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ORIGINAL PAPER

Does free education help combat child labor? The effect of a free compulsory education reform in rural China

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Abstract

This paper evaluates the effect of a free compulsory education reform in rural China on the incidence of child labor. We exploit the cross-province variation in the rollout of the reform and apply a difference-in-differences strategy to identify the causal effects of the reform. We find that exposure to free compulsory education significantly reduces the incidence of child labor for boys, but has no significant effect on the likelihood of child labor for girls. Specifically, one additional semester of free compulsory education decreases the incidence of child labor for boys by 8.3 percentage points. Moreover, the negative effect of the reform on the likelihood of child labor is stronger for boys from households with lower socioeconomic status. Finally, the free compulsory education reform may induce parents to reallocate resources towards boys within a household and thus may enlarge the gender gap in human capital investment.

Keywords Free compulsory education reform · Child labor · Son preference · Rural China

JEL codes I28 · I38 · O20

1 Introduction

A large number of developing countries have implemented policies designed to reduce child labor and increase schooling by lowering the cost of schooling via educational

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subsidies. Examples include Programa de Erradicação do Trabalho Infantil (child labor eradication program, PETI) and *Bolsa Escola* in Brazil, the Mid-day Meals program in India, and the *Progresa* program in Mexico. These school subsidy programs, which both lower the relative costs of schooling while raising family incomes, are found to reduce children's participation in economic activities and improve their school enrollment (see, among others, Ravallion and Wodon 2000, Bourguignon et al. 2003, Schultz 2004, Dammert 2009, and Fiszbein and Schady 2009). Children's participation in economic activities may have adverse effects on their education (Heady 2003; Ray 2003; Gunnarsson et al. 2006) and health (Parker 1997; Kassouf et al. 2001; O'Donnell et al. 2005), and may suppress their human capital accumulation and future wages. Thus, these school subsidy programs tend to alleviate long-run poverty by fostering human capital accumulation among the poor.

In general, studies find that cash or in-kind transfers that are conditioned on school attendance increase schooling but have a much smaller effect on child labor. For example, Ravallion and Wodon (2000) study the effects of an enrollment subsidy on children's labor force participation and school enrollment in rural Bangladesh and find that the subsidy increased schooling by far more than it reduced child labor. Schultz (2004) finds a significant but modest reduction in child work associated with a family being eligible for *Progresa* educational grants. de Janvry et al. (2006) also document a strong mitigating effect of Mexico's *Progresa* program on the school enrollment response to an income shock, but a minimal effect on the child work response. Cardoso and de Souza (2009) investigate the impacts of conditional cash transfers of Brazil's *Bolsa Escola* program on market work and schooling, and find that the increases in schooling are larger than the declines in market work. Galiani and McEwan (2013) find that the Honduran conditional cash transfer increases school enrollment by 8 percentage points and decreases the proportion of children who work outside the home by 3 percentage points. However, a few studies find that cash transfers lead to a sharp decline in both paid employment and unpaid economic activity of children, e.g., Skoufias et al. (2001) and Schady and Araujo (2006). For a comprehensive review of the literature on cash transfers and child labor, see Chapter 4 in Fiszbein and Schady (2009) and de Hoop and Rosati (2014).

The Free Compulsory Education Reform, which aims to reduce educational fees for rural students and promote compulsory education in rural China, was initiated in rural areas of 13 provinces and 3 direct-controlled municipalities (municipalities hereafter), and then gradually expanded to all rural areas by 2008. Under the reform, all rural students are exempted from paying school fees, and selected students from poor households are exempted from paying for textbooks and can receive living subsidies if they live in school dormitories. In this paper, we investigate the effects of the Free Compulsory Education Reform on the incidence of child labor by exploiting the cross-province variation in the rollout of the reform in rural China.

The Free Compulsory Education Reform is essentially a school subsidy program, where eligible students are provided with a school subsidy that covers tuition and miscellaneous fees. The reduction in the relative price of schooling (substitution effect) and the increase in family income (income effect) induced by the reform imply that the educational fee reductions tend to improve the school enrollment rates of the target population. As shown in Chyi and Zhou (2014) and Shi (2016), the estimated effects of the Free Compulsory Education Reform on primary and junior high school enrolment

are significantly positive. However, the magnitude of the reform effect is small, which may be attributable to the already high enrollment rates in compulsory education in rural China prior to the reform (Shi 2016).[1] Although the enrollment rates in primary and junior high schools are high in rural China in 2010, approximately 7.74% of children aged between 10 and 15 years old are engaged in child labor and most of them are still in school and combine economic activity with schooling (Tang et al. 2018). The reductions in the costs of compulsory education increase households' disposable income and thus may reduce the labor supply of children from poor families in rural China despite its modest impact on school enrollment.

This study examines the causal effect of the Free Compulsory Education Reform on children's labor force participation in rural China. To this end, we exploit the cross-province variation in the phase-in of the reform and construct the number of semesters that a child is supposed to be exposed to free compulsory education. Specifically, we apply a difference-in-differences strategy to identify the causal impact of this reform on children's labor force participation using variation in exposure to the reform among children ages 10–15 within the same province. We find that exposure to free compulsory education significantly reduces the incidence of child labor for boys, but has no significant effect on the likelihood of child labor for girls. More specifically, one additional semester of free compulsory education decreases the incidence of child labor for boys by 8.3 percentage points. The results are robust to a variety of robustness checks and placebo tests. Moreover, the negative effect of the reform on the likelihood of child labor is stronger for boys from households with lower socioeconomic status. Finally, the free compulsory education reform may induce parents to reallocate resources towards boys within a household. The reform results in a significant decrease in voluntary educational expenditure on the targeted girls but has no significant effect on voluntary educational expenditure on the targeted boys. The results suggest that relaxing resource constraints may increase the gender gap in schooling/work.

We contribute to the research on educational subsidies and child labor in several ways. First, few studies have analyzed the issue of child labor in China, which is the largest developing country in the world.[2] However, according to Maplecroft's 2014 Child Labor Index, China was classified as being at "extreme risk" of using child labor.[3] This paper is the first study to investigate the effect of educational subsidies on the incidence of child labor in the context of China. Second, this study identifies the causal impact of the educational subsidy program through exploiting the cross-province variation in the rollout of the Free Compulsory Education Reform. Third, this paper

[1] Since the implementation of Compulsory Schooling Law in 1986, the enrollment rates of primary and junior high school has increased remarkably. In 2005, the gross enrollment rate of primary and junior high school was 95%. However, although the short-term impact of the school subsidy program on school enrollment is small, Xiao et al. (2017) show that the program has larger long-term effects on individuals' educational attainment and cognitive achievement in early adulthood.

[2] He (2016), Tang et al. (2018), and Zhao et al. (2016) are among the few which explicitly analyze child labor in China. He (2016) shows a significant negative effect of child labor on a child's academic achievement and concludes that child labor is not a big problem in China. However, Tang et al. (2018) find that child labor is not a negligible social phenomenon in China: about 7.74% of children ages 10–15 were working in 2010. Zhao et al. (2016) demonstrate that China's accession to the World Trade Organization significantly increased the incidence of child labor in rural China.

[3] Maplecroft's 2014 Child Labor Index evaluates the frequency and severity of reported child labor incidents in 197 countries. China ranks 20th in child labor risks among 197 countries.

also explores the resource reallocation within a household induced by the school subsidy program and adds some new insights into the impacts of relaxing resource constraints on children's time allocation. Finally, in contrast to previous studies that find a larger impact of the school subsidy program on schooling than on child labor, our study shows that, in China, where the compulsory schooling law was implemented long before the Free Compulsory Education Reform, the school subsidy program leads to a larger decline in child labor than an increase in schooling.

The remainder of the paper is organized as follows. Section 2 briefly introduces the Free Compulsory Education Reform in rural China. Section 3 develops the conceptual framework. Section 4 describes the data and outlines the empirical strategy used in this paper. The results are presented and discussed in Section 5. Section 6 concludes.

2 The free compulsory education reform in rural China

The Law on 9-Year Compulsory Education, which took effect on July 1, 1986, entitles school-aged children the right to receive at least 9 years of education (6-year primary education and 3-year junior high school education). Although the bill authorized tuition-free education for the 9-year compulsory education (Article 10), the law was never strictly enforced. On the contrary, the financial burden of compulsory education was substantially borne by households, especially after the financial reform of basic education in 1985, which gave local governments full responsibility for the provision and financing of basic education.

