Maternal Education and Early Childhood Outcomes in China*

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Abstract

In this paper, we study how maternal education affects children's early childhood health outcomes and the development of social and motor skills. We take advantage of the higher education expansion in China, which creates credible exogenous variation in access to colleges that improves mothers' educational attainment, to examine these effects through an instrumental variable approach. Our results show that increases in years of schooling beyond the nine-year compulsory education level significantly improve children's outcomes. Specifically, we find that more maternal education reduces the likelihood of low birth weight and accelerates the development of skills such as speaking, counting, and walking. We also conduct multiple hypothesis tests to confirm robustness, finding that the positive effects on child development remain significant. Mechanism analyses suggest that maternal schooling is associated with assortative marriage, rural-urban migration, delayed fertility, and potentially greater awareness of effective child care and investment strategies. This study provides new evidence on the intergenerational benefits of maternal education on a comprehensive set of child outcomes in an emerging economy and contributes to the literature by focusing on educational attainment beyond compulsory schooling.

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1 Introduction

Extensive research has documented that the early childhood environment is vital for later life outcomes (Almond and Currie, 2011; Currie, 2011). Children's health conditions at birth and during their early childhood are especially important as they can positively impact educational attainment, income, labor supply, and health status (Behrman and Rosenzweig, 2004; Case, Fertig, and Paxson, 2005; Black, Devereux, and Salvanes, 2007; Oreopoulos et al., 2008; Smith et al., 2012). Equally important is the early mastery of cognitive and non-cognitive skills, which also significantly affect those outcomes later in life (Heckman, Pinto, and Savelyev, 2013). Among various factors that shape children's birth conditions and skills development, maternal education is of special interest to researchers as it plays a major role in determining those early childhood outcomes (Almond, Currie, and Duque, 2018). A clear understanding of the impact of maternal education on these outcomes also provides essential policy implications about the intergenerational effects of education, especially for developing countries that usually have a lower level of schooling. In this paper, we study how maternal education affects children's early childhood health outcomes and the development of social and motor skills in the context of a large-scale college expansion in China, which doubled the number of colleges and dramatically increased college enrollment rates in just 10 years. This unprecedented reform expanded access to higher education, offering a unique opportunity to examine how such changes translate into early childhood development outcomes for the next generation.

There is a long-lasting discussion related to the intergenerational transmission of human capital that focuses on how parental factors influence children's outcomes. Theoretically, parental investment is essential to human capital accumulation (Becker and Tomes, 1979, 1986). More educated parents often have higher socioeconomic status, enabling them to better pass on health and other positive outcomes to their children (Grossman, 1997). However, as noted by Grossman (2006), establishing causality remains challenging due to endogeneity concerns—such as omitted factors like parental health—that may affect both parental education and child outcomes, potentially biasing estimates (Currie, 2009).

Two primary research strands address these challenges in examining parental education's effect on children. One leverages family structures (e.g., twin or adoptee studies) to disentangle the nature effect from the nurture effect, while others, such as Sacerdote (2002), Sacerdote (2007), and Chen and Li (2009), use adoptees to obtain the exogenous variation in parental education. Another strand of the literature uses policy changes to provide exogenous variation in education (Currie and Moretti, 2003; Black, Devereux, and Salvanes, 2005*a*; Lindeboom, Llena-Nozal, and van Der Klaauw, 2009; Chou et al., 2010; McCrary and Royer, 2011; Andrabi, Das, and Khwaja, 2012; Güneş, 2015; Keats, 2018). Much of this literature focuses on increases in basic education

levels, yielding mixed results, and few studies examine higher educational attainment's effects on children (Currie and Moretti, 2003; Carneiro, Meghir, and Parey, 2013). In contexts with multiple overlapping education reforms, as seen in some countries, isolating the impacts of specific policies becomes particularly complex.

