Parental education and child health: Evidence from an education reform in China

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Preliminary Draft

October 15, 2014

Abstract

This paper investigates the impact of parental education on child health, exploiting a compulsory schooling law implemented in China in 1986 that extended schooling from 6 to 9 years. It finds that it is maternal, rather than paternal, education that matters for child health. An additional year of mother's education raises the height-for-age of children by 0.227 standard deviations and lowers the probability of being stunted by 3.3 percentage points. Estimating separately for boys and girls, I find that the impact of maternal education is twice as large for boys than girls and the effect for girls is statistically insignificant once individual and household controls are accounted for. An additional year of maternal education is associated with an estimated increase of 0.299 standard deviations of boys height and a reduction in the probability of boys being stunted of 4.2 percentage points. This suggests that son preference in China has additional impacts beyond the sex-ratio at birth.

JEL Classification: C21, I12, I21
Keywords: Intergenerational Mobility; Gender; Health; China

1 Introduction

Health is an important component of well-being (Deaton, 2008) and is correlated with economic status (Smith, 1999). Such is the belief that health goes some way to determining a

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society's potential for economic advancement that both the World Health Organisation (WHO) and the European Commission (EC) have argued that governments should increase spending on health in order to induce economic growth (Swift, 2011).

Despite recent advancements in the health of children in developing countries, with reductions in mortality (Liu et al., 2012) and anthropometric failure (De Onis et al., 2013), stunting (height $<$ 2 s.d. below the reference mean) is still a major issue; in 2010 an estimated 167 million children in developing countries were classified as stunted (De Onis et al., 2012). In 2012, the WHO adopted a resolution to address malnutrition which included a target to reduce by 40% the number of children under the age of 5 who were classified as stunted by 2025 (De Onis et al., 2013).

A large body of work investigates intergenerational relationships between the socioeconomic status (SES) and/or health of parents and children (see Black and Devereux, 2011, for a comprehensive survey), and has stressed the importance of parental education, income, and health for child outcomes. Income gradients in health begin in childhood and increase with child age (Case et al., 2002), and there is overwhelming evidence concerning a positive relationship between childhood health and adult health and SES (e.g. Case et al., 2005). Thus, the study of how parental socioeconomic status affects child outcomes is of interest if we are concerned with ensuring equality of opportunity.

The relationship between parental education and child health is of interest for two reasons. First, if health contributes to well-being, we may be intrinsically interested in it as an outcome. In addition, we may be interested in the distribution of health and - in particular - how inequalities in health relate to inequalities in other contexts. Currie (2009) argues that low parental education may impact the future education and labour market outcomes of their children through it's impact on child health. In other words, health may mediate the intergenerational transmission of education. Parents with low levels of education may be less able to invest in the health of their children, and this may have long-reaching implications for the adult outcomes of the child (Cunha and Heckman, 2007; Almond and Currie, 2011). Thus, disparities in parental education have farther reaching implications than one might first think.

Mechanisms through which parental education may impact on health are numerous (Lindeboom et al., 2009); parental education may enter the child health production function directly (e.g. through increased knowledge and associated increased efficiency in health investments) and indirectly (e.g. through increased income resulting in increased spending on health inputs).[1] Much of the existing literature studying the impact of parental education on child health focuses on maternal rather than paternal education (Chen and Li, 2009). It has been argued that this reflects the fact that mothers - as primary caregivers - may have more of a direct influence on child health than fathers (Aslam and Kingdon, 2012), and that efficiency gains in health

[1]See Lindeboom et al. (2009) for a more complete discussion.

production from increased education are larger for mothers than fathers due to the fact they are primary care-givers (Amin et al., 2014).

Improved education of girls has been a development policy focus for several decades (Monkman and Hoffman, 2013). There has been an increased focus on this since the introduction of the Millenium Development Goals (MDG), two of which explicitly focus on increasing the level of girls education. In response to this, there have been several high profile initiatives to raise education of girls such as the United Nations Girls Education Initiative (UNGEI). The World Bank's Education Strategy 2020 explicitly focuses on extending education to all, with a particular focus on improving access to education for girls and other disadvantaged groups. Traditional arguments for a policy focus on girls education fall in the realms of justice-based arguments (equality and human rights), utility arguments (improving girls schooling will e.g. reduce poverty and raise well-being), and empowerment arguments (education as facilitating female empowerment) (Monkman and Hoffman, 2013). Alongside this, it is increasingly being recognised by policymakers that there may be second order effects to raising girls education. Improvements in girls education may have intergenerational effects for their future offspring, with the World Bank arguing that improving female education 'yields enormous intergenerational gains' (Tembon and Fort, 2008, p. xvii).

A particular issue in the context of China concerns son preference, which is historically entrenched in society and culture so that this son preference has persisted despite economic change (Das Gupta et al., 2003; Murphy et al., 2011). Thus, such intergenerational gains of from improved parental education may not necessarily benefit boys and girls equally.

Estimation of the causal relationship between parental education and child outcomes such as health or education is complicated by various sources of endogeneity. For example, unobserved time preferences of parents may be such that those who discount the future less heavily are both more likely to invest in their own education and in the human capital of their children. The solution in the literature has been to isolate *exogenous* changes in parental education, either through the use of data on twins or adoptees, or through instrumental variables (IV) methods (Holmlund et al., 2011).

Chen and Li (2009) investigate the impact of maternal education on child health in China using the 1992 Chinese Children Survey data, and analyse determinants of the health of adoptees. They find that an additional year of education raises child height-for-age by 0.022 standard deviations, although they do acknowledge that some of their control variables may be endogenous, which may make their results problematic. Studies using twin data have focused on the intergenerational impact of parental education on child education and have tended to find a role for father's education but not mothers (Amin et al., 2014). However, many of these twin studies investigate the impact of parental health without knowing the zygosity of the twins; i.e whether they are identical or not; Amin et al. (2014) find that failure to account for zygosity of twins can substantially change results.

