See the Opinions on Regulating the Layout Adjustment of Rural Compulsory Schools (Guo Ban Fa [2012] No.48), http://www.gov.cn/zwgk/2012-09/07/content_2218779.htm.

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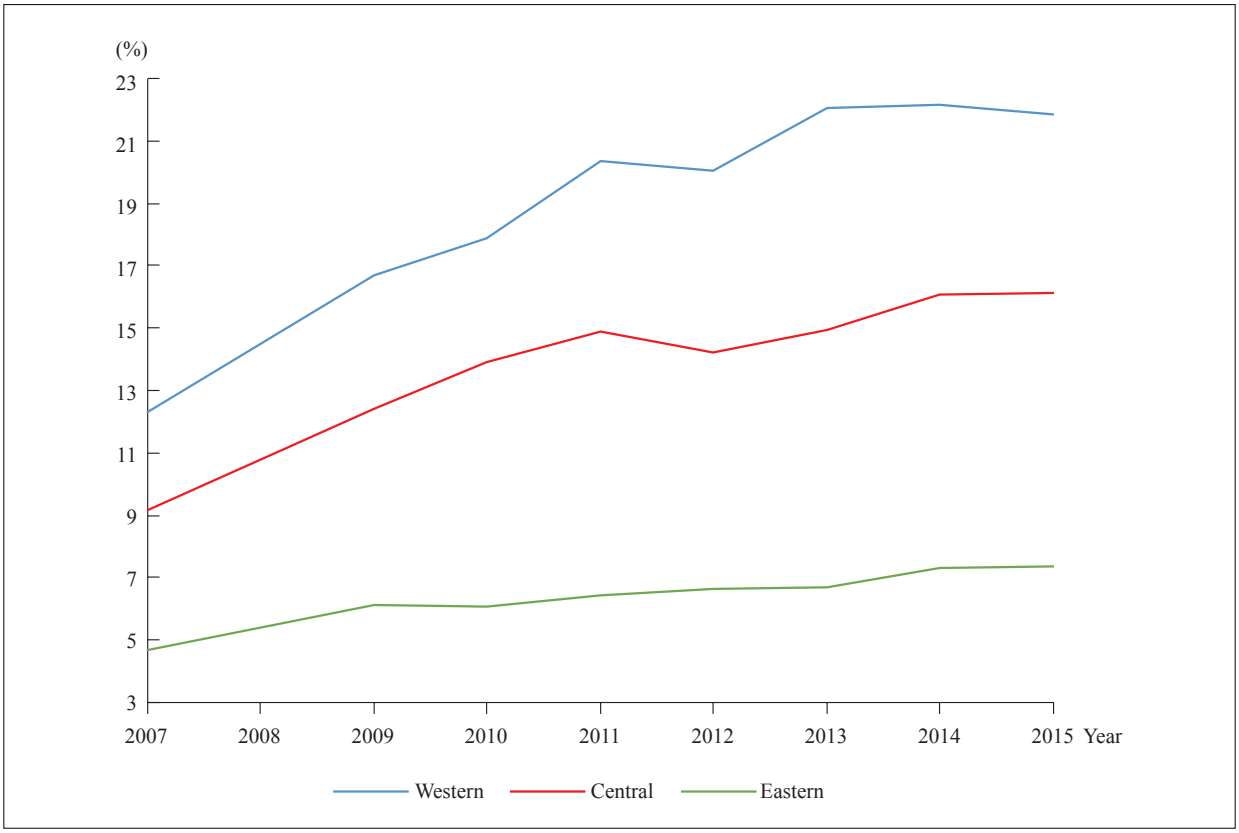

Figure 2: Percentage of Rural Primary Boarding School Pupils by Region (%)

Note: Percentage of rural primary boarding school pupils by region = (Total rural primary boarding school pupils by region / Total rural primary school students in the region) × 100%.

Source: *Concise Statistical Analysis of China's Educational Undertakings* by the Development and Planning Department of the Ministry of Education (internal document).

ensure that students can be admitted to schools close to their homes. This policy directive marks the end of rural school closure and consolidation. As shown in Figure 1, the number of teaching sites started to increase after 2012.

2.1.2 Creating rural primary boarding schools

In central and western parts of China, local governments have closed more schools than elsewhere, and a higher percentage of primary school students attend boarding schools. In 2003, the central government allocated a earmarked fund to create boarding schools in the countryside of central and western regions to expedite the closure of teaching sites, resulting in a higher percentage of primary school pupils at boarding schools.