Prior to the Free Compulsory Education Reform in 2006, the Chinese government implemented two educational reforms to alleviate the financial burden of compulsory education for poor, rural households. The first is the "Tuition Control" reform in 2001, which requested that the tuition of primary school students in rural areas should not exceed 160 CHY (approximately US$23.5) per student per year, and that of junior high school students in rural areas was set to 260 CHY (approximately US$38.2). The "Tuition Control" reform was expanded to the whole nation by the fall of 2004. The second is the "Two Exemption and One Subsidy" (TEOS) reform launched in 2003. The "two exemptions" include exemptions from paying school fees and textbook charges. The "one subsidy" refers to a living subsidy for students living in school dormitories. The TEOS was first introduced for students from extremely poor households. In the spring of 2005, the reform was expanded to all primary and junior high school students from nationally designated poor counties.

The government initiated the Free Compulsory Education Reform on a nationwide basis in 2006. As a part of the reform, all rural students are entitled to receive tuition fee exemptions, and students from poor families are provided with free textbooks and living subsidies if they live in school dormitories. The Free Compulsory Education Reform mainly benefits those students that were not eligible for school subsidies under the TEOS reform by exempting their tuition and miscellaneous fees. Thus, the Free Compulsory Education Reform is essentially a conditional in-kind transfer program, that is, households enrolling children ages 6–15 into schools can receive in-kind transfers that cover tuition and miscellaneous fees. The lower price of schooling and increased income as a result of the program tend to increase school enrollment rates. Nevertheless, enrollment rates in compulsory education were already high prior to the reform. Thus, the enrollment impact of the reform may be small. If children's leisure (or

education) is a normal good, the income effect of the transfer may decrease children's labor force participation.[4]

Under the new system, the central and local governments take the joint responsibility in financing basic education. The central government contributes more in less-developed regions. Specifically, the central government covers 80% of the funding in the western provinces and 60% in the central provinces. For municipalities and the eastern provinces, the percentage of the funding covered by the central government is determined by the local government's fiscal capacity.

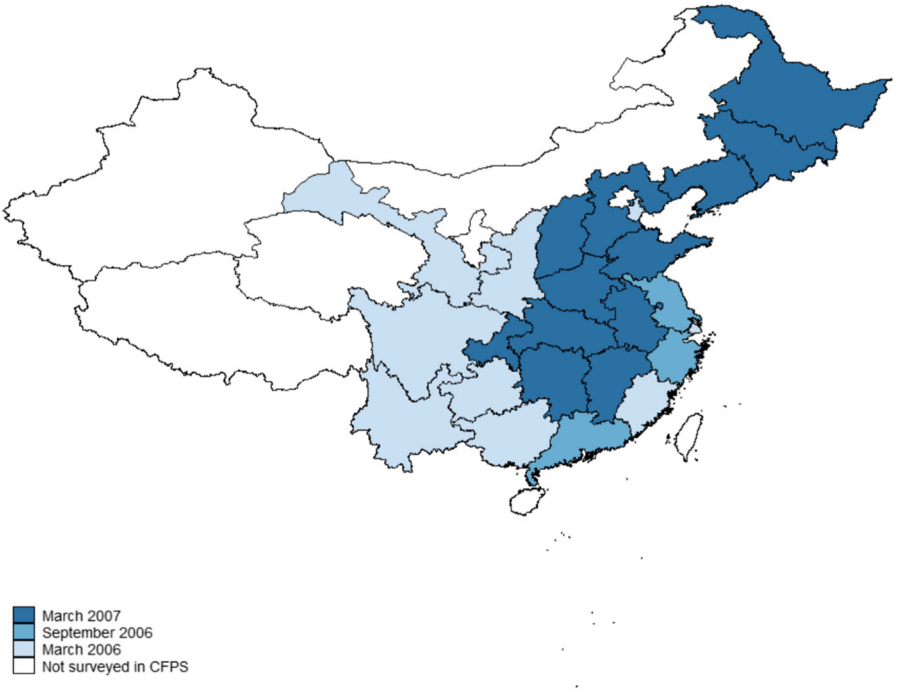
The state council made the rollout plan of the reform. All western provinces were required to implement the reform no later than the spring of 2006, and the other provinces no later than the spring of 2007. As a result, all primary and junior high school students in rural areas of 3 municipalities and 13 provinces, most of which are western provinces of China, have been exempt from paying tuition fees since the spring of 2006. By the fall of 2007, all primary and junior high school students in rural China were eligible for the free compulsory education. Figure 1 shows the actual rollout of the free compulsory education reform in provinces and municipalities covered by this study.

3 Conceptual framework

In this section, we discuss the link between the exposure to the Free Compulsory Education Reform and the incidence of child labor. The Free Compulsory Education Reform both lowers the relative costs of schooling and raises family incomes. The free compulsory education reform reduces the price of schooling and thus may increase school attendance. If there is substitution between child labor and schooling, then such program will reduce child labor. However, because of the 1986 Compulsory Schooling Law, the school enrollment rate in primary and junior high school in China was already high prior to the reform. The impact of the reform on school attendance is therefore small, and changes in the price of schooling may not affect child labor supply significantly.

The reform also increases households' disposable income. The money saved from educational fee reductions leads to increased voluntary educational expenditure on the child targeted by the reform, for example, pens, exercise books, and supplementary tutoring (Shi 2012). Thus, longer reform exposure is associated with higher accumulated voluntary investments in education, which may improve children's educational performance. This may further affect child schooling and working decisions. Children with better educational performance are less likely to participate in labor market. As a result, exposure to the Free Compulsory Education Reform reduces the incidence of child labor.

[4] Child labor is associated with an income constraint on parents (Basu and Van 1998). Edmonds (2005) shows a strong decline in child labor as a consequence of improved household per capita expenditure.



Note: Authors' own construction based on various local legal and administrative documents.

Fig. 1 Rollout of the free compulsory education reform

4 Data and empirical strategy

4.1 Data

The data set used in this paper is from the China Family Panel Studies (CFPS) survey, which was launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University in China. The CFPS is a nationally representative, longitudinal survey of Chinese communities, families, and individuals. The CFPS sample covers 25 provinces/municipalities/autonomous regions (excluding Hong Kong, Macao, Taiwan, Xinjiang, Tibet, Qinghai, Inner Mongolia, Ningxia, and Hainan), representing 95% of the Chinese population. Three follow-up waves were conducted in 2012, 2014, and 2016. However, only CFPS 2010 has a time use module, based on which we construct the key variable in this study, i.e., a child labor indicator. Thus, we only use the 2010 baseline survey for the analysis in this study. The 2010 baseline survey interviewed a total of 14,960 households and 42,590 individuals. For detailed information on the CFPS, refer to Xie (2012).

Child labor In China, three relevant laws, namely, the Labor Law of the People's Republic of China (Article 15) enacted on 1st Jan. 1995, Regulations Banning Child Labor (Article 2) enacted on 1st Dec. 2002, and the Law of People's Republic of China on the Protection of Minors (Article 28) enacted on 1st Jan. 1992, stipulate that state organs, social bodies, enterprises, institutions, non-governmental not-for-profit

organizations, and private businesses are prohibited from employing children under the age of 16. Employment of children under the age of 16 is referred to as using child labor.[5] Employers who use child labor shall be fined by the labor protection authorities at the rate of 5000 yuan per month for each child laborer used (Regulations Banning Child Labor, Article 6). Thus, for the purpose of our study, we restrict our analysis to all rural children ages 10–15 (inclusive). Our sample for the main analysis is composed of 2534 rural children.

In this paper, we define the child labor indicator based on individual work. More specifically, we mainly focus on work outside the household for pay (cash or in kind), work in agriculture for the household, and work in a household business. In the literature, however, there is no consensus regarding the definition of child labor (Edmonds 2008). Most studies adopt a stringent definition and define child laborers as children in wage work. Some researchers define them as children who engage in economic production. A few researchers define child labor as all non-school and non-leisure activities of children. From this perspective, child labor would include domestic chores, such as cooking, home cleaning, or caring for family members. The definition of child labor in this paper is consistent with the definition officially employed by the International Labor Organization's (ILO), which depends on whether the work is harmful to a child's health or development, regardless of whether this work is economic or non-economic, market or non-market.

The CFPS has a child module, which collects detailed information on the education, working experience, time use, interpersonal communications, daily life, health, and personal experience of children ages 10–15 in both urban and rural areas. In particular, respondents are required to report their time spent in various activities in the last month. The activities are divided into six categories: personal life (including sleep, meals, personal hygiene, household chores, and taking care of family members), individual work, study, entertainment and social activities, transportation, and other. In this paper, we define the child labor indicator based on individual work. Specifically, we code any child with positive time in the work category as a child laborer.