A popular IV methodology has been to use *educational reforms* to identify exogenous changes in parental education; typically these educational reforms involve changes to compulsory schooling laws, and typically they focus on developed economies. This identification strategy has been used to estimate the impact of education on e.g. own earnings (Harmon and Walker, 1995; Meghir and Palme, 2005; Pischke and von Wachter, 2008), child education (Black et al., 2005; Holmlund et al., 2011; Chevalier, 2004; Dickson et al., 2013; Oreopoulos et al., 2006), and child health (Lindeboom et al., 2009; Chou et al., 2010; Lundborg et al., 2014). These latter papers are of particular interest for the analysis in this paper.

Lindeboom et al. (2009) investigate the impact of both maternal and paternal education on child health, using a rise in the compulsory school-leaving age in the UK in 1947. They find no evidence of an impact of parental education on child health, and argue that this may be because they also find no impact of the increased education on inputs to child health production such as pre-natal or child care. Chou et al. (2010) investigate the impact of an increase in compulsory schooling from 6 - 9 years in Taiwan and find that an additional year of maternal education lowered infant mortality by 0.774 deaths per thousand, whilst the impact of father's education is smaller, at 0.602 deaths per thousand. Lundborg et al. (2014) estimate the impact of parental education on a range of outcomes including cognitive and non-cognitive skills, and a variety of measures of health. They find that it is primarily mother's education that matters, with an additional year of education estimated to raise offspring adult height by 0.089 standard deviations.

This paper identifies the impact of parental education on child health using a schooling reform in China in 1986 which extended compulsory schooling from 6 to 9 years (primary to junior secondary). It first estimates a pooled relationship for boys and girls, before estimating the relationship separately by child gender so as to investigate whether there is evidence of differential parental investments according to child gender. It is one of only a handful of studies employing this methodology to investigate impacts of parental education on child health and the first to look at this question in China. It also contributes to evidence concerning the importance of son preference in China for child outcomes.

I find that it is maternal, rather than paternal, education which matters for child health, consistent with the evidence found in Lundborg et al. (2014), and more generally in the intergenerational literature that uses IV methodologies to estimate the impact of parental education on child outcomes (Amin et al., 2014). Estimates suggest that an increase of maternal education by one year raises child height by 0.227 standard deviations and lowers the probability of being stunted by 3.3 percentage points. Estimating separately by gender of the child, I find that maternal education raises the height of boys by 0.299 standard deviations and lowers the probability of being stunted by 4.2 percentage points. In contrast, effects on girls height are half the size and statistically insignificant in all but one specification. This offers evidence of differential parental investments, with son preference continuing to disadvantage girls in China.

The rest of the paper is organised as follows. Section 2 briefly outlines the reform, section 3 describes the data, section 4 describes the methodology, section 5 outlines results and section 6 concludes.

2 Reform of China's Education Structure, 1986

2.1 The historical context: Chinese schooling pre-1986 reform

Historically, the Confuican tradition in education was one of *elite-orientated* education rather than wide-spread education (Lewin et al., 1994). As such, the education system pre-1949 was underdeveloped with 80% of the population being illiterate. The post-1949 period saw a huge expansion in education with an increase in the number of primary (secondary) schools from 346,800 (4,000) in 1949 to 547,300 (11,100) in 1957 (Hannum, 1999). However, the great famine of 1959-61 led to a large drop in enrollment in schools (Hannum, 1999). This was further compounded by the cultural revolution starting in 1966 which saw the forced closure of many schools (Lee, 2006), a shortage of teachers at all levels of education (Ning, 1992) and a lowering of educational quality due to an emphasis on political loyalty over academic achievement in determining progress through school (Hannum, 1999).

In the early 1980s several problematic areas in education were identified. These included: low quality elementary education; vocation and technical education were underdeveloped; a poor match existed between higher education studies and ultimate jobs performed by graduates; education development had failed to keep pace with other technological, social and economic change; and education administration was too rigid (Lewin et al., 1994; Hawkins, 2000). As part of a strategy to ensure education would facilitate economic development and in response to these perceived failures in the education system, a wide-ranging reform was designed at a national conference on education in 1985 (Ning, 1992).

2.2 Reform of China's Education Structure

The structure of China's education system is as follows. Pre-school or kindergarten is available from ages 3-6, after which children enter grade 1 of primary school. This lasts for 6 years so that at age 12 they enter junior secondary school and enrol in grade 7. After three years of junior secondary education a student may enter either academic or vocational senior secondary school at the age of 15 (grade 10). Entry into higher education is at age 18.

The *Reform of China's Education Structure* consisted of a package of reforms which aimed to address the identified problems in the Chinese education system outlined above. The reform decentralised educational finance (Hawkins, 2000), promoted vocation and technical education, and gave more thought into correctly matching higher education enrollment to the skill set of graduates needed by employers (Lewin et al., 1994). The *Law on Nine-Year Compulsory Education* was introduced; this consisted of the extension of compulsory education from the primary cycle of education (six years) to junior secondary education (nine years).

2.3 The Law on Nine-Year Compulsory Education

The *Law on Nine-Year Compulsory Education* was implemented from 1st July 1986; its ultimate aim was to implement a nine year cycle of compulsory education. However, it was recognized that there existed inherent differences between the level of economic development in different regions and between urban and rural areas, so that the nine-year cycle was to be implemented at varying rates according to the level of development of an area (Hannum, 1999). Cities and economically developed areas in coastal provinces and some select interior provinces that had high levels of enrollment in junior secondary education were expected to make it universal by 1990; these areas contained around 25% of the population (Song et al., 2006). Townships and villages that were classified as economically semi-developed (around 50% of the population) were required to focus on securing universal primary education and to expand enrollment in junior secondary schooling, with universal enrollment targeted by 1995. Finally, economically underdeveloped areas were expected to expand primary and junior secondary education, but with no target for universal enrollment (Lewin et al., 1994). Thus, although the requirements varied across areas, there was an emphasis on raising the years of schooling at the lower end of the education distribution in all areas.