Figure 2 reveals increasing percentages of primary school pupils at boarding schools in China's eastern, central and western regions from 2007 to 2015. Obviously, the western region saw the sharpest rise. As the rural school-age population continues to fall amid urbanization, more teaching sites are expected to become consolidated into boarding schools to accommodate a higher percentage of students in the countryside of the central and western regions. According to other small-scale sample surveys, the percentage of primary boarding school students above the third grade is close to that of junior middle school students, and primary boarding school pupils below the third grade also account for a rising share

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Table 1: Change in the Number of Primary Schools in Sample Counties

Province	County	2000	2012	2017
Hebei	A	400	108	102
	B	390	19	19
	C	560	96	44
Sichuan	D	147	77	38
	E	730	115	95

Note: Some counties' data in this table are "countywide number of primary schools" since some small village schools are not in the county statistics due to time span and data limitations.

Source: (1) Data of 2000 are from *Education Chronicles of Guangyuan City* by the Drafting Committee of *Education Chronicles of Guangyuan City*, 2005, Xi'an Cartographic Publishing House; *Education Chronicles of Zhangjiakou City* by the Bureau of Education, Zhangjiakou City, 2009, internal document; (2) Data of 2012 and 2017 are provided by the Elementary Education Section of Education Bureau in sample counties.

(Yang, Wu, 2014; Dong, 2015).

2.1.3 Closure and consolidation of schools in sample counties

The five counties in the two provinces surveyed by our research team shared a generally consistent trend in the number of primary schools with Figure 1: Before 2001, most counties could ensure that each of their administrative villages had one primary school under the goal of universalizing nine-year compulsory education. From 2001 to 2012, the number of village primary schools and teaching sites shrank sharply, particularly in the sparsely populated County B in Hebei Province close to China's northern pasturing area and County E of Sichuan Province adjacent to the Qinba Mountains with villagers scattered across its broad jurisdiction. This finding chimes with other studies conducted in China: Mountainous and pasturing areas are keener to close and consolidate schools (21st Century Education Research Institute, 2013).

2.2 Research Hypothesis

As villages' teaching sites are closed and consolidated into larger schools in townships, students have to commute longer distances for schools and even board at schools at a very young age. Yet rural boarding schools are often underfunded, underequipped and understaffed. Inadequate pastoral care is harmful to young pupils' physical and psychological development. Based on the above analysis, this paper puts forward the following hypothesis:

The closure and consolidation of schools have made it more likely for rural premature students to board at schools, where a lack of professional care harms their human capital investment.

Based on this hypothesis, this paper comes up with the following inferences that can be tested at the empirical level:

Inference 1: The intensity of school closure and consolidation affects the likelihood for pupils to be sent to boarding schools at a premature age.

Inference 2: Premature boarding harms pupils' academic performance and psychological health and makes them more susceptible to school bullying.

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3. Data Source and Statistical Description

From 2015 to 2017, a three-phase tracking survey was carried out for 137 township primary schools with boarding qualifications from five state-level poor counties in Hebei and Sichuan provinces by a project team consisting of researchers from the China Institute for Educational Finance Research (CIEFR) of Peking University, the Institute of Population and Labor Economics of the Chinese Academy of Social Sciences (IPLE-CASS) and the Capital University of Economics and Business (CUEB). The project team collected information about students who entered the fourth and fifth grades of primary school in October 2015, including their boarding experience, academic performance, psychological health and family economic status.[5]

School information employed in the study is from the school questionnaire survey conducted in May 2017, and information about students' academic performance and psychological health is from the second-round survey data collected in May 2016. Premature boarding experience is from self-reported information of respondents. Information about students' academic performance and psychological health was collected during the survey. Studies suggest that early experience has a lasting impact on an individual's human capital investment, and that such an impact may grow with age (Heckman, 2008; Almond et al., 2017).

Definition of core explanatory variables: Premature boarding is defined as boarding in the first and second grades of primary school[6] according to educational regulations and local educational practice[7]. The questionnaire asks: "Did you board at school in the first/second/third/fourth grade?" If the answer is "boarded at school in the first or second grade," the respondent will be deemed as an "premature boarding school student"; if the child "never boarded at school" or "started to board at the third grade or higher," he/she will be classified as a "boarding school student at an appropriate age." Premature boarding students account for 31.15% of total samples. The "boarding students at an appropriate age," if defined as the control group, contain two groups of students: "students starting to board at schools at the third grade or above" (boarding school students at an appropriate age) (31.85%) and "students who have never boarded at school" (37.00%).

As for the "distance" variable, this paper classifies the distance between students' homes and schools into seven ranges by percentile, to which 1-7 points are assigned, respectively, and the range with 1 point is the control group.

The question "Is there any teaching site within the range?" asks about whether there is any teaching site in a circle with the surveyed school as the center, and the radius is any of the above-defined ranges. The coverage area increases with the radius. Under the "one village, one school" layout, the number of schools will increase as the ring expands. This layout ceased to exist with the closure and consolidation of schools in remote rural areas from 2001 to 2012. As shown in Table 2, with the increase of radius, the average number of schools in each range increases from 0.045 to 0.811 (3-5 kilometers); as the distance between home and school becomes longer, the average number of schools drops to 0.613 and further falls to 0.334.