Reform exposure Following Xiao et al. (2017), we measure the duration of reform exposure by the number of semesters (*Semester*) that an individual is supposed to be exposed to free compulsory education at the time of the survey.[6] In China, each academic year begins on September 1st and ends in July the next year. Spring semester, i.e., the second semester of an academic year, begins on March 1st the next year. According to the school enrollment policy, a child should enroll in primary school after celebrating the 6th birthday. Thus, the number of semesters that an individual is supposed to be exposed to free compulsory education is jointly determined by the effective date of the reform in the province of residence and the date of birth. For example, a child born between September 1997 and August 1998 should enroll in primary school in September 2004. Suppose that the effective date of the reform in the province of residence is March 2006. Then at the time of the survey in 2010, the child is

[5] In general, the minimum age of employment is 15 years old, which is the minimum age of completion of compulsory schooling (ILO, 1973).

[6] As a robustness check, we also construct the expected number of semesters that a child is supposed to be exposed to the free compulsory education during ages 6–15 and estimate the treatment effects on child labor incidence. The results, which are available from the authors upon request, do not change much.

Table 1 Treatment status by birth year

Semesters eligible for free education	Year of birth						Total
	1995	1996	1997	1998	1999	2000	
5	0	0	0	0	0	2	2
6	0	7	0	5	4	147	163
7	171	169	159	168	178	99	944
8	84	85	66	53	136	151	575
9	229	168	186	180	87	0	850
Total	484	429	411	406	405	399	2534

Authors' own calculation based on the effective date of the reform in each province and birth dates of children in the sample (CFPS (2010)). Each cell in the table shows the number of observations eligible for free education for the number of semesters indicated

supposed to be exposed to 9 semesters of the reform. Table 1 shows the distribution of *Semester* by birth year.

Table 2 reports the summary statistics of the variables used in this study. The percentage of rural children engaged in child labor in our study sample is 8.7%. However, only 3.1% of children drop out of schools. The average reform exposure at the time of the survey is 7.75 semesters. 54.5% of children are boys. On average, fathers have 6.09 years of schooling, while mothers have 4.41 years of schooling. Voluntary educational spending per year is 932.5 CHY (approximately US$148.5). Provincial characteristics used in the analysis are from China Statistical Year Books (National Bureau of Statistics of China, 2005, 2006).

In order to better understand child labor in China, we divide children's activities into four categories: economic activity only, school only, combined economic activity and school, and neither school nor economic activity. Table 3 reports the proportion of children in each category. Approximately 87% of child laborers in China are still in school and combine economic activity with schooling.[7] Exactly 3.1% of children drop out of schools. However, only 36.1% of children who drop out of schools participate in child labor. Approximately 2% of children are neither in school nor in economic activity. Table 3 also shows that the proportion of boys who combine economic activity with schooling is higher than that of girls.

4.2 Empirical strategy

In this paper, following a similar identification strategy as in Duflo (2000, 2001), we exploit the cross-province variation in the phase-in of the reform and apply a difference-in-differences strategy to identify the causal impact of the free compulsory education on children's labor force participation. Our regression equation is

[7] Unpaid work may be easier to combine with schooling than paid work, because paid work generally involves less flexible hours and a greater intensity of work (as suggested by Edmonds 2008; Edmonds and Schady 2012).

Table 2 Summary statistics

Variable	Number	Mean	Std. Dev.	Min	Max
Child labor	2545	0.087	0.282	0	1
Semester (during ages 6–15)	2534	13.571	3.422	7	18
Semester (till 2010)	2534	7.750	0.970	5	9
Boy	2545	0.545	0.498	0	1
Han	2545	0.810	0.392	0	1
Education of father (years)	2485	6.086	3.919	0	15
Education of father (category)					
Illiterate	2505	0.198	0.399	0	1
Primary school	2505	0.334	0.472	0	1
Junior high school	2505	0.373	0.484	0	1
Senior high school	2505	0.080	0.271	0	1
College and above	2505	0.016	0.126	0	1
Education of mother (years)	2507	4.409	4.028	0	15
Education of mother (category)					
Illiterate	2498	0.370	0.483	0	1
Primary school	2498	0.318	0.466	0	1
Junior high school	2498	0.270	0.444	0	1
Senior high school	2498	0.034	0.181	0	1
College and above	2498	0.008	0.090	0	1
Age of father	2534	40.115	5.068	28	70
Age of mother	2515	38.278	4.693	24	72
Number of kids below 6	2543	0.244	0.506	0	3
Number of kids from 6 to 16	2543	1.593	0.779	0	6
Household size	2543	4.951	1.646	2	14
Household educational spending (CHY)	2545	932.477	1478.674	0	21,500

Based on CFPS (2010). Child labor is defined as a child who works outside of the household for pay (cash or in kind), works in agriculture for the household, or works in a household business

Table 3 Child involvement in economic activity and schooling by gender in rural China

	Economic activity only (%)	Combining school and economic activity	School only	Neither in school nor in economic activity	Total
All children	3.54	8.65	86.14	1.67	100
Boys	3.48	9.61	85.96	0.95	100
Girls	3.60	7.72	86.32	2.37	100

Based on CFPS (2010). Economic activity refer to work outside the household for pay (cash or in kind), work in agriculture for the household, and work in a household business

$$Y_{ipt} = \phi \text{Semester}_{ipt} + X_{ipt}\beta + \delta_P + \gamma_t + \theta_P \times t + \pi_t W_p + s_m + \omega_m + \epsilon_{ipt}, \quad (1)$$

where Y_{ipt} is the labor force participation of child i born in year t and attending primary and junior high schools in province p. Reform exposure, denoted by Semester_{ipt}, is the number of semesters that a child is supposed to be eligible for free compulsory education at the time of the survey. ϕ is the parameter of interest that quantifies the effect of one additional semester of reform exposure on children's labor force participation. Note that we employ an intention-to-treat (ITT) analysis here, as we use the treatment that individuals were supposed to receive rather than the treatment actually received.[8] X_{ipt} is a vector of exogenous individual and household characteristics that may be related to the incidence of child labor, including gender, ethnicity, both parents' age and years of schooling, and household demographic characteristics.

Province fixed effects δ_P are included to control for time-invariant characteristics of provinces that may be related to both the effective date of the reform and the incidence of child labor. Birth cohort fixed effects γ_t account for cohort trends in the outcome variable that are common to all provinces.[9] In addition to birth cohort fixed effects, $\theta_P \times t$ is included to control for province-specific linear cohort trends in the outcome variable. To allow the cohort trends in outcome variables to vary with provincial characteristics in the initial period, we include interactions of provincial characteristics in 2005 denoted by W_p and a vector of birth year-specific coefficients π_t. The vector of provincial characteristics includes the fraction of rural residents, log population, and log gross domestic product (GDP). We also include survey month fixed effects s_m in Eq. (1) to capture potential seasonal variation in demand for child labor, which is especially a concern in rural areas.

The treatment status is jointly determined by the effective date of the reform and the birth date of individuals. For any children born in the same year in a given province, their treatment status depends on their birth month. Therefore, the effect we identify is probably driven by the systematic difference between those born earlier and those born later in the same birth cohort. In our preferred specification, we include birth month fixed effects denoted by ω_m. In all regressions, standard errors are adjusted for clustering at the province-birth cohort level to account for any potential correlation across children in the same birth cohort within the same province (Bertrand et al. 2004).

One important assumption underlying Eq. (1) is that no other educational reforms that might have affected the outcome variable occurred at the same time as the Free Compulsory Education Reform. However, the "Tuition Control" reform and the "Two Exemption and One Subsidy" reform occurred prior to the Free Compulsory Education Reform. Specifically, the "Tuition Control" reform was first introduced in provincially designated poor counties, and was then expanded to the whole nation by the fall of 2004. The "Two Exemption and One Subsidy" (TEOS) reform was first introduced for students from extremely poor households and was expanded to all primary and junior

[8] There are two alternative measures of reform exposure: the actual number of semesters that an individual is exposed to the free compulsory education at the time of the survey and the number of semesters that an individual is supposed to be exposed to the free compulsory education. The actual reform exposure depends on the actual enrollment age, which may be endogenous, so we use the supposed reform exposure instead.

[9] Birth cohort is constructed based on school academic year. For example, children born between September 1997 and August 1998 are supposed to enroll in primary school in the same year and are defined in the same birth cohort.

high school students from nationally designated poor counties in 2005. This implies that the older cohorts in poor rural areas were already affected by the "Tuition Control" and TEOS reforms. However, we assume that the older cohorts (control group) were not affected by any other educational reforms. The reform effect of the Free Compulsory Education Reform without taking into account of these reforms is hence underestimated, and statistically significant estimates indicate more sizable effects in reality.

5 Results

5.1 Baseline results

Table 4 reports the baseline results of DID estimation. All regressions include exogenous individual characteristics, province fixed effects, birth cohort fixed effects, province-specific linear cohort trends, birth month fixed effects, and survey month fixed effects. In columns (2), (5), and (8), we further control for exogenous household characteristics. We further allow the cohort trends in the incidence of child labor to vary with certain provincial characteristics in the initial period in columns (3), (6), and (9).