3 Data and Descriptive Statistics

3.1 Data

I use the China Health and Nutrition Survey (CHNS).[2] This is an ongoing open cohort study; the first round was collected in 1989 and drew a sample of about 4400 households, with a total of 26,000 individuals, in nine provinces: Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong. These provinces differ in geography, economic development, public resources, and health indicators. Seven additional panels were collected in 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011 with new households added to the data after 1993. Figure 1 shows the provinces used in the analysis. Information in each survey round was collected on demographic and socioeconomic characteristics, individual health, diet,

[2] See http://www.cpc.unc.edu/projects/china for information on and access to the data.

income, time use, child care, fertility and birth histories, and health care availability and use. Health data for 2011 has not yet been released, and since the reform occured in 1985, I use only the 1997-2009 survey waves so as to ensure that parents are old enough to have completed their schooling.

3.2 Descriptives

As discussed above, the reform expanded education from primary to junior secondary level. Since the school year in China starts on September 1st, individuals who were born between September 1973 - August 1974 would have been in grade 6 (the final year of primary school) and were due to enter grade 7 (the first year of junior secondary schooling) when the reform was implemented. These are the first primary schooling cohort affected by the reform. The cohort born between September 1971 - August 1973 are classified as 'partially treated' as they were due to enter grades 8 or 9 of junior secondary. Thus, they may have already dropped out of school (untreated) or they were in school at the time of the reform but in the absence of the reform may have otherwise dropped out and not completed junior secondary education (treated). Individuals born before this belonged to cohorts that would have already graduated junior secondary schooling at the time of the reform's implementation and would have been unaffected by the reform.[3] A summary of treatment status is given in table I below:

Table I: Cohort Reform Status

Date of birth	Grade entry point at 1st September 1986	Reform Status
Aug 1971 or before	>9 (Post Junior Secondary)	Not Treated
Sept 1971 - Aug 1973	8 or 9 (Years 2 or 3 of Junior Secondary)	Partially Treated
Sept 1973 - Aug 1974	7 (Year 1 of Junior Secondary)	Treated
Sept 1974 or later	<7 (Final year of primary or below)	Treated

In the descriptive graphs that follow, I use the latest wave available (2009) and focus on those born in the schooling cohorts September 1954/August 1955 to September 1984/August 1985.[4]

Figures 2(a) - 2(c) show the average education of the female and male cohorts, respectively, as well as lowess plots for the pre- and post-reform trends. The first vertical line indicates the cut-off point for the partially treated cohorts, whilst the second vertical line indicates the cut-off point for the treated cohorts, and the horizontal line indicates nine years of education.[5]

[3] Of course, this does not take into account individuals who dropped out and re-entered the schooling system, or who had to resit a grade. Since I cannot identify these individuals I assume they do not constitute a large fraction of the sample.

[4] Note that I keep only individuals who are not currently in school and I implement the end cut-off of 1984/85 so as to allow for individuals observed in 2009 to have completed education.

[5] Note also that for reasons of space, the x-axis is only partially labeled.

For women schooled in the post-reform period, a distinct rise in education above nine years is apparent; prior to the reform education had risen for earlier cohorts but had been stagnant in the period of the cultural revolution. For men, pre-reform education averaged around nine years, so that the reform had less scope for impact, though a rise in average education is observed for the post 1973/74 cohort.

Disparities in the level of development across different geographical units of analysis in China exist. In particular, inequality at the inter-provincial and urban/rural level have been highlighted, with much of the recent focus on urban/rural inequalities (Tsui, 1993; Herrmann-Pillath et al., 2002). In the 2009 wave of the CHNS data, average education in the urban sub-sample is 9.53 (7.97) for men (women) whilst in rural areas it is 7.93 (6.03) years. Provincial differences in education levels are also apparent; average education of men (women) varies across provinces from 7.23 (4.77) in Guizhou to 9.38 (8.44) years in Liaoning (figure 3). These means also mask variation in the distribution of education, shown in figure 3; e.g. in Liaoning women tend to have either 6 (primary), 9 (junior secondary) or 12 (senior secondary) years of education, whilst in Guizhao women tend to have either no education (0 years) or 9 years of education. Given these geographical inequalities in education levels, I also investigate trends by urban and rural location and by province.

Figures 4(a) and 4(b) show differences in the trend of education for each province for men and women, respectively. Trends to appear to vary across province, suggesting that both the pre- and post-reform education levels differed across province.

The urban/rural splits confirm that the effect of the reform was stronger in more developed (i.e. urban) locations, particularly for women. Rural men appeared to make little gains in average education, hovering around 9 years. In contrast, urban men did appear to experience gains in education (figure 5(a)). Urban women being schooled in the post-1985 regime made significant gains in average education, beyond 9 years, whilst rural women saw a rise in average education such that for the later cohorts average education was at 9 years (figure 5(b)).

4 Methodology

The empirical model is summarised by the following two equations:

$$H_{ijt} = \beta_0 + \beta_1 E^p_{ijt} + \beta_2 X_{ipjt} + \beta_3 \gamma_j + \beta_4 YOB^p_{ijt}\gamma_j + \beta_5 \psi_t + \varepsilon_{ijt} \tag{1}$$

$$E^p_{ijt} = \alpha_0 + \alpha_1 Z_{pjt} + \alpha_2 X_{ipjt} + \alpha_3 \gamma_j + \alpha_4 YOB^p_{ijt}\gamma_j + \alpha_5 \psi_t + \eta_{ijt} \tag{2}$$

The outcome of interest H_{ijt} is either i) the (gender- and month- specific) z-score of height or ii) an indicator for stunting (height-for-age $<$ 2 s.d. below reference mean), for a child i

living in province j at time t.[6] E^p_{ijt} is the education of child i's parent, where $p = m$ (mother) or $= f$ (father), so that the coefficient of interest is β_1. X_{ipjt} is a vector of child, parent and household control variables: household income per capita, ethnicity, gender of the child, urban status, an indicator for living in a coastal province, child age, and mother's age at birth. I also include province specific fixed effects (γ_j), province-specific trends for the year of birth of the parent, $YOB^p\gamma_j$, and survey wave fixed effects ψ_t. The panel of children is unbalanced and children are observed in different waves; I pool all waves together and calculate robust standard errors that are correlated at the child level, to allow for correlations over time within child observations.[7] I estimate equation 1 for children aged 0-10 at the time of the survey.