The human capital of primary school students is measured by the following indicators:

[5] With the school information from the education bureaus of the five counties in the two provinces, we identified township primary schools with boarding qualifications and excluded samples with fewer than 20 fourth and fifth graders and those with fewer than 10 students. All the remaining schools were included into the scope of our survey. For the fourth and fifth grades of each school, if there were fewer than three classes in each grade, all classes would be surveyed; if there were more than three classes, two classes would be randomly surveyed.

[6] At rural schools, the third grade is usually the starting year for boarding. The reason is twofold: First, most village teaching sites only teach the first and second grade pupils; second, English becomes a core course since the third grade, but there is no English teacher at village schools. Therefore, primary school pupils have to study at central primary schools since the third grade, and have to board at school if their homes are too far from school.

[7] See the Ministry of Education: *Rural primary school pupils from the first to the third grade should not attend boarding schools,* http://politics.people.com.cn/n/2012/0913/c1001-19004469.html.

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Table 2: Distribution of Home-School Distances

Range of distance (km)	Variable value/ identifier	Percentage of premature boarding students (%)	Number of schools in the radius	Observations
(0, 0.6]	1	9.57	0.045	2,486
(0.6, 1]	2	17.70	0.108	2,700
(1, 2]	3	28.14	0.335	2,463
(2, 3]	4	30.54	0.500	1,994
(3, 5]	5	42.06	0.811	2,639
(5, 9]	6	44.84	0.613	1,985
(9, 100][a]	7	49.28	0.334	2,348

Note: Numbers in the first column to the left is the distance interval unbounded to the left and bounded to the right. For instance, (0, 0.6] means home-school distance is 0-0.6km (including 0.6km).

Source: Sample survey data collected by the project team from 137 rural boarding schools in Sichuan and Hebei provinces in May 2016. The students are from other counties and townships and attend boarding schools over 100 km away from their homes. This paper uniformly adopts the value of 100 km. For other boarding schools, their distance to students' homes is mainly in the range of 0-40 km.

Reading score: Respondents are required to complete a reading test designed by the Progress International Reading Literacy Study (PIRLS) in 2011.[8] For the results to have economic significance, this paper converts the scores into percentiles (range of values is 0-100), which denotes the status of individual samples in the distribution of total samples. The average score of premature boarding students is at the 47.3th percentile, i.e. 47.3% of respondents are below the average score of premature boarding students. In addition, 49.1% of boarding school students are below the average score of boarding school students at an appropriate age, and 52.2% of them are below the average score of students who have never attended boarding school.

Depression risk: Based on the Center for Epidemiological Studies-Depression Scale (CES-D), the questionnaire calculates respondents' scores. A score above 15 points means the detection of depression risk, which is marked as 1; otherwise, it is 0. Among the samples, 63% of premature boarding students are exposed to depression risk, which is two and seven percentage points higher than boarding students at an appropriate age and students who have never boarded at schools.

Involvement in school bullying: The questionnaire asks students "How many times were you bullied at school over the past half year?" and "How many times did you bully others at school over the past half year?" The dividing point is "Two or three times a month" (Solberg and Olweus, 2003): If any answer to the two questions is above this dividing point, the respondent will be classified as "involved in school bullying." Among the respondents, premature boarding pupils are two and six percentage points more likely to be involved in school bullying compared with boarding students at an appropriate age and students who have never boarded at school.

[8] See https://timss.bc.edu/. PIRLS believes the age bracket of 9-10 years is a critical turning point for children's reading skills. Most countries require children in this age bracket to attempt accessing information by reading. Hence the selection of around nine-year-old students (fourth grade) as test subjects.

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Table 3: Statistical Description of Variables

	Premature boarders Observations: 5,175	Boarding students at an appropriate age Observations: 5,292	Non-boarders Observations: 6,148
Reading score	47.323	49.080	52.174
	(28.419)	(28.452)	(28.463)
Depression risk (Yes=1, No=0)	0.632	0.606	0.556
	(0.482)	(0.489)	(0.497)
Involvement in school bullying (Yes=1, No=0)	0.413	0.386	0.353
	(0.492)	(0.487)	(0.478)
Home-school distance (km)	7.062	5.657	2.738
	(9.523)	(8.392)	(6.356)
Gender (Male=1, Female=0)	0.516	0.506	0.481
	(0.500)	(0.500)	(0.500)
Age	10.365	10.408	10.331
	(0.955)	(0.934)	(0.907)
Grade (Fifth grade=1, fourth grade=0)	0.496	0.501	0.489
	(0.500)	(0.500)	(0.500)
Weight (kg)	32.347	32.623	33.380
	(7.386)	(7.529)	(8.227)
Height (m)	1.378	1.381	1.389
	(0.078)	(0.075)	(0.079)
Father's education length	9.120	9.036	9.529
	(2.721)	(2.615)	(2.784)
Mother's education length	8.845	8.716	9.068
	(2.889)	(2.767)	(2.857)
Parental marital status (Married=1, divorced or widowed=0)	0.863	0.888	0.910
	(0.344)	(0.315)	(0.286)
Migration of parents (Yes=1, No=0)	0.271	0.275	0.192
	(0.444)	(0.446)	(0.394)
Caregiving by grandparents (Yes=1, No=0)	0.374	0.380	0.282
	(0.484)	(0.486)	(0.450)
Family economic status at or below average level (Yes=1, No=0)	0.701	0.719	0.649
	(0.458)	(0.450)	(0.477)
Teacher-to-student ratio	0.074	0.076	0.066
	(0.037)	(0.036)	(0.031)
Number of students (100 persons)	6.492	6.618	7.405
	(4.553)	(4.204)	(4.690)
Does school offer one bed for each boarder? (Yes=1, No=0)	0.512	0.517	0.615
	(0.500)	(0.500)	(0.487)