In this paper, we embrace the challenges of estimating the causal effect of maternal education on children's early childhood outcomes following the second strand of literature. Our paper differs from the aforementioned studies by looking at a policy reform that specifically targeted the higher margins of educational attainment and occurred after the well-studied compulsory education.[1] We study the impact of maternal education on a comprehensive set of child outcomes in China through the lens of higher education expansion, a recent educational reform implemented in 1999 that massively increased access to college. In the late 1990s, although child health outcomes in China were improving, they remained low by international standards. For example, the under-five mortality rate was 31.9 per 1,000 live births in 1999—well above the rates seen in more developed economies (The World Bank, 2024).[2] By raising maternal education, the higher education expansion may have provided an indirect pathway to improving child well-being and narrowing generational health gaps. China's college expansion represents one of the most significant and rapid transformations in higher education globally, nearly doubling enrollment rates in just a few years. The scale and swift implementation of this policy created a unique context to examine the intergenerational impacts of increased educational attainment. Studying this expansion within an emerging economy adds to the literature by offering a fresh perspective that complements findings from both developed countries and other developing nations that have recently experienced higher education expansions (González-Velosa et al., 2015).

Our empirical analysis encompasses a broad range of child outcomes, including not only conventional health measures such as birth weight, gestational age, and health conditions before age one, but also key developmental milestones in social and motor skills. These include the time taken for a child to begin speaking, counting, walking, and independently using the toilet—outcomes that are rarely explored in existing literature. By examining this diverse set of indicators, our study offers a more holistic view of the ways in which maternal education can influence various dimensions of early childhood development. To address the endogeneity issue of education and children's outcomes, we employ an instrumental variable approach that utilizes the number of colleges in the mother's college-going year and province, induced by the expansion, as an instrument. It overcomes several empirical challenges in the existing studies. First, the instrument provides ample variation across both location and time. China's college admission

[1] For the studies on China's compulsory education law reform on children's health, see Huang et al. (2018).

[2] In 1999, the under-five mortality rate was 7.2 in the United States, 6.2 in South Korea, and 3.4 in Japan.

system is province-based. We leverage variations in the number of colleges across different provinces and college-going years, given the substantial heterogeneity in higher education institutions across provinces (Borsi, Valerio Mendoza, and Comim, 2022). Second, as previous literature established, national-level educational reforms are unlikely to be correlated with location-specific conditions in many countries (Black, Devereux, and Salvanes, 2005*a*; Machin, Salvanes, and Pelkonen, 2012),[3] which creates credible exogenous variation in educational attainment, and it is unlikely to affect future child outcomes. To further verify whether provinces that received larger expansions differ significantly from those that received smaller expansions, we examine the pre-trend evidence of various variables representing economic development and healthcare provision prior to the expansion. Once again, we find no evidence that the expansion of higher education was targeted at specific provinces. Third, given that there was a compulsory education reform before the higher education expansion and some cohorts were exposed to both policies, using the most recent reform delivers a more accurate estimate of the impact of mothers' education on the next generation.

We use the China Family Panel Studies (CFPS) 2010 wave as the main data set. It has important information that helps us identify mothers' childhood location and college-going year. We focus on mothers from rural areas because they constitute a large percent of the sample[4] and also have larger variations in educational attainment. We define the mother's college-going province as her self-reported province at age 12 since this is the closest year we could get before the typical college-going year (age 18), and migration between age 12 and college-going age is rare in China given hukou restrictions during that time. Mother's college-going year is obtained from her self-reported high school graduation year. If she does not attend high school, we use the end of the education year. After we match the province-year number of colleges with the mother's college-going year and province, we perform the two-stage least-squares estimation and obtain the causal effect of maternal education on child outcomes.

Results from the Ordinary Least Squares (OLS) show that maternal years of schooling above compulsory education level are negatively correlated with the probability of having an abnormal weight baby and are positively correlated to a child's gestational age. Mother's education is also associated with a higher probability of reporting the child having any sickness or hospitalization before age one. In addition, the OLS estimates reveal a strong negative correlation between maternal education and the age at which a child begins to walk independently, speak in full

[3] Ding (2021) shows higher education expansion in China is independent of provincial characteristics.