I first estimate equation 1 by OLS. Since parental education E^p_{ijt} is likely to be endogenous I then estimate using 2SLS, and instrument E^p_{ijt} with the instrument set Z_{pjt}, with equation 2 as the first stage. I investigate two different instruments. First,

$$Z_{pjt} = Post_{pjt}$$

where $Post_{pjt}$ is a dummy variable indicating that parent p belongs to the post-reform cohort. I focus on the 5 cohorts preceding the reform, and the 5 cohorts following the reform, not including those who were partially affected and who are omitted from the analysis. Thus $Post_{ijt}$ equals 1 if the parent belongs to the 'treated' cohort described in Table I above, and 0 if the individual belongs to the 'untreated' cohort. This is a straightforward difference in difference strategy in which parents exposed to the reform are compared to parents unexposed to the reform, taking into account observable characteristics X_{ipjt}, province of birth γ_j and when allowing for differential trends by province $YOB^p_{ijt}\gamma_j$.

An identifying assumption of the IV strategy used is that the reform would not have affected child health in any way other than through it's impact on parental education. It is important to consider whether this is valid, given that the extension of compulsory education to nine years was part of a package of reforms. To recap, other aspects of the *Reform of China's Education Structure* were: changes to educational finance, with more involvement from local governments; reforms to enrollment planning of higher education to give more control to HE institutes over enrollment policies; and the promotion of vocational and technical education; Of these it is plausible to assume that the former two aspects of the reform would not directly affect child health 20 years or so later. The focus on promotion of vocational and technical schooling is probably the largest threat to identification, since it may be the case that this affected school quality. However, although this policy led to the opening of technical and vocational schools, in reality these were often simply pre-existing schools which had been

[6] The z-score of height is calculated using the Stata command -zanthro- which uses the 2000 CDC Growth Reference from the US. For children under the age of two, length-for-age is calculated.

[7] Note that since the variable of interest, parental education (E^p_{ijt}) is constant over time, it is not possible to identify its effect using fixed effects regression methods.

renamed with the same staff who were not given additional training (Lewin and Hui, 1989). In addition, explicit objectives targeting the quality of education did not occur until the late 1990s (Tiedao et al., 2004).

There are two drawbacks to using reform status as an instrument. The first is that the equation is exactly identified, so that it is not possible to test for validity of the instrument. The second is that when using a national compulsory schooling reform as an instrument, it can be difficult to disentangle cohort effects from the reform unless there is some geographical variation in the way in which the reform is implemented (Holmlund et al., 2011). There is little specific information available on the implementation of the reform in different areas. However, given that - as outlined in section 2 - the pace of the implementation of the nine-year cycle at a local level was determined by the level of development of the area, I investigate the use of a variable proxying the level of development prior to the reform.

The second instrument set is:

$$Z_{pjt} = Post_{pjt}, \quad E_j^p, \quad Post_{pijt} \cdot E_j^p$$

where E_j^p is the urban-, rural- and provincial-average education (in years) of the last cohort unaffected by the reform (individuals born 1970/71; see Table I above) for a parent p living in province j. E_j^p is calculated separately for urban and rural areas to account for inherent differences in educational development between urban and non-urban locations, as discussed in section 3. I also include its interaction with the indicator for being of the post-reform cohort, $Post_{pijt}E_j^p$. The motivation for using E_j^p is that this will proxy for pre-reform differences in the level of education in different areas which may have affected the pace of reform.[8]

A final issue is whether to investigate mothers and fathers education together or in isolation. Holmlund et al. (2011) argue that it is not clear whether spousal education should be included as an additional (endogenous) explanatory variable in IV regressions; either spousal education is omitted - so that resulting estimates partially reflect assortative matching - or it is included as an additional endogenous regressor, instrumented with an indicator for if the spouse was affected by the reform. This can be problematic if spouses are close in age so that there is little variation in reform status within spouses, resulting in imprecise estimates. The choice is therefore to either omit spousal education and accept that the estimates partially reflect assortative mating, or instrument both parents' education in the same analysis and potentially face a weak instruments problem. I choose the former, estimating equation 1 separately for mothers and fathers.[9]

[8] I also investigated the use of provincial road density (length of highways per area km-sq) prior to the implementation of the reform as a measure of development. The instrument set $Post_{pjt}, \quad Post_{pijt} \cdot RoadDensity_j^p$ was rather weak and so is not included in the paper; however, results using this instrument were very similar to results shown in the paper and are available on request.

[9] As a robustness check, I included both parents in the analysis; as expected the instruments were very weak

Given its history of son preference and the resulting poorer health and education outcomes for female infants and children (e.g. Chen et al., 2007; Hannum et al., 2009), it is of interest to investigate whether improvements in parental education disproportionately improve the health of one gender relative to another. I therefore re-estimate equation 1 separately for boys and girls.[10]

5 Results

Pooled analysis

Tables 1 and 2 show results when investigating mothers' education for child height-for-age and stunting, respectively. In each specification that follows, I first estimate without X_{ipjt} before adding in these controls. OLS estimates indicate that maternal education has a statistically significant positive effect on health (columns (I) and (II)) but, as already outlined, are likely invalid due to endogeneity concerns.

The two stage least squares estimates (columns (III) - (VI)) show that maternal education has a protective influence on health. Using just the post-reform indicator $Post_{pijt}$ (instrument set 1, Columns (III) and (IV)), weak instruments are a problem, particularly once I include the vector of controls X_{pijt}. This is to be expected given that $Post_{pijt}$ does not allow for any geographical variation in the implementation of the reform. In addition, because these IV regressions are exactly identified, it is not possible to test for validity of the instruments.