Note: Statistics for each variable are mean values and standard deviations, respectively, and numbers in parentheses are standard deviations.

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Furthermore, some control variables are defined as follows:

Age: Months of age are calculated based on the birthday of respondents and survey date, and divided by 12 to arrive at age.

Migration of parents: The questionnaire asks "Did your dad/mom work outside your county as a migrant worker over the past half year?" If both parents took migrant jobs, this paper defines the answer as "Yes," marked as 1; otherwise, it is 0.

Whether a child is taken care of by his/her grandparents: The questionnaire asks "Who is responsible for taking care of you after school?" If the respondent ticks "grandpa" or "grandma," the answer will be defined as "Yes" and marked as 1; otherwise, it is 0.

Family economic status at or below average level: The questionnaire for parents asks "How do you think about your family's economic conditions?" Options A, B, C and D are "Very good," "Upper middle level," "Lower middle level" and "Very poor," respectively. If the respondent ticks C or D, this paper defines the answer as "Yes," marked as 1.

Teacher-to-student ratio: This ratio is the reciprocal of data from education authorities. In the linear probability model, our calculation method may narrow down the range of values to make the coefficient more straightforward.

4. School Closure's Impact on the Premature Boarding of Rural Primary School Pupils

4.1 Baseline Model

Home-school distance and the availability of teaching sites jointly influence the likelihood for a pupil to board at school below the third grade. Township schools generally offer better teaching quality compared with teaching sites. Below the third grade, a pupil is more likely to attend a township primary school without boarding as long as it is close to his/her home irrespective of whether there is any teaching site in the vicinity. When a pupil's home is far from the township primary school, however, if there is a teaching site in the vicinity, the pupil may complete the first and second-grade study at the teaching site; if there is no teaching site in the vicinity, he/she faces two options either to study at a more remote teaching site or board at the township primary school.

This paper defines home-school distance and the availability of a teaching site as core variables for explaining the choice of boarding. For primary school students, the existence of teaching sites in the vicinity of their homes is not only an exogenous variable, but also influenced by the policy to close down teaching sites. A linear probability model is selected as the empirical equation with the following specific form:

$$B_{ijkc} = \alpha_1 + \sum_{k=2}^{7}(D_{ik} \times Tch_{ik})\beta_{ik} + \sum_{k=2}^{7} D_{ik}\gamma_{ik} + \sum_{k=2}^{7} Tch_{ik}\eta_{ik} + X'_{ijkc}\Gamma + X'_{c}\Phi + \varepsilon_{ijkc} \qquad (1)$$

In equation (1), explained variable B_{ijkc} is a dichotomous variable, and its subscript means whether student i whose home has a distance k from school j in county c opts to board at school below the third grade. This paper divides home-school distance into k (k=1,2,3,4,5,6,7) ranges, and identifies range k=1 as the control group. Dummy variable D_{ik} means the student i's home is in range k; Tch_{ik} means whether there is any school within distance range k from the student i's home; γ_{ik} and η_{ik} respectively denote the fixed effects of distance and teaching site; X'_{ijkc} is the vector matrix of a pupil's individual, family and school characteristics; X'_{c} is the fixed effect of county; ε_{ijkc} is stochastic error term.