The results in the first three columns of Table 4, based on full sample, suggest that the length of reform exposure has no significant impact on children's labor force participation. In columns (4)–(9), we further explore whether the reform has differential effects on girls and boys. We find that exposure to the free compulsory education significantly reduces the incidence of child labor for boys. The estimates from our preferred specification in column (9) suggest that one additional semester of reform exposure decreases the probability of child labor by 8.3 percentage points for boys.[10] However, the reform does not have a significant effect on the likelihood of child labor for girls. Boys experience a larger negative impact on the probability of engaging in labor activities.

A substantial number of studies find a significant impact of conditional cash transfers on child labor among boys and no significant impact on child labor among girls (see Dammert 2009, Behrman et al. 2010, Galiani and McEwan 2013, de Hoop and Rosati 2014, and Ferreira et al. 2017, among others). Gender differences in the results may be related to how child labor is defined. Boys and girls perform different activities. Boys are more likely to engage in economic activities, whereas girls have a high participation rate in domestic activities, such as cleaning, cooking, sewing, and preparing food. Galiani and McEwan (2013) find that programs have a stronger impact on work for pay and work outside the home for boys than for girls. Girls, on the other hand, appear to experience larger reductions in household chores and work inside the home. Thus, the impact of conditional cash transfers on work carried out by girls tends to be underestimated if we focus on economic activities. A broader definition including detailed household chores may decrease this gender difference in participation rates. Nevertheless, the program effect on schooling is larger for girls (Skoufias et al. 2001).

[10] The relatively large coefficient on semester is mainly driven by the older boys from western China in which the incidence of child labor for 15-year old boys is up to 23.3% in 2010, and the detailed results are available upon request.

Table 4 Effects of the reform on child labor

Variables	(1) All	(2) All	(3) All	(4) Girl	(5) Girl	(6) Girl	(7) Boy	(8) Boy	(9) Boy
Semester	0.013	0.008	−0.008	0.058	0.036	0.014	−0.061**	−0.058*	−0.083**
	(0.022)	(0.024)	(0.027)	(0.042)	(0.039)	(0.045)	(0.029)	(0.030)	(0.037)
Boy	−0.005	−0.005	−0.003						
	(0.011)	(0.011)	(0.011)						
Han ethnicity	−0.129***	−0.125***	−0.124***	−0.155***	−0.159***	−0.153***	−0.124***	−0.109**	−0.110**
	(0.036)	(0.032)	(0.033)	(0.048)	(0.046)	(0.047)	(0.044)	(0.043)	(0.044)
Education of father (reference: illiterate)									
Primary school		−0.014	−0.014		0.040	0.036		−0.062**	−0.062**
		(0.019)	(0.019)		(0.026)	(0.027)		(0.029)	(0.030)
Junior high school		−0.037*	−0.038**		0.008	0.001		−0.071***	−0.072***
		(0.019)	(0.019)		(0.026)	(0.025)		(0.027)	(0.027)
Senior high school		−0.051	−0.049		−0.018	−0.023		−0.066	−0.063
		(0.031)	(0.032)		(0.028)	(0.028)		(0.051)	(0.054)
College and above		−0.012	−0.013		0.012	−0.001		−0.024	−0.029
		(0.069)	(0.069)		(0.067)	(0.066)		(0.093)	(0.095)
Education of mother (reference: illiterate)									
Primary school		−0.036**	−0.036**		−0.032	−0.029		−0.040	−0.039
		(0.015)	(0.015)		(0.020)	(0.020)		(0.025)	(0.025)
Junior high school		−0.001	−0.000		−0.022	−0.023		0.011	0.015
		(0.017)	(0.017)		(0.024)	(0.024)		(0.022)	(0.023)
Senior high school		0.011	0.010		0.065	0.055		−0.021	−0.017
		(0.039)	(0.039)		(0.059)	(0.058)		(0.044)	(0.044)

Table 4 (continued)

Variables	(1) All	(2) All	(3) All	(4) Girl	(5) Girl	(6) Girl	(7) Boy	(8) Boy	(9) Boy
College and above		0.053	0.052		0.015	0.010		0.060	0.074
		(0.053)	(0.053)		(0.063)	(0.064)		(0.083)	(0.084)
Age of father		0.014	0.011		0.069***	0.063***		−0.011	−0.013
		(0.012)	(0.013)		(0.022)	(0.023)		(0.012)	(0.013)
Age of father squared/100		−0.014	−0.011		−0.078***	−0.072***		0.015	0.017
		(0.014)	(0.014)		(0.025)	(0.025)		(0.014)	(0.014)
Age of mother		0.016	0.020*		0.003	0.012		0.032***	0.035***
		(0.011)	(0.011)		(0.031)	(0.031)		(0.011)	(0.011)
Age of mother squared/100		−0.018	−0.022*		−0.002	−0.012		−0.036***	−0.040***
		(0.013)	(0.013)		(0.038)	(0.039)		(0.013)	(0.013)
Constant	0.175	−0.467	−0.368	0.019	−1.500**	−1.434**	0.416**	−0.027	0.124
	(0.166)	(0.312)	(0.303)	(0.289)	(0.653)	(0.655)	(0.195)	(0.324)	(0.347)
Observations	2534	2460	2460	1257	1224	1224	1277	1236	1236
R-squared	0.192	0.207	0.213	0.213	0.238	0.251	0.223	0.247	0.254
Cohort FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province linear trend	Y	Y	Y	Y	Y	Y	Y	Y	Y
Birth month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Survey month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cohort dummy*2005 province char.	N	N	Y	N	N	Y	N	N	Y

The dependent variable is children's labor force participation. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0$

In China, the overall likelihood of child labor for boys is similar to that for girls. Thus, different activities performed by boys and girls may not be the cause of the stronger impact of the reform on child labor for boys. Child labor is usually a sign of extreme poverty. When a family is faced with severe credit constraints, both sons and daughters may have to engage in economic activities. The relaxing of constraints induced by the reform may lead to resource reallocation towards boys within a household due to the strong son preference in rural China. Consequently, a relaxation of the resource constraints may increase the gender gap in schooling/work. Moreover, the reform's impact would be greater for boys from households with both sons and daughters. As a robustness check, we also restrict our analysis to the children from households with both sons and daughters and present the results in Table 11 in the Appendix. As expected, the effect of reform exposure is larger for boys from households with both sons and daughters.

Children's labor force participation may also be affected by their siblings' reform exposure. For example, the money saved from siblings' fee exemptions may increase the amount of resources that can be allocated to the child who is exposed to fewer semesters of free compulsory education. Manacorda (2006) finds a positive spillover in children's labor supply, i.e., a child's increased work eligibility not only increases his probability of work but also simultaneously reduces his siblings' probability of work and increases their probability of being in school. However, Shi (2012) finds no spillover effect of free compulsory education, and parents spend the money saved from fee reductions on voluntary educational expenditure on the child targeted by the reform.

To take the potential spillover effects of the reform into account, we construct the reform exposure of all brothers and sisters (i.e., total number of semesters that all brothers and sisters are supposed to be exposed to the reform) and include them in the regression. The results presented in Table 12 in the Appendix suggest that after controlling for the total number of semesters of all siblings, our key results remain. Interestingly, brothers' reform exposure does not significantly affect the labor force participation of both girls and boys in rural China, whereas sisters' reform exposure significantly reduces the labor force participation of boys, indicating that parents tend to reallocate resources towards boys when the targeted children are girls.

We also examine the impact of the Free Compulsory Education Reform on school enrollment. The results, reported in Table 5, suggest that the reform has no significant impact on school enrollment of children. This is consistent with the findings in Chyi and Zhou (2014) and Shi (2016). These results imply that the reform mainly induces boys who combine economic activity with schooling to quit the labor market. The significant effects of the gender of children on school enrollment in column (1) of Table 5 suggest that boys are more likely to enroll in school.