Using the pre-reform education level instrument set (columns (V) and (VI)), the instruments are valid and appear to be stronger. The first stage F-statistics with and without X_{ipjt} controls are 29.198 and 10.460, respectively. The test of validity is passed in all specifications, except for the stunting regressions when we exclude the X_{ipjt} controls (columns (V), tables 1 and 2). For this reason, I limit discussion in text to specifications which include X_{pijt}. In my preferred specification (instrument set 2, including X_{pijt}; column (VI)), estimates suggest that an additional year of maternal education improves the height of children by 0.227 standard deviations, and lowers the probability of a child being stunted by 3.3 percentage points, relative to a sample rate of 15.9%.

Tables 3 and 4 show results when investigating fathers' education. Again, OLS estimates indicate that education has a statistically significant positive effect on health (Columns (I) and (II)). However, once we investigate using 2SLS, father's education becomes statistically insignificant. One issue is that the instruments appear to be weaker than in the specificatons investigating maternal education. However, even when the F-stat is close to or above 10 (columns

and therefore not particularly informative. Results available on request.

[10]Note that this is not my main specification since the available sample sizes are quite small, so that it is still of interest to investigate the impact on the pooled sample, which has the advantage of improved estimation power.

(IV) and (V)) we fail to find a significant effect of father's education on either measure of child health. There are two potential reasons for this. The first is that - as discussed in section 1 above - mother's education may matter more due to their status as primary care givers. The second is that equation 1 includes household wealth, which may be the main mechanism through which father's education enters the child health production function. Thus, results from the analysis provide little evidence that father's education has any direct impact on child health.

Gender-specific estimates

Investigating the impact of maternal education on girls height for age and stunting (Panel A of tables 5 and 6, respectively), the coefficient is only significant in one specification (Table 5, instrument set 2, not including X_{pijt}; Column (V)) and is not significant in the preferred specification controlling for X_{pijt}. In contrast, for boys (Panel B), we continue to find a statistically significant effect of maternal education on child height which is robust across all specifications. An additional year of maternal education raises boys height by 0.299 standard deviations (column (VI), table 5); this is over twice the effect found for girls. It also lowers the probability of a boy being stunted by 4.2 percentage points (column (VI), table 6). This is particularly interesting given the history of son preference in China, and suggests that boys predominantly benefit from improvements to maternal education or income.

For father's education, for both boys and girls we continue to find no statistically significant effects on height or the probability of being stunted (tables 7 and 8). Again, the instrument set is weaker, but the lack of statistical significance persists even when the instruments have F-statistics close to 10 (Panel B, Column (IV), tables 7 and 8).

6 Conclusion

This paper investigates the impact of parental education on child health, exploiting a compulsory schooling law to identify exogenous effects. It is one of the first few papers to study this in the context of an emerging economy and the first paper to study this question in China. Results suggest that, once household and individual characteristics are controlled for, it is maternal education that matters for child health, rather than paternal education. Estimates suggest that an additional year of schooling raises child height for age by 0.227 standard deviations and reduces the probability of being stunted by 3.3 percentage points. Investigating the impact by gender, an increase in maternal education of one year raises boys height-for-age by 0.299 standard deviations and lowers the probability of being stunted by 4.2 percentage points. In contrast, the effect for girls is half the size and statistically significant in only one specification; this statistical significance disappears once individual and household controls X_{ipjt} are controlled for.

The implications of these results are two-fold; first, they contribute to existing arguments that it is maternal rather than paternal education that matters for child health (Amin et al., 2014), lending further support for policies that focus on improving girls education. Second, it highlights concerns that son preference in China has persisted despite sweeping economic and social change in the last 25 years, and suggests that the benefits of any improvements in maternal education may not be equally distributed according to gender.

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Table 1: The impact of mother's education on z-scores for height

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
Mother's education	0.074***	0.072***	0.312**	0.359**	0.153***	0.227***
	(0.012)	(0.012)	(0.134)	(0.169)	(0.042)	(0.067)
First stage						
Post			1.709***	1.453***	4.445***	4.629***
			(0.543)	(0.552)	(1.565)	(1.625)
Post∗*Pre-reform education					-0.354**	-0.397**
					(0.171)	(0.178)
Pre-reform education					0.903***	0.893***
					(0.113)	(0.179)
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y
Hansen J P-stat					0.236	0.476
F-stat First Stage			9.813	6.958	29.198	10.460
Observations	1361	1333	1361	1333	1361	1333

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *X* controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Table 2: The impact of mother's education on stunting

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
Mother's education	-0.016***	-0.017***	-0.076**	-0.086*	-0.018*	-0.033*
	(0.004)	(0.004)	(0.037)	(0.046)	(0.010)	(0.017)
First stage						
Post			1.709***	1.453***	4.445***	4.629***
			(0.543)	(0.552)	(1.565)	(1.625)
Pre-reform education					0.903***	0.893***
					(0.113)	(0.179)
Post∗*Pre-reform education					-0.354**	-0.397**
					(0.171)	(0.178)
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y
Hansen J P-stat					0.074	0.162
F-stat first stage			9.813	6.958	29.198	10.460
Observations	1361	1333	1361	1333	1361	1333

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. X controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Table 3: The impact of father's education on z-scores of height

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
Father's Education	0.077***	0.071***	0.133	0.129	0.081	0.087
	(0.015)	(0.015)	(0.192)	(0.133)	(0.071)	(0.129)
First stage						
Post			-1.088**	-1.527***	0.151	-0.585
			(0.542)	(0.534)	(1.860)	(1.814)
*Post**Pre-reform Education					-0.160	-0.115
					(0.218)	(0.211)
Pre-reform Education					0.617***	0.130
					(0.126)	(0.185)
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y
Hansen J P-stat					0.255	0.283
F-stat first stage			4.050	8.277	11.475	2.920
Observations	1034	1000	1034	1000	1034	1000

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *X* controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Table 4: The impact of father's education on stunting

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
Father's Education	-0.012***	-0.013***	-0.075	-0.054	-0.012	-0.047
	(0.004)	(0.004)	(0.062)	(0.039)	(0.015)	(0.036)
First stage						
Post			-1.088**	-1.527***	0.151	-0.585
			(0.542)	(0.534)	(1.860)	(1.814)
*Post**Pre-reform Education					-0.160	-0.115
					(0.218)	(0.211)
Pre-reform Education					0.617***	0.130
					(0.126)	(0.185)
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y
Hansen J P-stat					0.383	0.593
F-stat first stage			4.050	8.277	11.475	2.920
Observations	1034	1000	1034	1000	1034	1000