Since each school has its unique way of management and campus atmosphere, the unobservable characteristics of students at the same school are correlated (disturbance term assumption is not

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Table 4: Impact of Teaching Site Closure on Premature Boarding

Explanatory variable	Explained variable: Premature boarding			
	(1)	(2)	(3)	(4)
(0.6, 1]×Teaching site exists within range	0.054	0.057	0.056	0.055
	(0.057)	(0.057)	(0.056)	(0.056)
(1, 2]×Teaching site exists within range	-0.108***	-0.112***	-0.115***	-0.115***
	(0.039)	(0.040)	(0.040)	(0.040)
(2, 3]×Teaching site exists within range	-0.082**	-0.082**	-0.082**	-0.081**
	(0.036)	(0.036)	(0.036)	(0.036)
(3, 5]×Teaching site exists within range	-0.076*	-0.076*	-0.074*	-0.074*
	(0.041)	(0.041)	(0.041)	(0.041)
(5, 9]×Teaching site exists within range	-0.035	-0.036	-0.035	-0.036
	(0.047)	(0.047)	(0.047)	(0.048)
(9, 100]×Teaching site exists within range	-0.004	-0.005	-0.007	-0.008
	(0.045)	(0.045)	(0.045)	(0.045)
Boys	—	0.018***	0.019***	0.019***
	—	(0.007)	(0.007)	(0.007)
Age	—	0.018**	0.016**	0.016**
	—	(0.007)	(0.007)	(0.007)
Fifth grade	—	-0.003	-0.002	-0.002
	—	(0.012)	(0.012)	(0.012)
Weight (kg)	—	-0.001	-0.001	-0.001
	—	(0.001)	(0.001)	(0.001)
Height (m)	—	-0.262***	-0.254***	-0.252***
	—	(0.096)	(0.095)	(0.095)
Father's education length	—	—	-0.004**	-0.004**
	—	—	(0.002)	(0.002)
Mother's education length	—	—	-0.001	-0.001
	—	—	(0.002)	(0.002)
Parental marital status	—	—	-0.042***	-0.042***
	—	—	(0.013)	(0.012)
Cared by grandparents	—	—	0.022**	0.022**
	—	—	(0.009)	(0.009)
Family economic status at or below average	—	—	0.026*	0.025*
	—	—	(0.014)	(0.013)
Teacher-to-student ratio	—	—	—	0.112
	—	—	—	(0.545)
Number of students on campus (×100)	—	—	—	0.000
	—	—	—	(0.005)
Separate beds for boarders	—	—	—	0.009
	—	—	—	(0.043)
Observations	16,615	16,615	16,615	16,615
R^2	0.205	0.208	0.210	0.211

Note: *, ** and *** indicate significance at 10%, 5% and 1% levels; numbers in parentheses are standard errors of school-level cluster; the regression of columns (1)-(5) also controls for the fixed effects of teaching site, distance and county.

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satisfied). In the estimation process, the cluster correlation at school level cannot be controlled for even if the fixed effect of county is controlled for (Angrist and Pischke, 2009). Hence, this paper employs robust standard error clustered at the school level to increase the effectiveness of estimation.

4.2 Regression Results

The first-column results of Table 4 are from the basic equation. The table only presents the interaction coefficient of the two core explanatory variables. The existence of teaching sites in the proximity of a township primary school (0.6-1 km) has no significant impact on premature boarding. As the home-school distance increases, the existence of a teaching site in the vicinity significantly reduces the probability of premature boarding. However, after the home-school distance exceeds 5 kilometers, the existence of a teaching site has a negative impact coefficient for premature boarding, but the impact is statistically no longer significant. Based on information from Table 2, when the home-school distance exceeds 5 kilometers, the average number of teaching sites tends to decrease. In remote township regions, teaching sites are far and few between, making it less likely for low-grade primary school pupils to go to school in their home villages. In the extended equation from Column (2) to Column (4), the individual, family and school characteristics of students are controlled for step-by-step. At this moment, there is barely any change in the coefficient and significance of core explanatory variables, which demonstrate fairly good robustness.

In the extended equation, some control variables also provide valuable information: Boys are more likely to board at school in the first and second grades; students who go to school at an older age are more likely to board at school in the first and second grades; children's height is negatively correlated with premature boarding. When the parents' level of education, marital status and household income are further controlled for, it becomes apparent that premature boarders are from more adverse family environments. Students without proper family care are also more likely to become premature boarders. As for school characteristics, school size has a limited impact. When there are sufficient teachers at school and separate beds, which means well-equipped dorms, for boarding students, the coefficient for the choice to board at school turns positive but not significant.

5. Premature Boarding's Human Capital Implications

5.1 Equation Specification

This paper specifies the following regression equation to verify Inference 2:

$$Y_{1,ijc} = \vartheta_1 + B_{1,ijc} \cdot \theta + X'_{1,ijc}\Lambda + X'_{1,c}\Pi + \xi_{1,ijc} \tag{2}$$

In equation (2), $Y_{1,ijc}$ on the right side of the equation denotes the primary school student's human capital, expressed by reading score, psychological health and involvement in school bullying; $B_{1,ijc}$ denotes whether the student is a premature boarder, and is a core variable.

The distribution of premature boarding is not stochastic. Unobservable characteristics such as family income may affect the choice of premature boarding and the student's human capital level, causing the result of the ordinary least square estimation to be biased. This paper adds an interaction term between the home-township school distance and the existence of teaching sites in the village vicinity as a proxy variable for the policy of closing down and consolidating teaching sites into schools to correct for the classical endogenous bias error.