[4] Mothers with a rural hukou make up more than 90% of the CFPS 2010 children sample after excluding observations with missing values in essential variables. Educational attainment in urban China has less variation, and the urban sample size is smaller. This results in a weak first stage for the urban sample, as we demonstrate empirically. The first-stage F-statistic for the urban subsample is significantly lower than that for the rural subsample, making the rural sample a more appropriate focus for analyzing the effects of maternal education. More details about the sample information can be found in Section 3.

sentences, count from one to ten, and use the toilet independently. The IV estimations show consistent results that an extra year of education beyond compulsory schooling reduces the probability of having a low birth weight child by two percentage points. It also accelerates the time it takes a child to start walking independently by 0.3 months, speaking a full sentence by 0.7 months, counting from one to ten by 1.3 months. To strengthen the reliability of our results, we conduct multiple hypothesis tests across key outcome measures. The adjusted p-values remain consistent with our primary findings, particularly highlighting significant improvements in children's low birth weight and social and motor skills development due to maternal education. We test our results by switching our independent variable to an alternative measure of years of education—maternal total years of education, and we find very similar effects. To avoid the potential confounding effect of China's Compulsory Schooling Law, we also perform robustness checks by restricting the sample to mothers born after 1975 who were fully exposed to this earlier reform and then later affected by the higher education expansion reform. The results are both quantitatively and qualitatively similar to our main findings.

Further examination of potential mechanisms reveals that assortative marriage, rural-urban migration, and delayed timing of first birth explain the impact of mothers' education and more educated mothers care more about children's education and communication skills. Our findings reveal that while increased maternal education does not lead to statistically significant changes in employment status or work hours, it is associated with shifts away from agricultural employment and with higher household income levels. Additionally, mothers with more education who are employed are less likely to be the primary caregiver for their children, although this effect is not statistically significant, suggesting that increased maternal education does not necessitate a trade-off between employment and childcare responsibilities. Furthermore, we find evidence that households with more educated mothers invest more actively in their children's development through activities such as playing with toys and reading books, contributing to observed improvements in children's social and motor skills.

This paper makes three significant contributions to the existing literature. First, to our best knowledge, this study provides the first estimate of the effects of maternal education on early childhood outcomes in a developing country, utilizing a substantial higher education expansion as the policy context. Unlike most previous research, which predominantly focuses on policies affecting the lower margins of education spectrum, our study examines a policy that significantly impacted individuals at the higher levels of the education distribution. Prior studies such as Chevalier and O'Sullivan (2007) and Lindeboom, Llena-Nozal, and van Der Klaauw (2009) use changes in the minimum school leaving age in the UK and find that increases in mother's education year have limited effects on child health. A similar small effect is confirmed in the US by McCrary and Royer (2011), which uses the age-at-school entry policies in California and

Texas, showing that mother's education has negligible effects on infant birth weight, prematurity, and infant mortality rate. However, other studies in developing countries generally show that maternal education leads to a smaller child mortality rate (Chou et al., 2010; Grépin and Bharadwaj, 2015), reduction in very low birth weight (Güneş, 2015), increased likelihood of having a normal birth weight child, decreased birth defects rate (Huang et al., 2018), and increased completed childhood immunization rate (Özer, Fidrmuc, and Eryurt, 2018). Despite the rich but mixed evidence related to policies targeting lower levels of education, limited research has explored the impact of maternal education on child outcomes within the context of higher level education system changes. Currie and Moretti (2003) show that increases in maternal education induced by new college openings can improve infant health in the U.S. as measured by birth weight and gestational age. Meanwhile, Carneiro, Meghir, and Parey (2013) use local market conditions and college tuition as instrumental variables of mothers' education, and they find similar improvements in child outcomes associated with maternal education. No current study focuses on the impact of an increase in higher-level education on child outcomes in developing countries. The massive higher education expansion in China provides us a unique opportunity to investigate the effects of a policy that extended schooling beyond the compulsory education level on child outcomes.

Second, this paper not only focuses on the impact of maternal education on infant health outcomes but also on the early childhood development of cognitive skills. Established research has demonstrated that early childhood development of cognitive skills is crucial to later life achievement, as indicated by Heckman, Pinto, and Savelyev (2013) and Campbell et al. (2014).[5] Nevertheless, there is limited evidence about how maternal education may affect children's skill development during their toddler years. Evidence has shown that the development of motor skills in toddlers has a positive impact on the development of cognitive skills such as language skills (Gonzalez, Alvarez, and Nelson, 2019). In addition, motor skills are also vital to physical activities (Cliff et al., 2009). Duncan et al. (2007) show that children's early mastery of math concepts and vocabulary have great predictive power to later education achievement. Based on Duncan et al. (2007)'s study, Grissmer et al. (2010) find that fine motor skills, in particular, speaking and reading, have positive correlation with children's math and reading scores. Carneiro, Crawford, and Goodman (2007) also show that children's early development of walking alone and speaking has extremely important impact on their social and cognitive skills during later childhood stage. Despite the importance of developing these skills in early childhood, only a few work has specifically examined how maternal education may influence them. Carneiro, Meghir, and Parey

[5] Another strand of literature focuses on non-cognitive skills. For example, a recent study looks at maternal education and non-cognitive skills in rural China (Leight and Liu, 2020). Carneiro, Crawford, and Goodman (2007) summarizes the impact of both cognitive and non-cognitive skills on later outcomes.