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *X* controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Table 5: The impact of mother's education on z-scores of height: by gender

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
A: Girls						
Mother's Education	0.079***	0.076***	0.506	0.626	0.100*	0.143
	(0.018)	(0.018)	(0.469)	(0.652)	(0.055)	(0.095)
First stage						
Post			1.064	0.657	2.106	2.237
			(0.885)	(0.863)	(2.345)	(2.286)
*Post**Pre-reform education					-0.124	-0.185
					(0.245)	(0.243)
Pre-reform Education					0.869***	0.861***
					(0.155)	(0.249)
Hansen J P-stat					0.210	0.161
F-stat first stage			1.460	0.580	14.498	4.343
Observations	606	595	606	595	606	595
B: Boys						
Mother's Education	0.069***	0.066***	0.273*	0.276*	0.224***	0.299***
	(0.016)	(0.016)	(0.143)	(0.160)	(0.072)	(0.103)
First stage						
Post			2.062***	1.881***	5.920***	6.732***
			(0.707)	(0.722)	(2.128)	(2.132)
*Post**Pre-reform Education					-0.510**	-0.617**
					(0.243)	(0.243)
Pre-reform Education					0.855***	0.854***
					(0.186)	(0.260)
Hansen J P-stat					0.924	0.944
F-stat first stage			8.564	6.815	11.563	5.700
Observations	755	738	755	738	755	738
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. X controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Table 6: The impact of mother's education on stunting: by gender

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
A: Girls						
Mother's Education	-0.019***	-0.020***	-0.128	-0.148	-0.015	-0.027
	(0.005)	(0.006)	(0.111)	(0.092)	(0.012)	(0.027)
First stage						
Post			1.064	0.657	2.106	2.237
			(0.885)	(0.863)	(2.345)	(2.286)
*Post**Pre-reform Education					-0.124	-0.185
					(0.245)	(0.243)
Pre-reform Education					0.869***	0.861***
					(0.155)	(0.249)
Hansen J P-stat					0.330	0.217
F-stat first stage			1.460	0.580	14.498	4.343
Observations	606	595	606	595	606	595
B: Boys						
Mother's Education	-0.016***	-0.017***	-0.064*	-0.068	-0.026	-0.042*
	(0.005)	(0.005)	(0.039)	(0.046)	(0.016)	(0.024)
First stage						
Post			2.062***	1.881***	5.920***	6.732***
			(0.707)	(0.722)	(2.128)	(2.132)
*Post**Pre-reform Education					-0.510**	-0.617**
					(0.243)	(0.243)
Pre-reform Education					0.855***	0.854***
					(0.186)	(0.260)
Hansen J P-stat					0.239	0.310
F-stat first stage			8.564	6.815	11.563	5.700
Observations	755	738	755	738	755	738
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *X* controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Table 7: The impact of father's education on z-scores of height: by gender

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
A: Girls						
Father's Education	0.056**	0.046*	0.162	0.053	0.140	-0.008
	(0.024)	(0.025)	(0.512)	(0.379)	(0.112)	(0.272)
First stage						
Post			-0.601	-0.824	1.871	2.029
			(0.865)	(0.829)	(2.431)	(2.377)
*Post**Pre-reform Education					-0.300	-0.347
					(0.269)	(0.262)
Pre-reform Education					0.565***	0.090
					(0.169)	(0.251)
Hansen J P-stat					0.579	0.893
F-stat first stage			0.480	0.986	4.386	1.154
Observations	427	411	427	411	427	411
B: Boys						
Father's Education	0.090***	0.087***	0.060	0.102	0.008	0.086
	(0.019)	(0.019)	(0.154)	(0.119)	(0.090)	(0.120)
First stage						
Post			-1.701**	-2.116***	-0.732	-1.746
			(0.708)	(0.691)	(2.602)	(2.484)
*Post**Pre-reform education					-0.130	-0.045
					(0.307)	(0.294)
Pre-reform Education					0.623***	0.050
					(0.188)	(0.279)
Hansen J P-stat					0.470	0.226
F-stat first stage			5.704	9.558	7.197	3.196
Observations	607	589	607	589	607	589
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *X* controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Table 8: The impact of father's education on stunting: by gender

	(I) OLS	(II) OLS	(III) 2SLS	(IV) 2SLS	(V) 2SLS	(VI) 2SLS
A: Girls						
Father's Education	-0.003	-0.004	-0.112	-0.052	-0.021	-0.060
	(0.007)	(0.007)	(0.196)	(0.117)	(0.020)	(0.074)
First stage						
Post			-0.601	-0.824	1.871	2.029
			(0.865)	(0.829)	(2.431)	(2.377)
*Post**Pre-reform education					-0.300	-0.347
					(0.269)	(0.262)
Pre-reform Education					0.565^{***}	0.090
					(0.169)	(0.251)
Hansen J P-stat					0.595	0.890
F-stat first stage			0.480	0.986	4.386	1.154
Observations	427	411	427	411	427	411
B: Boys						
Father's Education	-0.017^{***}	-0.019^{***}	-0.034	-0.040	-0.005	-0.037
	(0.006)	(0.006)	(0.045)	(0.033)	(0.023)	(0.033)
First stage						
Post			-1.701^{**}	-2.116^{***}	-0.732	-1.746
			(0.708)	(0.691)	(2.602)	(2.484)
*Post**Pre-reform Education					-0.130	-0.045
					(0.307)	(0.294)
Pre-reform Education					0.623^{***}	0.050
					(0.188)	(0.279)
Hansen J P-stat					0.657	0.428
F-stat first stage			5.704	9.558	7.197	3.196
Observations	607	589	607	589	607	589
Province and Wave FE	Y	Y	Y	Y	Y	Y
Province Trends	Y	Y	Y	Y	Y	Y
X controls	N	Y	N	Y	N	Y

Standard errors are clustered at the child level and are shown in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. X controls include household income per capita, child age, mother's age at birth, and indicators for urban location, han ethnicity, and coastal province.