The closure of teaching sites has altered the distance to school, thus affecting students' choice of boarding. Primary school students, especially premature students, who otherwise could study at teaching sites, have no other choice but to attend boarding schools. This outcome satisfies the correlation

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hypothesis of the instrumental variable.

Yet the closure of teaching sites itself does not affect students' human capital: If there is any difference in the academic performance between non-boarding and boarding students, there is reason to believe that such difference results from premature boarding rather than the closure of teaching sites itself, which satisfies the exogenous[9] assumption of the instrumental variable.

With the policy of closing teaching sites as the instrumental variable, this paper identifies the exogenous impact of teaching site closure as the first stage of the estimation equation, which is then introduced into the second stage to evaluate the human capital impact of premature boarding. See Bai and Kung (2015) for a similar methodology. In the two-stage least square estimation, this paper adopts the same model specification to combine equations (1) and (2) and create the following two-stage estimations:

$$B_{ijkc} = \alpha_1 + \sum_{k=2}^{7}(D_{ik} \times Tch_{ik})\beta_{ik} + \sum_{k=2}^{7} D_{ik}\gamma_{ik} + \sum_{k=2}^{7} Tch_{ik}\eta_{ik} + X'_{ijkc}\Gamma + X'_{c}\Phi + \varepsilon_{ijkc} \quad (3)$$

$$Y_{2,ijc} = \vartheta_2 + B_{2,ijc} \cdot \theta + X'_{2,ijc}\Lambda + X'_{2,c}\Pi + \xi_{2,ijc} \quad (4)$$

5.2 Empirical Results

In Panel A of Table 5, the ordinary least square (OLS) estimation results suggest that premature boarding has reduced students' reading scores by 3.1-3.5 percentile, and compared with the estimation results of the basic equation, there is barely any change in the coefficient and significance of results in the extended model. After the instrumental variable is employed for estimation, the coefficient of the main variable significantly increases to 6.8-7.4 percentile. As can be learned from experience, the first and second grades are initial stages for developing learning habits. Children who lack professional care during this period are more likely to underperform their peers in the early stage of primary school.

Panel B's results indicate that premature boarding significantly increases the risk for children to suffer psychological depression by 4.8-5.6 percentage points estimated with the ordinary least square method or 8.1-10.7 percentage points estimated with the instrumental variable. Younger children are more psychologically dependent on their family members, and premature boarding students are more susceptible to homesickness. Their anxieties, if not placated, may trigger depression.

Panel C reports the impact of school bullying on premature boarding students. The results of ordinary least square method reveal that premature boarding increases the risk for children to get bullied at school by 3.2-3.7 percentage points. The two-stage estimation results suggest that such risk increases by 9.6-10.2 percentage points. Being less capable to care for themselves and physically weaker than their elders, young students are more vulnerable to fall prey to school bullying, especially repeated bullying if they cannot seek timely assistance.

This paper also reports Crag-Donald F value and Hausman test p value to assess the instrumental variable's evaluation effect. All the first-stage Crag-Donald F statistics exceed the empirical threshold, rejecting the weak instrumental variable assumption. Through Durbin-Wu-Hausman test, this paper observes the interference of classical endogenous problems such as missing variables to the OLS estimation results (Nunn and Wantchekon, 2011). In Panel A and Panel C, Hausman test concludes at

[9] This paper also examines the exogeneity of teaching site distribution, and finds that the existence of village teaching site is not correlated with township primary school and socio-economic characteristics. Interested readers may ask for details from authors.

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Table 5: Impact of Premature Boarding on the Human Capital of Primary School Students

		(1)	(2)	(3)	(4)
Panel A Explained variable: Reading score					
OLS	Premature boarding	-3.492***	-3.213***	-3.191***	-3.150***
		(0.912)	(0.908)	(0.928)	(0.772)
	R^2	0.025	0.057	0.060	0.068
Instrumental variable	Premature boarding	-7.363**	-7.378**	-7.331**	-6.853**
		(3.027)	(3.051)	(3.179)	(2.988)
	C-D Wald F	114.229	112.433	109.572	109.474
	Hausman test of p value	0.006	0.003	0.004	0.009
	Observations	16,615	16,615	16,615	16,615
Panel B Explained variable: Depression risk					
OLS	Premature boarding	0.056***	0.052***	0.048***	0.048***
		(0.013)	(0.013)	(0.013)	(0.013)
	R^2	0.021	0.025	0.028	0.029
Instrumental variable	Premature boarding	0.107**	0.095**	0.083*	0.081*
		(0.043)	(0.043)	(0.044)	(0.042)
	C-D Wald F	114.229	112.433	109.572	109.474
	Hausman test of p value	0.039	0.082	0.162	0.183
	Observations	16,615	16,615	16,615	16,615
Panel C Explained variable: Involvement in bullying					
OLS	Premature boarding	0.037***	0.034***	0.032**	0.032**
		(0.013)	(0.013)	(0.013)	(0.013)
	R^2	0.018	0.023	0.025	0.025
Instrumental variable	Premature boarding	0.102***	0.101***	0.096***	0.096***
		(0.036)	(0.036)	(0.037)	(0.036)
	C-D Wald F	114.229	112.433	109.572	109.474
	Hausman test of p value	0.007	0.007	0.010	0.010
	Observations	16,651	16,651	16,651	16,651
Control variable					
County fixed effect		Controlled	Controlled	Controlled	Controlled
Individual characteristic		—	Controlled	Controlled	Controlled
Family characteristic		—	—	Controlled	Controlled
School characteristic		—	—	—	Controlled