5.2 Validity of DID strategy

5.2.1 Placebo tests

The key identification assumption for the DID strategy is that individuals in provinces with different effective dates of the reform would have had the same cohort trends in the outcome variable in the absence of the reform. To test the validity of this assumption, we have two placebo tests. The first test is a permutation test in which we use rural

Table 5 Effects of the reform on school enrollment

Variables	(1) Boy	(2) Boy	(3) Boy
Semester	−0.015	−0.019	−0.008
	(0.013)	(0.020)	(0.016)
Boy	0.012**		
	(0.005)		
Han ethnicity	0.053***	0.096***	0.022
	(0.015)	(0.033)	(0.021)
Education of father (reference: illiterate)			
Primary School	0.012	0.009	0.016
	(0.012)	(0.018)	(0.015)
Junior High School	0.004	0.003	0.011
	(0.014)	(0.020)	(0.018)
Senior High School	0.009	0.009	0.020
	(0.021)	(0.032)	(0.030)
College and above	0.032*	0.024	0.043
	(0.018)	(0.032)	(0.026)
Education of mother (reference: illiterate)			
Primary School	0.018*	0.031*	0.006
	(0.010)	(0.017)	(0.015)
Junior High School	0.016	0.050***	−0.012
	(0.010)	(0.015)	(0.014)
Senior High School	0.012	0.005	0.017
	(0.011)	(0.036)	(0.023)
College and above	−0.053	0.039	−0.132
	(0.055)	(0.034)	(0.113)
Age of father	0.012	−0.013	0.024
	(0.013)	(0.015)	(0.020)
Age of father squared/100	−0.016	0.015	−0.030
	(0.016)	(0.018)	(0.024)
Age of mother	0.004	0.045**	−0.008
	(0.007)	(0.020)	(0.008)
Age of mother squared/100	−0.007	−0.060**	0.009
	(0.009)	(0.026)	(0.008)
Constant	0.559**	0.223	0.628*
	(0.280)	(0.520)	(0.336)
Observations	2460	1224	1236
R-squared	0.125	0.186	0.155
Cohort FE	Y	Y	Y
Province FE	Y	Y	Y
Province linear trend	Y	Y	Y
Birth month FE	Y	Y	Y
Survey month FE	Y	Y	Y

Table 5 (continued)

Variables	(1) Boy	(2) Boy	(3) Boy
Cohort dummy*2005 province char.	Y	Y	Y

The dependent variable is school enrollment. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

boys ages 10–15 but randomly assign the effective date of the Free Compulsory Education Reform to provinces. The second sample comprises children ages 10–15 from urban areas.

The permutation test allows us to test whether the estimated results are statistically significant or just due to random chance, particularly if the sample size is small. Moreover, the permutation test makes no assumptions on the underlying distribution of the data; this approach is particularly relevant in experimental studies, e.g., Lu and Anderson (2015). In the permutation test, the null hypothesis is that there is no effect of the Free Compulsory Education Reform on the odds of child labor. Under the null hypothesis, the estimated coefficient from the actual data can be considered a random sample from the permutation distribution. We can produce the permutation distribution of the estimated coefficients and use it for statistical inference. We randomly assign the effective dates of the reform to provinces and construct placebo treatment status for each rural child (Rosenbaum 2007; Lu and Anderson 2015). Specifically, we randomly divide the 24 provinces covered by this study into three groups, with the first group containing 10 provinces, the second containing 3 provinces, and the third containing 11 provinces. This is consistent with the numbers of provinces in different groups by the actual effective dates (see Fig. 1). We then randomly assign an effective date on March 1st or September 1st between 2004 and 2008 to each group without repetition. A placebo treatment variable is constructed for each boy using the assigned effective date and his birth date. We estimate the placebo treatment effect on the incidence of child labor. The distribution of placebo treatment effects from 1500 random assignments are displayed in Fig. 2. The dashed line shows the estimated treatment effect from the baseline analysis. The p value of the permutation placebo test is the proportion of placebo estimates that are equal to or larger in absolute value than the corresponding estimate from the baseline analysis. We find that p value is 0.034, which rejects the null hypothesis of no effect and provides further support for our identification strategy.

The sample used in the second placebo test is children ages 10–15 in urban areas. The free compulsory education reform was not implemented in urban areas until September 2008. We assign treatment status to urban children using the effective date of the reform in rural areas in the same province. We expect that the "placebo" treatment status has no significant

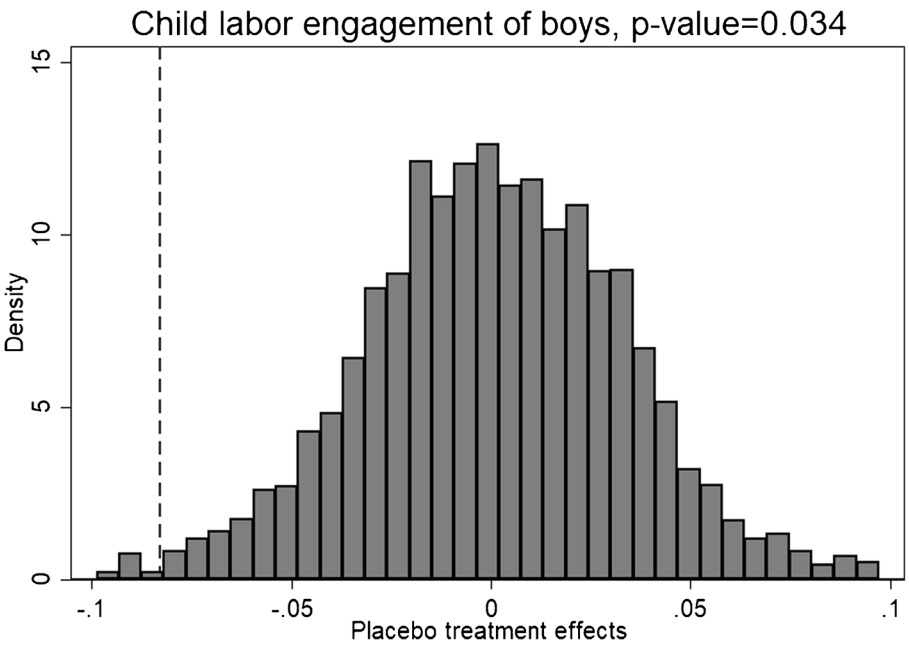


Fig. 2 Estimated coefficients from the permutation placebo tests. We randomly assign the effective dates of the reform to provinces and construct placebo treatment status for the same sample of individuals as that in the baseline analysis. These histograms display the distribution of placebo treatment effects from 1500 random assignments. The dashed line shows the estimated treatment effect from the baseline analysis. The *p* value of each permutation placebo test is the proportion of placebo estimates that are equal to or larger in absolute value than the corresponding estimate from the baseline analysis

effects on the incidence of child labor in urban areas. The results, presented in Table 6, suggest that the "placebo" semester does not have a significant effect on the labor force participation of urban boys. The insignificant effect of *Semester* for urban boys may be due to the small sample size. The Wald chi-squared test shows that the difference in the coefficients on *Semester* for rural and urban boys is significant at the 0.05 level. The results in Table 6 indicate that the baseline results are not driven by any sudden province-level shocks that coincided with the reform and might have affected a child's labor force participation.

5.2.2 Robustness checks: confounding factors

The DID strategy also assumes that no other shocks that might have affected the outcome variable occurred simultaneously with the Free Compulsory Education Reform. In this section, we re-estimate Eq. (1) taking account of the impacts of concurrent shocks that may confound our results.

"Two exemption and one subsidy" (TEOS) reform "Two Exemption and One Subsidy" (TEOS) reform, launched in 2003, was first introduced for students from extremely poor households. The reform was expanded to all students from nationally designated poor counties in the spring of 2005. As students

Table 6 Placebo tests using urban sample

Variables	(1) All	(2) Girl	(3) Boy
Semester	−0.015	−0.042	0.065
	(0.038)	(0.065)	(0.061)
Boy	0.001		
	(0.014)		
Han ethnicity	0.008	−0.042	0.040
	(0.027)	(0.064)	(0.026)
Education of father (reference: illiterate)			
Primary school	0.005	0.028	−0.005
	(0.020)	(0.038)	(0.035)
Junior high school	−0.009	0.029	−0.045
	(0.022)	(0.036)	(0.028)
Senior high school	0.037	0.029	0.032
	(0.035)	(0.043)	(0.051)
College and above	0.052	0.065	0.042
	(0.041)	(0.053)	(0.067)
Education of mother (reference: illiterate)			
Primary school	−0.006	−0.021	−0.011
	(0.025)	(0.035)	(0.028)
Junior high school	0.011	−0.001	0.019
	(0.023)	(0.039)	(0.024)
Senior high school	−0.023	0.001	−0.055
	(0.029)	(0.045)	(0.037)
College and above	−0.066*	−0.042	−0.090
	(0.038)	(0.041)	(0.056)
Age of father	−0.008	0.035	−0.027
	(0.032)	(0.026)	(0.028)
Age of father squared/100	0.007	−0.048	0.031
	(0.038)	(0.030)	(0.033)
Age of mother	0.012	0.001	0.026
	(0.029)	(0.031)	(0.031)
Age of mother squared/100	−0.007	0.008	−0.025
	(0.037)	(0.040)	(0.040)
Constant	−0.089	−0.575	−0.591
	(0.376)	(0.717)	(0.672)
Observations	1237	596	641
R-squared	0.171	0.218	0.269
Cohort FE	Y	Y	Y
Province FE	Y	Y	Y
Province linear trend	Y	Y	Y
Birth month FE	Y	Y	Y
Survey month FE	Y	Y	Y

Table 6 (continued)

Variables	(1) All	(2) Girl	(3) Boy
Cohort dummy*2005 province char.	Y	Y	Y

The dependent variable is children's labor force participation. Each column is from a separate regression estimated with the same specification as in column (3) of Table 4. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

from extremely poor households or nationally designated poor counties have been receiving fee exemptions since the TEOS reform, they may not be affected by the Free Compulsory Education Reform even though their treatment *Semester* is not zero.[11] To account for the implementation of the TEOS in nationally designated poor counties in 2005, we control for the interactions between the proportion of nationally designated poor counties in each province in 2005 and birth cohort dummies. The results presented in panel A of Table 7 suggest that the effects of the Free Compulsory Education Reform remain after controlling for the "Two Exemption and One Subsidy" reform in rural areas.