Figure 1: Map of provinces included in analysis

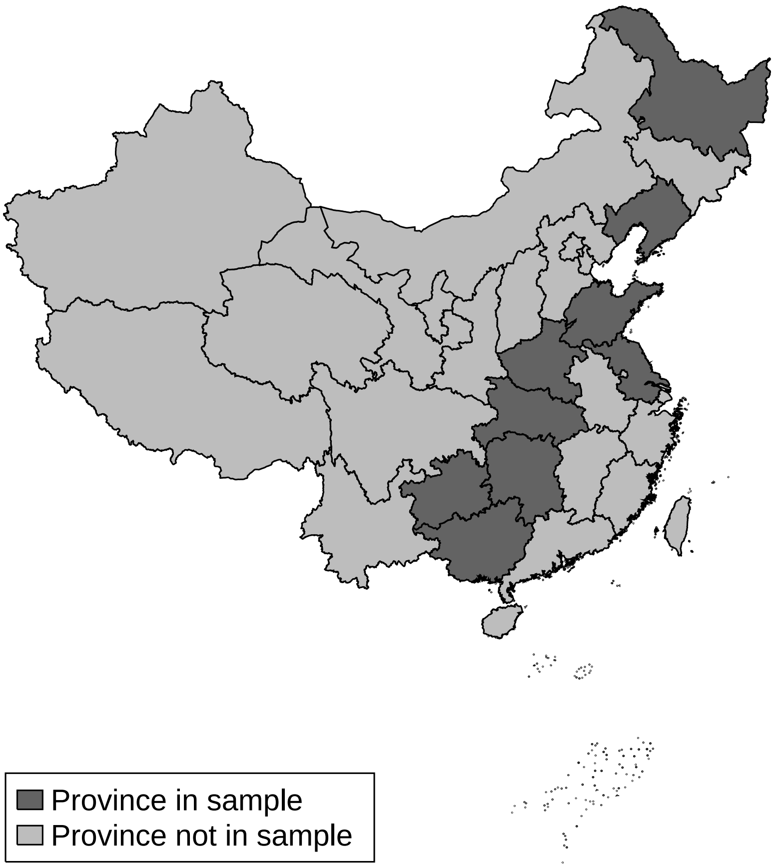
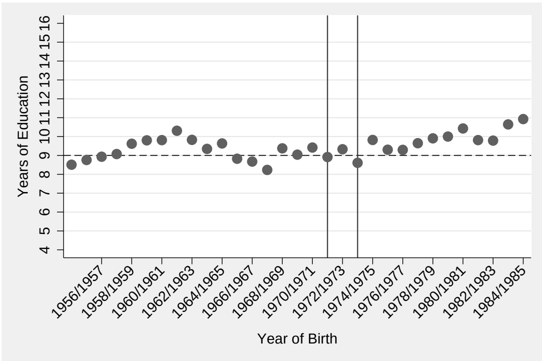
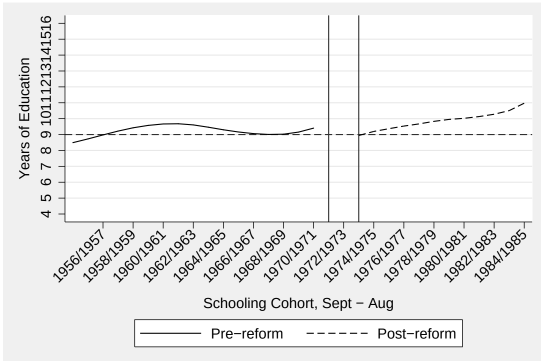


Figure 2: Trends in education around the reform: by schooling cohort

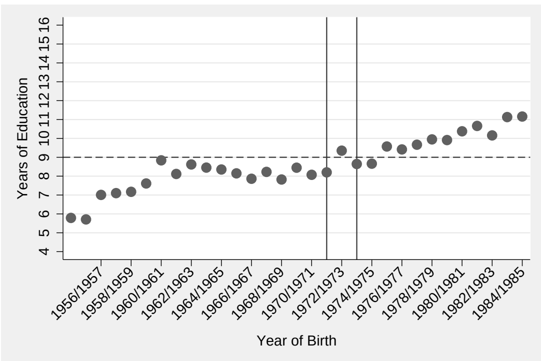
(a) Men: scatter plot



(b) Men: lowess plots pre- and post-reform



(c) Women: scatter plot



(d) Women: lowess plots pre- and post-reform

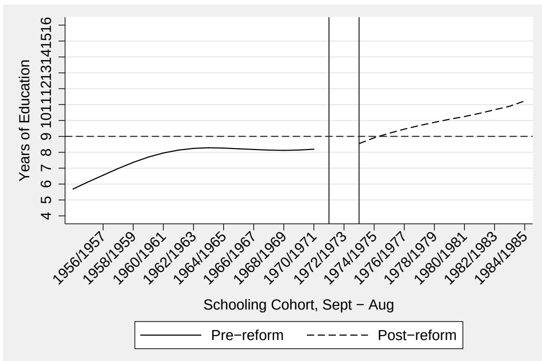
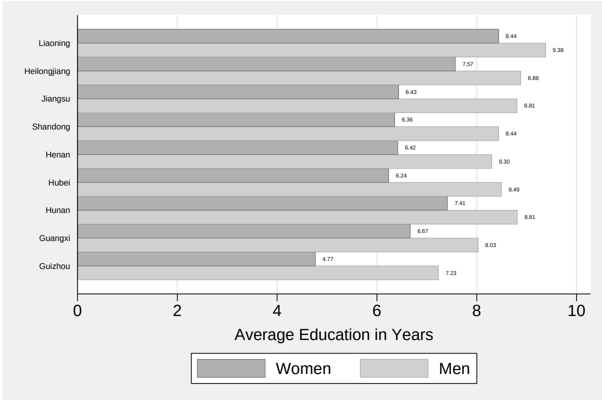
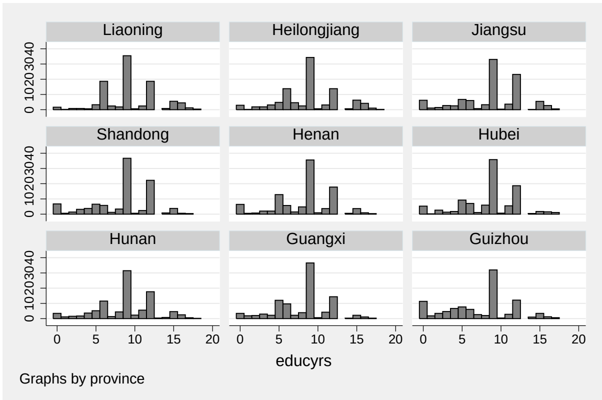