(2013) presents findings indicating that there is no evidence that maternal education improves early childhood motor and social skills development up to 24 months in the U.S. In this paper, we provide the first evidence of the substantial effects of maternal education on early childhood motor and social skills development in a developing country context.

Third, this paper complements existing studies that look at the effects of China's college expansion by providing new evidence of the effects of intergenerational transmission of education, particularly focusing on improved maternal education on the next generation's early childhood health and social and motor skills development. Recent literature on the higher education expansion mainly examines its impacts on intergenerational education mobility (Guo, Song, and Chen, 2019), household savings (Bollinger, Ding, and Lugauer, 2022), and labor market outcomes such as college wage premium (Hu and Bollinger, 2021) and occupational choice (Duan et al., 2022). This paper adds to the literature by providing the effect of the higher education expansion from a different perspective. Using a comprehensive nationally representative data in 2010, we are able to identify the effect of mothers who were affected ten years after the expansion. Given that many countries are considering expanding their higher education access, including the US, it is important to understand the impact of education on the next generation's outcomes through the lens of intergenerational transmission of education.

The rest of this paper is organized as follows. Section 2 describes the background of higher education expansion in 1999. Section 3 presents the data and main variables, including the summary statistics. Section 4 outlines the identification strategy. The results are explained in detail in Section 5 and the discussion of mechanisms is in Section 6. Section 7 concludes.

2 Higher Education Expansion in China

The formal education timeline in China typically starts with six years of elementary school education. Students can enroll in elementary school once they reach age six but no later than age seven. After completing six years of elementary school, students must attend three years of middle school as required by the Compulsory Schooling Law. Then, if students want to get into higher education institutions, they must attend three years of high school and take the college entrance exam afterward.

Unlike most developed countries, the central government in China plays an essential role in the development of higher education and its related policies. Since the start of China's sweeping economic reform in 1978, the accompanied state-owned enterprise reform in the 1990s created massive layoffs, and the economic condition was worsened by the Asian financial crisis that happened at the same time. In order to reduce the labor market stress, the central government started the Higher Education Expansion (HEE) in 1999 in the hope of making more high school

graduates get into college and helping economic development. As suggested by the economist of the Asian Development Bank Mission in China, Ming Tang, the HEE could lead to more education consumption as well as induce more investment in services, construction, and other industries, which could eventually increase the aggregate demand and help the economic growth in the short term. The unexpected HEE was announced in November 1998 and implemented in June 1999 by the central government, and it reflects the government's social and economic development strategy at the national level.

As described in the official document published by the Chinese Ministry of Education—"Action Plan for Education Revitalization in the 21st Century," the central and local governments should gradually increase educational expenditures. The central government should raise the proportion of education spending to total government spending by three percentage points in 2000. The local government's educational expenditure should be increased even more based on their economic conditions.[6] Under these guidelines, the number of colleges went up simultaneously to support the expansion of higher education. Figure 1 plots the number of colleges in China from 1978 to 2010, and Figure 2 shows the number of colleges in selected provinces during this period. The number of colleges in each province remained almost unchanged before HEE, while it went up rapidly right after HEE.

The higher education expansion (HEE) in China was financed through a decentralized approach, in which the central government provided overarching policy direction, such as allocating admission quotas to various higher education institutions, while local governments took primary responsibility for funding institutional expansion. Local governments bore much of the financial burden of constructing new colleges and expanding existing ones, aligning regional economic needs with national educational goals. This decentralization allowed the central government to prioritize key national projects without significantly diverting resources from other sectors, such as healthcare (Yang and Wang, 2020).

Before the HEE, college students were typically assigned jobs upon graduation, and college education was largely tuition-free until the early 1990s. By the mid-1990s, nearly all higher education institutions began charging tuition and fees to help cover their expenses. After the HEE, tuition and fees continued to rise, prompting Chinese urban households to save more to finance college costs (Wan, 2006; Bollinger, Ding, and Lugauer, 2022). Figure 3 shows this increase in college tuition relative to the stable trend of non-tertiary education costs, which also contributed to funding the expansion.