Closures and mergers of rural schools In order to improve the quality of education in rural areas and reduce expenditure on education, China has carried out large-scale closures and mergers of rural schools since 2001. As a result, a large number of rural schools in remote villages have been closed. The number of primary schools has fallen by more than 50%, from 384,004 in 2001 to 169,045 in 2010 (Mu C. (Ed.) 2002; Xie H. (Ed.) 2011). Students in remote villages were transferred to county or township schools, which results in a considerable increase in the cost of education. Thus, the large-scale closures and mergers of rural schools may increase the likelihood of child labor. If more closures and mergers of rural schools take place in less-developed western provinces, the omission of the accessibility of schools may bias our estimates. To address this issue, we further include the interactions between a dummy indicating whether there is any primary school in the village and birth cohort dummies to capture school availability and the results are shown in panel B of Table 7. After controlling for school availability, neither the magnitude nor the significance of the estimates changes.

New cooperative medical scheme China launched the New Cooperative Medical Scheme (NCMS) pilots in July 2003, which aims to provide health insurance coverage for the nation's entire rural population by 2010. Access to public health insurance may decrease the use of child labor and improve the school

[11] The TEOS reform exempted 34 million rural students from paying tuition and miscellaneous fees in 2005 (The Central People's Government of the People's Republic of China, 2006), accounting for approximately 20% of 6–15-year-old rural children.

Table 7 Robustness checks: confounding factors

Variables	All	Girls	Boys
	(1)	(2)	(3)
Panel A: "Two Exemption and One Subsidy" (TEOS) reform			
Semester	−0.011	0.029	−0.090**
	(0.027)	(0.050)	(0.036)
Observations	2460	1224	1236
R-squared	0.214	0.255	0.255
Panel B: Control for Mergers and closures of rural schools			
Semester	−0.016	−0.000	−0.093***
	(0.025)	(0.044)	(0.034)
Observations	2460	1224	1236
R-squared	0.222	0.265	0.265
Panel C: Control for New Cooperative Medical Scheme (NCMS)			
Semester	−0.015	0.005	−0.077**
	(0.028)	(0.050)	(0.035)
Observations	2364	1181	1183
R-squared	0.213	0.262	0.251

The dependent variable is children's labor force participation. Each column is from a separate regression. Except for the full set of controls and fixed effects included in column (3) of Table 4, we further control for the interactions between the proportion of nationally designated poor counties in each province in 2005 and birth cohort dummies in panel A, the interactions between the dummy indicating whether there is any primary school in the village and birth cohort dummies in panel B, and the interactions between effective years of NCMS and birth cohort dummies in panel C. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

enrollment in rural areas when households experience negative health shocks (Chen and Jin 2012; Liu 2016). As the NCMS pilots were first introduced in economically more developed counties, our estimates of reform effects tend to be biased if the rollouts of the two reforms coincide. To address this concern, we further add controls for the interaction terms between the effective years of the NCMS at the county level and birth cohort dummies and re-estimate Eq. (1). The results reported in panel C of Table 7 indicate that our main results are robust to the inclusion of the New Cooperative Medical Scheme.

5.2.3 Robustness checks: additional controls

As we rely on CFPS 2010 in this study, we cannot control for household fixed effects in the regression. We include many exogenous household characteristics in the regression, for example, parents' age and educational attainment, household assets, and household demographic characteristics. However, as the Free

Table 8 Robustness checks: additional controls

Variables	(1) All	(2) All	(3) Girl	(4) Girl	(5) Boy	(6) Boy
Semester	−0.007	−0.006	0.016	0.019	−0.078**	−0.082**
	(0.029)	(0.031)	(0.050)	(0.050)	(0.037)	(0.038)
Boy	−0.010	0.003				
	(0.011)	(0.010)				
Han ethnicity	−0.121***	−0.117***	−0.151***	−0.136***	−0.102**	−0.113***
	(0.034)	(0.033)	(0.050)	(0.046)	(0.043)	(0.043)
Education of father (reference: illiterate)						
Primary School	−0.012	−0.009	0.041	0.042	−0.065**	−0.061*
	(0.021)	(0.021)	(0.029)	(0.029)	(0.031)	(0.031)
Junior high school	−0.039**	−0.036*	0.009	0.010	−0.080***	−0.074***
	(0.020)	(0.020)	(0.027)	(0.026)	(0.028)	(0.028)
Senior high school	−0.042	−0.042	−0.014	−0.015	−0.065	−0.066
	(0.034)	(0.033)	(0.033)	(0.033)	(0.057)	(0.056)
College and above	−0.075	−0.071	0.014	0.030	−0.117*	−0.115*
Education of mother (reference: illiterate)	(0.050)	(0.051)	(0.071)	(0.064)	(0.068)	(0.069)
Primary school	−0.040**	−0.038**	−0.038*	−0.035	−0.039	−0.039*
	(0.016)	(0.016)	(0.021)	(0.021)	(0.024)	(0.023)
Junior high school	−0.007	−0.004	−0.031	−0.025	0.007	0.006
	(0.018)	(0.018)	(0.027)	(0.028)	(0.024)	(0.023)
Senior high school	0.003	0.014	0.062	0.079	−0.046	−0.042
	(0.044)	(0.045)	(0.061)	(0.061)	(0.045)	(0.044)
College and above	0.065	0.074	0.007	0.007	0.076	0.087
	(0.053)	(0.052)	(0.070)	(0.072)	(0.083)	(0.082)
Age of father	0.018	0.023**	0.076***	0.079***	−0.004	0.003
	(0.013)	(0.011)	(0.025)	(0.024)	(0.012)	(0.013)
Age of father squared/100	−0.019	−0.024*	−0.088***	−0.091***	0.008	−0.001
	(0.014)	(0.012)	(0.027)	(0.027)	(0.014)	(0.014)
Age of mother	0.016	0.012	0.003	−0.010	0.031***	0.029**
	(0.010)	(0.011)	(0.032)	(0.036)	(0.010)	(0.012)
Age of mother squared/100	−0.017	−0.011	−0.002	0.015	−0.035***	−0.032**
	(0.012)	(0.013)	(0.040)	(0.045)	(0.011)	(0.013)
Log net asset (family income excluded)	−0.012	0.007	0.032	0.057	−0.043	−0.030
	(0.026)	(0.024)	(0.044)	(0.046)	(0.038)	(0.037)
Number of people below 6 in 2005		0.050***		0.050**		0.047*
		(0.019)		(0.023)		(0.024)
Number of people from 6 to 16 in 2005		0.014		0.030		0.000
		(0.013)		(0.018)		(0.014)
Household size in 2005		−0.011*		−0.012		−0.011
		(0.006)		(0.010)		(0.009)

Table 8 (continued)

Variables	(1) All	(2) All	(3) Girl	(4) Girl	(5) Boy	(6) Boy
Constant	− 0.252	− 0.548	− 1.914*	− 2.110**	0.516	0.270
	(0.505)	(0.446)	(0.987)	(0.942)	(0.632)	(0.584)
Observations	2315	2313	1154	1152	1161	1161
R-squared	0.218	0.219	0.254	0.247	0.271	0.277
Cohort FE	Y	Y	Y	Y	Y	Y
Province FE	Y	Y	Y	Y	Y	Y
Province linear trend	Y	Y	Y	Y	Y	Y
Birth month FE	Y	Y	Y	Y	Y	Y
Survey month FE	Y	Y	Y	Y	Y	Y
Cohort dummy*2005 province char.	Y	Y	Y	Y	Y	Y

The dependent variable is children's labor force participation. Each column is from a separate regression estimated with the same specification as in column (3) of Table 4. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0$

Compulsory Education Reform in rural China may affect household fertility decisions and household assets might be affected by child labor decisions in the past, we did not include household demographic characteristics and household assets in the baseline analysis. As a robustness check, we include all these variables in Table 8. The results imply that the baseline results are robust to the inclusion of additional controls.