Notes: *, ** and *** respectively denote significance at 10%, 5% and 1% levels; numbers in parentheses are standard errors of school-level cluster; student characteristics include gender, age, grade, height and weight; family characteristics include parental education length, parental marital status, caretaking by grandparents and family economic conditions; school characteristics include teacher-to-student ratio, number of students on campus and provision of separate beds for students at the dormitory.

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1% and 10% significance levels that the OLS coefficient is underestimated due to endogenous problems like missing variables. Panel B indicates that after the individual, family and school characteristics of students are controlled for, OLS and instrumental variable methods have consistent coefficients, and the classical endogenous problems cause no bias in the OLS results. Which missing variables have caused the coefficients to be underestimated? We assume that a possible answer is the motivation for pupils to board at school. Parents who attach great importance to education prefer to send their children to township primary schools that offer better teaching quality and allow pupils to have more time to study and receive guidance from their teachers. Such a motivation has mitigated the negative impact of premature boarding.

5.3 Robustness Test

With the school consolidation as the instrumental variable, we still have a concern that although

Table 6: Premature Boarding's Impact on Pupils' Human Capital Using the Propensity Score Method

	Explained variable		
	Reading score	Depression risk	Involvement in bullying
Panel A Intervening variables: Premature boarding (control group: boarding students at an appropriate age)			
Nearest neighbor one-to-one matching	-1.952***	0.028**	0.022
	(0.715)	(0.013)	(0.015)
Nearest neighbor one-to-three (caliper) matching	-2.603***	0.039***	0.026**
	(0.658)	(0.011)	(0.011)
Radius (caliper) matching	-2.110***	0.038***	0.029***
	(0.605)	(0.010)	(0.010)
Kernel matching	-2.053***	0.036***	0.028***
	(0.578)	(0.010)	(0.010)
Panel B Intervening variables: Premature boarding (control group: students who never boarded at school)			
Nearest neighbor one-to-one matching	-4.917***	0.075***	0.053***
	(0.813)	(0.015)	(0.016)
Nearest neighbor one-to-three (caliper) matching	-4.511***	0.067***	0.048***
	(0.663)	(0.011)	(0.011)
Radius (caliper) matching	-4.664***	0.069***	0.049***
	(0.614)	(0.011)	(0.010)
Kernel matching	-4.309***	0.062***	0.048***
	(0.590)	(0.010)	(0.010)

Notes: *, ** and ***denote significance at 10%, 5% and 1% levels, respectively; in performing the nearest neighbor one-to-one matching (K=1), standard error is calculated with 100 bootstrapped random samples; In the nearest neighbor one-to-three (caliper) matching (K=3), designated caliper is 0.001; in radius (caliper) matching, designated radius is 0.001; kernel matching uses quadratic kernel by default with band width of 0.06; in each type of matching, we all select the individual, family and school characteristics and county of students as matching variables; numbers above the square boxes are the average treatment effect on the treated (ATT), and numbers in the parenthesis are standard errors.

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policy shock can address the classical endogenous problems like missing variables and reverse causality, selectivity bias may also exist between control group and study group, giving rise to systemic differences in the probabilities of policy impact on the two groups of samples. Based on the individual, family and school characteristics of respondents, this paper adopts the propensity score matching method to examine the differences in premature boarding's impact on individuals with similar observable characteristics. Furthermore, this paper combines students who started to board at school at or after the third grade and those who never boarded the school into one group, i.e. "boarding students at an appropriate age." Yet the heterogeneity of the control group may still influence the robustness of conclusions. Hence, further examination is carried out for different control groups.