HEE was unanticipated because it was first proposed in November 1998, then approved by the central government in January 1999, and finally implemented in July 1999. The initial plan for the 1999 expansion was to increase college enrollment by 0.23 million compared to 1998; then,

[6] See the news report from People's Daily at http://52.34.104.77/renminribao/1999/3/2/11/.

this number was finally increased to 0.567 million in the middle of June 1999. Prior to 1999, the average increase in college enrollment rate was about 8%. In 1999, the enrollment rate jumped by 47.4% and kept growing every year.

This expansion has led to millions of students getting into college, and it has also increased educational attainment at various levels because of a higher probability of getting into college after the expansion. As can be seen from Figure 4, new enrollment in high schools jumped dramatically after the higher education expansion. From the 2010 Population Census data, the number of college students per ten thousand increased to 15,467 compared to 8,930 in the 2000 Population Census. We take advantage of the unexpected HEE as an exogenous shock which may potentially increase mother's education to examine the impacts of maternal education on early childhood outcomes.

One concern regarding HEE-induced education attainment is that the Compulsory Schooling Law (CSL) in 1986, which requires all children to have nine years of education, could potentially confound the estimation of the impact of maternal education. For example, a mother who was born after 1980 should be affected by CSL as well as HEE. Therefore, the sizable potential impact of maternal education might be attributed to both policies. In this study, we address this concern by utilizing variation both across provinces and years in the number of colleges, which is independent of the previous compulsory educational reform. Further, we restrict our sample to mothers who were fully exposed to the CSL in the robustness checks. The main results are quantitatively and qualitatively similar to our main findings.

3 The Data and Variables

3.1 Overview of the Data

The main data set we use for this study is the baseline wave of China Family Panel Studies (CFPS) survey data. CFPS is a national representative survey conducted by Peking University.[7] The baseline CFPS survey was conducted in 2010 in 25 provinces of China.[8] These provinces consist of 95 percent of the total population, which can be viewed as a representative sample of China (Xie and Hu, 2014). There are five modules in CFPS, including community, family roster, family, child, and adult. This paper mainly uses survey data from child and adult modules. Child survey questions are answered by the adult family member who is the child's primary

[7]The analysis in this paper is based on data from the China Family Panel Studies (CFPS), which is administered by the Institute of Social Science Survey (ISSS) at Peking University. Due to the data use agreement, we are not permitted to redistribute the data. However, the data can be accessed by approved researchers through the official CFPS website: https://www.isss.pku.edu.cn/cfps/en/index.htm

[8]The administrative areas that are not in the survey are Hong Kong, Macao, Taiwan, Xinjiang, Tibet, Inner Mongolia, Ningxia, and Hainan.

caregiver. Children who are aged more than ten years old will answer part of the survey questions by themselves. Adult survey questions are answered by the adults who live in the chosen interviewed family.

The CFPS survey data are ideal for this research because it offers several advantages. First, it has detailed information on the timing and level of adult education, which helps us identify the college-going year for each individual. Second, it tracks an adult's past residence locations at birth, age three, and age 12, which helps us infer the province in the college-going year. We use province at age 12 as college-going province because migration between age 12 and 18 is rare (Ding, 2021).[9] Combining these two sets of information, we are able to match corresponding provincial-level variables to mothers, including number of colleges. Third, CFPS asks a wide range of questions related to children's birth outcomes and social and motor skills, which provides an unparalleled advantage in studying the effect of maternal education on these important but less-studied outcomes due to a lack of data. Fourth, this data set provides rich information on the social-economic status and health-related outcomes for mothers who had no exposure to the HEE and mothers who were affected by HEE in the early stage, which allows us to examine the potential channels of the effects of maternal education on the outcomes of child.

The college expansion does not only increase access to college but also induces people to stay longer in school (Xing, 2014). For those mothers who did not finish high school and take the college entrance exam, we follow Ding (2021) to obtain college-going year information. We use the end year of their education as college-going year so that we can match external variables in that year to these respondents. Although CFPS does not have the province information of mother's college-going year, we proxy the location with their reported province at age 12.[10] With these mother's college-going time and location information, we can match it with provincial-level macroeconomics variables and control for such aggregate provincial-level changes. Provincial-level economic variables data are from China Yearly Statistical Book. We also obtain the number of colleges, college enrollment, and high school graduates for each province and year from the Educational Statistical Book of China.