5.2.4 Heterogeneous effects of the reform

Children from households with lower socioeconomic status are more likely to engage in child labor because of credit constraint (Edmonds 2005; Tang et al. 2018). Thus, the income effects from the educational subsidy program may differ for children from families with different socioeconomic status. In this section, we apply household net assets as a proxy for household socioeconomic status.[12] The estimates of the reform by household net assets are reported in Table 9. Columns (1)–(3) show the estimates for children from poor households, i.e., households with net assets below the 50th percentile, and the estimates for children from rich households (with net assets above the 50th percentile) are reported in columns (4)–(6). The results show that the reform exposure only significantly reduces the odds of child labor for boys from poor households. However, it does not have a significant effect on labor force participation for children from rich households. Larger impacts are found among boys with lower socioeconomic status.

[12] Household net assets include assets in kind and financial assets, net of debt.

Table 9 Effect of the reform by household asset (excluding family income)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Net assets ≤ 50%			Net assets > 50%		
	All	Girl	Boy	All	Girl	Boy
Semester	−0.071	−0.003	−0.175**	0.036	−0.042	0.013
	(0.054)	(0.079)	(0.076)	(0.046)	(0.077)	(0.061)
Boy	0.008			−0.027		
	(0.018)			(0.017)		
Han ethnicity	−0.111***	−0.146***	−0.067	−0.129**	−0.191*	−0.106*
	(0.040)	(0.039)	(0.069)	(0.059)	(0.105)	(0.061)
Education of father (reference: illiterate)						
Primary school	−0.036	0.031	−0.116**	0.008	0.016	−0.011
	(0.030)	(0.044)	(0.050)	(0.030)	(0.052)	(0.035)
Junior high school	−0.030	0.051	−0.135**	−0.042	−0.026	−0.047
	(0.030)	(0.038)	(0.056)	(0.029)	(0.045)	(0.037)
Senior high school	0.007	0.019	−0.031	−0.070**	−0.026	−0.100**
	(0.074)	(0.047)	(0.121)	(0.035)	(0.050)	(0.044)
College and above	0.003	−0.017	−0.032	−0.115	0.074	−0.124
	(0.049)	(0.087)	(0.081)	(0.076)	(0.083)	(0.099)
Education of mother (reference: illiterate)						
Primary school	−0.036	−0.037	−0.014	−0.046*	−0.027	−0.043
	(0.028)	(0.033)	(0.043)	(0.024)	(0.035)	(0.033)
Junior high school	−0.001	−0.037	0.056	−0.020	−0.018	−0.022
	(0.033)	(0.048)	(0.046)	(0.022)	(0.037)	(0.031)
Senior high school	−0.099**	−0.086*	−0.087*	0.064	0.111	0.073
	(0.044)	(0.050)	(0.051)	(0.062)	(0.087)	(0.071)
College and above	−0.055	−0.189	0.055	0.159	−0.036	0.334
	(0.040)	(0.123)	(0.073)	(0.099)	(0.092)	(0.208)
Age of father	0.025	0.074*	0.007	0.027	0.116***	−0.023
	(0.022)	(0.039)	(0.019)	(0.020)	(0.040)	(0.022)
Age of father squared/100	−0.028	−0.092**	−0.007	−0.029	−0.131***	0.028
	(0.024)	(0.044)	(0.021)	(0.025)	(0.045)	(0.027)
Age of mother	0.017	−0.053	0.043***	−0.005	0.021	−0.023
	(0.016)	(0.048)	(0.016)	(0.038)	(0.054)	(0.036)
Age of mother squared/100	−0.018	0.072	−0.047***	0.008	−0.031	0.033
	(0.019)	(0.061)	(0.018)	(0.050)	(0.068)	(0.047)
Constant	−0.188	0.231	−0.164	−0.341	−2.375**	1.043
	(0.507)	(1.381)	(0.600)	(0.724)	(1.145)	(0.804)
Observations	1157	576	581	1158	578	580
R-squared	0.220	0.261	0.315	0.303	0.428	0.393
Cohort FE	Y	Y	Y	Y	Y	Y

Table 9 (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Net assets ≤ 50%			Net assets > 50%		
	All	Girl	Boy	All	Girl	Boy
Province FE	Y	Y	Y	Y	Y	Y
Province linear trend	Y	Y	Y	Y	Y	Y
Birth month FE	Y	Y	Y	Y	Y	Y
Survey month FE	Y	Y	Y	Y	Y	Y
Cohort dummy*2005 province char.	Y	Y	Y	Y	Y	Y

The dependent variable is children's labor force participation. Each column is from a separate regression estimated with the same specification as in column (3) of Table 4. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0$

5.3 Impact on household educational spending

The Free Compulsory Education Reform may induce parents to reallocate resources towards boys within a household. In this section, we examine whether educational fee reduction affects household educational spending, for example, tuition, books and supplies, extracurricular/home tutoring, room and board, transportation, and other expenses, on the targeted child. The results reported in Table 10 suggest that the impacts on household educational expenditure depend on children's gender. Specifically, an increase in household disposal income induced by the Free Compulsory Education Reform results in a significant decrease in household educational expenditure on targeted girls. However, household education expenditure on boys is not significantly affected by the reform exposure. The results imply that girls may even be worse off under the free compulsory education reform.

6 Conclusion

This paper examines the effect of a Free Compulsory Education Reform in rural China on children's labor force participation. The Free Compulsory Education Reform, which aims to reduce the costs of compulsory education for rural students and promote enrollment in rural China, was initiated in rural areas of 13 provinces and 3 municipalities in the spring of 2006 and gradually expanded to the entire nation. We exploit the cross-province variation in the rollout of the reform and apply a difference-in-differences strategy to identify the causal effects of the reform. We find that exposure to the free compulsory education significantly reduces the incidence of child labor for boys, but has no significant effect on the likelihood of child labor for girls. Moreover, the negative effect of the reform on the likelihood of

Table 10 Reform impact on household educational spending

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	All			Children from households with both sons and daughters		
	All	Girl	Boy	All	Girl	Boy
Semester	−0.525**	−0.562*	−0.306	−0.414*	−0.581*	0.086
	(0.222)	(0.333)	(0.356)	(0.227)	(0.349)	(0.346)
Boy	0.126			0.120		
	(0.092)			(0.102)		
Han ethnicity	0.863***	0.765**	0.978***	0.913***	1.004**	0.824*
	(0.294)	(0.348)	(0.338)	(0.340)	(0.437)	(0.453)
Education of father (reference: illiterate)						
Primary school	0.175	0.128	0.093	0.154	0.177	0.062
	(0.145)	(0.207)	(0.181)	(0.184)	(0.228)	(0.246)
Junior high school	0.094	0.029	0.191	0.097	−0.028	0.206
	(0.149)	(0.193)	(0.207)	(0.179)	(0.216)	(0.271)
Senior high school	0.242	0.267	0.294	0.416	0.310	0.469
	(0.215)	(0.285)	(0.288)	(0.262)	(0.346)	(0.401)
College and above	0.469	0.114	0.470	0.234	−0.223	0.310
	(0.344)	(0.509)	(0.445)	(0.453)	(0.668)	(0.723)
Education of mother (reference: illiterate)						
Primary school	0.310**	0.487**	0.160	0.254	0.292	0.285
	(0.133)	(0.196)	(0.161)	(0.161)	(0.187)	(0.282)
Junior high school	0.363***	0.615***	0.191	0.295*	0.564***	0.044
	(0.126)	(0.214)	(0.161)	(0.155)	(0.194)	(0.264)
Senior high School	0.475*	0.967***	0.067	0.193	0.614**	−0.289
	(0.281)	(0.226)	(0.482)	(0.340)	(0.292)	(0.623)
College and above	−0.061	1.699***	−1.453	1.868	1.928	3.150***
	(0.832)	(0.506)	(1.204)	(1.186)	(1.340)	(0.783)
Age of father	0.203	−0.158	0.380**	0.154	−0.190	0.321
	(0.147)	(0.194)	(0.187)	(0.161)	(0.240)	(0.237)
Age of father squared/100	−0.264	0.166	−0.466**	−0.240	0.191	−0.437
	(0.178)	(0.236)	(0.219)	(0.195)	(0.292)	(0.274)
Age of mother	−0.070	0.573***	−0.257**	0.064	0.685***	−0.153
	(0.094)	(0.204)	(0.104)	(0.111)	(0.240)	(0.125)
Age of mother squared/100	0.081	−0.720***	0.301**	−0.057	−0.860***	0.182
	(0.122)	(0.273)	(0.131)	(0.137)	(0.323)	(0.143)
Constant	6.525*	1.747	5.612	5.267	1.328	3.384
	(3.328)	(4.043)	(3.985)	(3.684)	(4.664)	(5.338)
Observations	2460	1224	1236	1596	889	707
R-squared	0.264	0.340	0.304	0.291	0.371	0.359
Cohort FE	Y	Y	Y	Y	Y	Y

Table 10 (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	All			Children from households with both sons and daughters		
	All	Girl	Boy	All	Girl	Boy
Province FE	Y	Y	Y	Y	Y	Y
Province linear trend	Y	Y	Y	Y	Y	Y
Birth month FE	Y	Y	Y	Y	Y	Y
Survey month FE	Y	Y	Y	Y	Y	Y
Cohort dummy*2005 province char.	Y	Y	Y	Y	Y	Y

The dependent variable is log household educational spending. Each column is from a separate regression estimated with the same specification as in column (3) of Table 4. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

child labor is stronger for boys from households with lower socioeconomic status.