Table 6 shows similar results for different matching strategies, and the negative impact grows with the duration of boarding. The difference between premature boarding students and boarding students at an appropriate age may be smaller than that between premature boarding students and those who never boarded at school, which indicates that a longer duration of boarding may increase the adverse impact. But for any control group, the negative impact remains significant, indicating robustness of

Table 7: Premature Boarding's Impact on Pupils' Human Capital - Observed by Sub-Samples

Different sub-samples	Number of pastoral teachers		Different guardians		Family income		Gender	
	Up to two pastoral teachers	At least three pastoral teachers	Parents or parent	Grandparents	Above average	Below average	Girl	Boy
Panel A Explained variable: Reading score								
Premature boarding	-4.420**	-1.261	-3.196***	-3.122***	-3.492***	-3.041***	-3.599***	-2.726***
	(1.011)	(0.912)	(0.912)	(1.027)	(1.140)	(0.835)	(0.935)	(0.910)
Observations	9,663	6,952	10,935	5,680	5,196	11,419	8,314	8,301
R^2	0.076	0.055	0.067	0.065	0.073	0.063	0.065	0.071
Panel B Explained variable: Depression risk								
Premature boarding	0.055***	0.025	0.033**	0.071***	0.080***	0.033***	0.053***	0.043***
	(0.014)	(0.022)	(0.016)	(0.015)	(0.018)	(0.015)	(0.017)	(0.014)
Observations	9,663	6,952	10,935	5,680	5,196	11,419	8,314	8,301
R^2	0.032	0.018	0.027	0.021	0.073	0.063	0.032	0.027
Panel C Explained variable: Involvement in school bullying								
Premature boarding	0.051***	-0.002	0.009	0.066***	0.079***	0.010	0.044***	0.020
	(0.015)	(0.010)	(0.016)	(0.015)	(0.019)	(0.013)	(0.016)	(0.016)
Observations	9,663	6,952	10,935	5,680	5,196	11,419	8,314	8,301
R^2	0.023	0.030	0.028	0.017	0.030	0.025	0.032	0.019

Note: *, ** and *** respectively denote significance at 10%, 5% and 1%, respectively; numbers in parentheses are robust standard errors of school-level cluster; the regression of all sub-samples has controlled for the individual, family and school characteristics of students and the county virtual variable.

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the conclusion that premature boarding significantly reduces primary school students' human capital accumulation.

5.4 Hetereogeneity

The availability of pastoral teachers may serve as a reference for the analysis of boarding facilities and services. Among the 137 schools, 42% have up to two pastoral teachers - the minimum for boarding schools. As shown in Table 7, at boarding schools with minimum pastoral teachers, the academic performance of premature boarders is 4.4 percentile below average and more susceptible to depression by 5.5 percentage points and bullying by 5.1 percentage points. Yet among samples with at least three pastoral teachers, premature boarding has an insignificant impact on children's human capital accumulation.

For different guardian sub-samples, many parents have migrated to cities for jobs, leaving their children in the care of elderly rural grandparents who are less educated. Guardianship by grandparents is bad for children's physical and psychological development. As shown in Table 7, compared with respondents raised by parents or parent, boarding pupils below the third grade raised by their grandparents suffer more in terms of human capital. This paper further divides sub-samples by family income, and the result indicates that the negative impact is more significant for respondents from families above the average income level. That is to say, the higher family economic status appears to do little to mitigate the human capital loss resulting from premature boarding.

For gender-specific sub-samples, premature boarding may have a greater negative impact on girls. Young girls tend to perform much worse at boarding school and are more susceptible to depression and bullying. They must receive more care and protection.

6. Conclusions and Policy Implications

Based on the sample survey data of 2016, this paper defines school closure as an exogenous shock and the distribution of teaching sites within different distances from township central schools as the proxy variable for the policy of school closure to evaluate the impact of school layout adjustment on the premature boarding of primary school pupils. Our findings suggest that the creation of teaching sites near villages makes it much less likely for primary school students to board at school; premature boarding has a continuously negative impact on primary school pupils' human capital accumulation, which is particularly striking for students lacking pastoral teachers, raised by less educated grandparents and from families above-average income levels. Girls are especially vulnerable to the negative effects of boarding.

In 2012, the central government put an end to the practice of closing down teaching sites and consolidating them into township schools, but the adjustment in the layout of rural schools for compulsory education will not end there. In recent years, growth in the rural school-age population has been slowing. More children have moved to study at county schools or moved with their migrant parents. As a result, fewer students study at rural primary schools and teaching sites. The demise of teaching sites is bound to occur with or without government intervention. The relocation of compulsory education institutions from villages to townships is a natural result of urbanization. For this reason, boarding schools will continue to exist as an important part of rural compulsory education in central and western parts of China.

Yet rural boarding schools are ill-prepared for accepting boarding students in the first and second grades of primary education. Local education authorities do not encourage, nor do they oppose, premature boarding. Boarding facilities are not upgraded or modified to cope with a growing influx of boarding pupils. Oftentimes, two or more than two young pupils have to share one bed in the dorm. Some parents have to rent a flat close to primary school and stay with their children. Rural

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boarding schools are yet to recruit sufficient pastoral teachers with special skills to properly care for boarding students. Boarding problems present challenges to young pupils' physical and psychological development and academic performance. Special resources must be devoted to equipping boarding schools with adequate facilities and recruiting qualified pastoral teachers to prevent human capital investment to fail for premature boarding pupils.

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