3.2 The Outcome Variables

In this paper, we study the impact of mother's education on two main sets of outcomes: early childhood health outcomes and social and motor skills.

CFPS collects detailed information on child birth outcomes, and we obtained corresponding

[9] Using the census 2010 data, we find that the 5-year migration rate is 1.57% for school children aged from 12 to 17.

[10] Among the total sample of 4,803 in our final sample size, only 26 mothers (0.5%) reported having migrated to different provinces from birth to age 12, supporting the assumption that mobility during this period is infrequent.

data from adults responding to questions about their children. There are six questions regarding child health outcomes, such as gestational age, birth weight, current weight, current height, length of breastfeeding, and location of birth (whether or not delivered in a hospital). Since our focus is on early childhood outcomes, we selected birth weight and gestational age as key variables. Following the literature, we derived additional variables based on birth weight to determine if a child is classified as low birth weight (LBW), very low birth weight (VLBW), or macrosomia. LBW equals one if the infant's birth weight is lower than 2500 grams and zero otherwise. VLBW is defined as one if the infant's birth weight is lower than 1500 grams and zero if it is not. Macrosomia is defined as an infant's birth weight exceeding 4000 grams. We also study whether the child had been reported to have any sickness before age one and whether the child had been hospitalized in this stage. Though these two outcomes could imply the health status of children, they could also serve as an indication of whether the parents were aware of the health conditions of the child before age one since the response is retrospectively self-reported without describing the exact symptoms. As for the second set of early childhood outcomes, we focus on four measures that demonstrate early childhood social and motor skills development. CFPS asks the child's primary caregiver how many months after birth the child started to perform these skills, including when the child began walking independently, speaking a full sentence, counting from one to ten, and urinating without assistance. These skills are considered to have strong predictive power to later educational achievements, such as reading, math, and attention skills (Duncan et al., 2007).

3.3 The Independent Variables

The variable of interest is maternal education. In the main specification, we construct a measure of maternal education as years of schooling above the 9th grade. We adopt this measure for two reasons. First, China's compulsory education law mandates nine years of formal education since 1986, which has been studied extensively. The cohorts who were exposed to this reform potentially have less variation in educational attainment. Second, as pointed out by Xing (2014), the expansion of the higher education system likely induced students to stay longer in school due to the increased college opportunities. We do use the regular continuous measure of years of education in the robustness check to verify our result is not sensitive to the choice of education variable. The comparison of these two results could also provide informative evidence about the health and cognitive skills return to different levels of maternal education. We discuss this issue later. For those individuals who only completed compulsory education or below, their years above grade 9 are coded zero. Otherwise, we use the reported years of schooling subtracting 9 to obtain the years of education.

We control for the child's mother's ethnicity (an indicator variable equal to one if the mother's ethnicity is Han), the child's maternal grandmother's education level (elementary school, middle school, high school, and college and above). We do not control for the father's education since it is highly correlated with the mother's education, and it is a potential channel that could affect children's outcomes (Chou et al., 2010; Güneş, 2015). In addition, we add provincial-level economic variables in the mother's college-going year in all specifications because these variables could be correlated with the number of colleges in that province and also potentially affect the mother's choice of college location.

Furthermore, we include mother's birth year fixed effect, province at age 12 fixed effect, and child province by year of birth fixed effect in the main specifications. The inclusion of mother's childhood province fixed effect accounts for geographical heterogeneity, accounting for cultural and social norms that could influence a mother's child-rearing practices and a child's early behavioral development. The mother's year of birth fixed effect controls for common shocks at the time dimension, which is likely to improve both educational attainment of mothers and factors that potentially affect future child outcomes. For example, mothers in a younger cohort are more likely to be affected by the one-child policy, which reduces sibling size and encourages parents to spend more resources on them. In addition, the child province by year of birth fixed effect accounts for the time-varying changes in the child's birth year and location, which could affect the birth outcomes and early childhood social and motor skills. Meanwhile, there could still be provincial-cohort-specific variables that might be correlated with the number of colleges in that province in a given year and also potentially affect child outcomes. Therefore, we add two provincial-level trends to control for such unobservables. The first is the interaction between mother's year-of-birth dummies and the provincial-level college degree population ratio in the 1995 mini census, and the second is the interaction between mother's year-of-birth dummies and the provincial-level college admission rate in 1998, the year before higher education expansion.