Figure 3: Provincial variation in education

(a) Average education: Men and Women



(b) Men: histogram of education in years



(c) Women: histogram of education in years

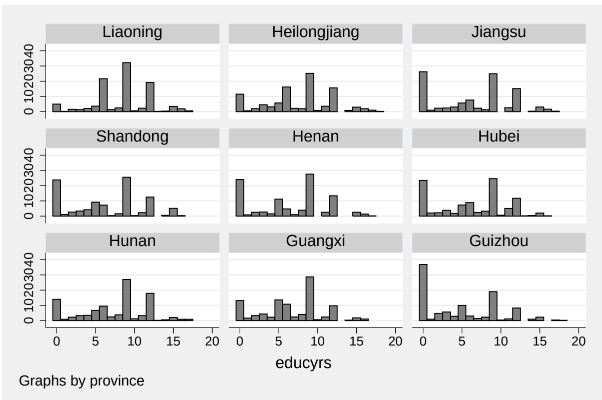
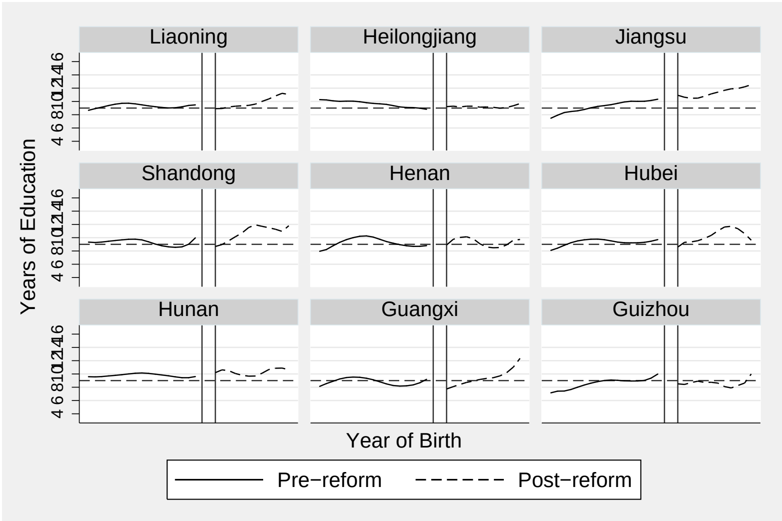


Figure 4: Provincial trends in education: by schooling cohort

(a) Men: Lowess plots pre- and post-reform



(b) Women: Lowess plots pre- and post-reform

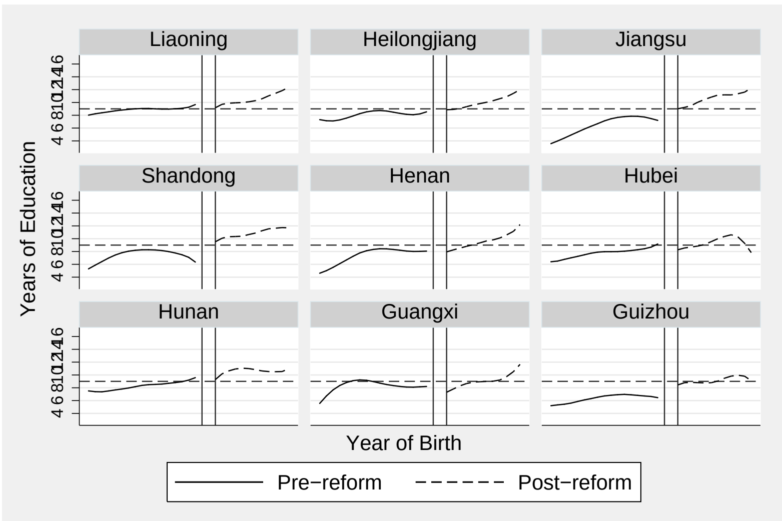
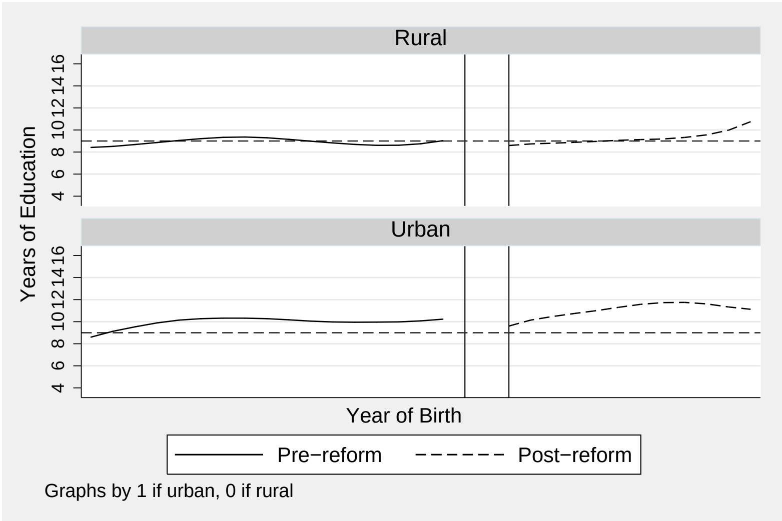


Figure 5: Rural and urban trends in education: by schooling cohort

(a) Men: Lowess plots pre- and post-reform



(b) Women: Lowess plots pre- and post-reform