The free compulsory education reform may induce parents to redistribute transfers towards boys within a household. An increase in household disposal income induced by the free compulsory education reform results in a significant decrease in voluntary educational expenditure on targeted girls. However, reform exposure has no significant effect on voluntary educational spending on boys.

Our results suggest that the Free Compulsory Education Reform may enlarge the education gaps between boys and girls in rural areas. Given that female education is associated with a variety of positive social outcomes, including lower fertility, decreases in child mortality, improvements in child health and nutrition, and better education and child cognitive development (see reviews in Strauss and Thomas 1995), governments should exert more effort to target their policies on more vulnerable groups, such as girls or children from poor families.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

Table 11 Effects of the reform on child labor: children from households with both sons and daughters

Variables	(1) All	(2) All	(3) All	(4) Girl	(5) Girl	(6) Girl	(7) Boy	(8) Boy	(9) Boy
Semester	−0.001	−0.003	−0.058	0.047	0.034	0.017	−0.104**	−0.096**	−0.208***
	(0.034)	(0.035)	(0.038)	(0.049)	(0.048)	(0.060)	(0.046)	(0.047)	(0.044)
Boy	−0.017	−0.023	−0.021						
	(0.016)	(0.016)	(0.016)						
Han ethnicity	−0.163***	−0.154***	−0.153***	−0.170***	−0.178***	−0.172***	−0.181**	−0.147**	−0.148**
	(0.054)	(0.046)	(0.048)	(0.061)	(0.057)	(0.060)	(0.071)	(0.062)	(0.063)
Education of father (reference: illiterate)									
Primary school		−0.002	−0.003		0.044	0.042		−0.068	−0.076*
		(0.027)	(0.027)		(0.038)	(0.039)		(0.044)	(0.043)
Junior high school		−0.060**	−0.062**		−0.025	−0.027		−0.114***	−0.118***
		(0.028)	(0.028)		(0.037)	(0.036)		(0.040)	(0.040)
Senior high school		−0.068	−0.069		−0.062	−0.064		−0.078	−0.073
		(0.042)	(0.043)		(0.038)	(0.039)		(0.073)	(0.076)
College and above		−0.062	−0.070		0.022	0.001		−0.101	−0.113
		(0.076)	(0.075)		(0.097)	(0.094)		(0.102)	(0.102)
Education of mother (reference: illiterate)									
Primary school		−0.028	−0.025		−0.025	−0.019		−0.032	−0.030
		(0.018)	(0.019)		(0.026)	(0.026)		(0.030)	(0.030)
Junior high school		0.018	0.022		−0.018	−0.019		0.040	0.051
		(0.026)	(0.026)		(0.034)	(0.034)		(0.037)	(0.039)
Senior high school		−0.027	−0.030		0.025	0.012		−0.037	−0.034
		(0.044)	(0.043)		(0.060)	(0.058)		(0.052)	(0.052)
College and above		0.204	0.202		0.174	0.162		0.098	0.161*

Table 11 (continued)

Variables	(1) All	(2) All	(3) All	(4) Girl	(5) Girl	(6) Girl	(7) Boy	(8) Boy	(9) Boy
		(0.178)	(0.183)		(0.166)	(0.166)		(0.092)	(0.093)
Age of father		0.026	0.022		0.088***	0.086***		−0.006	−0.012
		(0.018)	(0.018)		(0.027)	(0.027)		(0.020)	(0.021)
Age of father squared/100		−0.025	−0.021		−0.100***	−0.098***		0.011	0.017
		(0.020)	(0.020)		(0.030)	(0.029)		(0.023)	(0.024)
Age of mother		0.007	0.012		−0.028	−0.021		0.026	0.031*
		(0.014)	(0.015)		(0.042)	(0.043)		(0.016)	(0.017)
Age of mother squared/100		−0.008	−0.014		0.038	0.030		−0.030*	−0.037*
		(0.017)	(0.017)		(0.053)	(0.054)		(0.018)	(0.019)
Constant	0.240	−0.550	−0.237	0.082	−1.351	−1.293	0.703**	0.244	0.845*
	(0.213)	(0.400)	(0.385)	(0.277)	(0.869)	(0.886)	(0.296)	(0.514)	(0.490)
Observations	1642	1596	1596	914	889	889	728	707	707
R-squared	0.213	0.237	0.246	0.255	0.288	0.301	0.252	0.282	0.302
Cohort FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province linear trend	Y	Y	Y	Y	Y	Y	Y	Y	Y
Birth month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Survey month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cohort dummy*2005 province char.	N	N	Y	N	N	Y	N	N	Y

The dependent variable is children's labor force participation. We restrict the sample to children from households with both sons and daughters. Robust standard errors in parentheses are clustered at the province-birth cohort level

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 12 Spillover effects of the reform

Variables	(1) All	(2) Girl	(3) Boy
Semester	−0.010	−0.012	−0.083**
	(0.027)	(0.051)	(0.037)
Boy	0.009		
	(0.013)		
Total number of semesters of all sisters	−0.003**	0.002	−0.004*
	(0.001)	(0.002)	(0.002)
Total number of semesters of all brothers	0.004	0.003	0.003
	(0.003)	(0.004)	(0.003)
Han ethnicity	−0.112***	−0.137***	−0.106***
	(0.031)	(0.048)	(0.040)
Education of father (reference: illiterate)			
Primary School	−0.005	0.037	−0.049*
	(0.020)	(0.027)	(0.029)
Junior High School	−0.033	0.007	−0.057**
	(0.020)	(0.027)	(0.028)
Senior High School	−0.043	−0.024	−0.041
	(0.032)	(0.031)	(0.052)
Above	−0.012	0.004	−0.023
	(0.075)	(0.071)	(0.102)
Education of mother (reference: illiterate)			
Primary School	−0.035**	−0.027	−0.036
	(0.015)	(0.022)	(0.026)
Junior High School	0.001	−0.013	0.007
	(0.018)	(0.025)	(0.023)
Senior High School	0.021	0.061	−0.006
	(0.040)	(0.062)	(0.044)
Above	0.081	0.057	0.079
	(0.062)	(0.077)	(0.097)
Age of father	0.020	0.060**	0.003
	(0.014)	(0.024)	(0.014)
Age of father squared/100	−0.019	−0.069**	0.001
	(0.015)	(0.027)	(0.015)
Age of mother	0.020	0.029	0.033***
	(0.014)	(0.036)	(0.013)
Age of mother squared/100	−0.021	−0.035	−0.037***
	(0.016)	(0.045)	(0.013)
Number of brothers from age 6 to 16	0.014	−0.023	0.048*
	(0.020)	(0.023)	(0.029)
Number of sisters from age 6 to 16	0.044**	0.054**	0.027
	(0.018)	(0.023)	(0.024)
Number of brothers under the age of 6	0.056**	0.041	0.055

Table 12 (continued)

Variables	(1) All	(2) Girl	(3) Boy
	(0.027)	(0.036)	(0.042)
Number of sisters under the age of 6	0.038	− 0.029	0.093
	(0.032)	(0.030)	(0.061)
Constant	− 0.539*	− 1.536**	− 0.283
	(0.293)	(0.681)	(0.355)
Observations	2313	1133	1180
R-squared	0.225	0.284	0.272
Cohort FE	Y	Y	Y
Province FE	Y	Y	Y
Province linear trend	Y	Y	Y
Birth month FE	Y	Y	Y
Survey month FE	Y	Y	Y
Cohort*2005 province char.	Y	Y	Y

The dependent variable is children's labor force participation. Each column is from a separate regression estimated with the same specification as in column (3) of Table 4. Robust standard errors in parentheses are clustered at the province-birth cohort level

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

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