3.4 Sample Descriptive Statistics

The main sample used in this paper is child survey data matched with their parents' information, both are from the CFPS 2010 baseline data. We select mothers who had rural hukou at age 12 because they consists of the largest share of the sample[11]. We exclude children with missing values of their mother's education information. We also exclude mothers who were born before 1969.[12] The youngest mother in CFPS 2010 was born in 1994. To eliminate the potential

[11] Hukou is the residence registration system in China where only local residents could have certain public benefits within the geographical administration

[12] We are aware that mothers born before 1969 might have been highly affected by the Great Famine and therefore tend to be totally different from mothers born in later years. In addition, China started the "Later, Longer, Fewer"

effects of the Compulsory Education Law in 1986 on mother's educational attainment, in the robustness check, we further restrict the sample to mothers who were born after 1975.[13]

Table 1 presents the summary statistics of major variables in our empirical study. We present these information in two ways. We break the variables by four categories, including child birth outcomes, early childhood social and motor skills, our instrumental variable (number of colleges at province-year level), key explanatory variables related to maternal characteristics, and provincial economic conditions of those mothers. We also present the summary statistics for the full sample, mothers whose college year before 1999, and mothers whose college year after 1999. Among the study sample, around 25% of the sample used in this analysis was exposed to HEE. The average number of colleges for the mother's college-going year before HEE is 39, and this number increased to 51 for those mothers exposed to HEE. For mothers who were exposed to HEE, 80% of their college-going year is between 1999 to 2005. Therefore, our focus in this paper is more on the early years of higher education expansion.

Panel B tells us that there are around 5.8% of children have low birth weight and only 0.3% children were in very low weight condition at birth. There are around 3.8% children who were born overweight and the sample children's gestational age is around 9.3 months. Comparing the early childhood health outcomes of the two groups of mothers, we do see large differences among very low birth weight and gestational age. Younger mothers who were exposed to HEE reduced the incidence of very low birth weight by almost 50% but also decreased the gestational age around 0.05 month. Around 70% of children were reported to had been sick before age one and mothers whose college years are after the expansion are more likely to report a higher incidence. A similar pattern is also found on hospitalization where the average is 60% and college expansion affected mothers reported 67%.[14]

Panel C shows the four measures of social and motor skills. The average number of months for a child to start walking is 14.4 and for a child to start speaking is 20.6, both slightly decreased for mothers who were affected by college expansion. Children take longer time to know how to count (36.2 months) and urinate without assistance (33.9 months). It is clear that the length is shorter for children whose mothers that were exposed to HEE.[15]

family planning policy in 1969. After that, China's total fertility rate decreased stably (Chen and Fang, 2021). Therefore, we only focus on the group of mothers who were born after 1969 and are still of child-bearing age in 2010. The excluded mothers sample is around 5% of the matched sample.

[13]There are only two provinces, Hunan and Gansu, which had the Compulsory Education Law to be effective in 1991, and their first eligible birth cohort is 1976 (Ma, 2017).

[14]We plot the average of these child birth and health outcomes by mother's college-going year in Figure A1 and the associated trends are noisy potentially due to the low probability nature of low and very low birth weight. Figure A3 presents the similar trend but at child birth cohort level.

[15]The cohort trend confirms this pattern. Figure A2 plots four graphs that show the overall decline of time children use to master these skills, which roughly match the college expansion time in 1999. Figure A4 shows more apparent improvement in these skills of children who were born after 2003, around the time when the first cohort

Panel D presents the characteristics of mothers. On average, mothers in our sample have 6.6 years of education and 0.5 years of above grade 9 education. The mean years of schooling increases to 7.7 for mothers whose college year is after 1999 and their average education years above grade 9 are almost doubled the sample average. Following Fan et al. (2018), a regression-discontinuity style Figure A5 shows the cohorts after 1999 on average have more years of education compared to cohorts prior to the expansion. There is no noticeable differences for ethnicity and maternal grandmother's education.

In Panel E, we also show the characteristics in terms of the mother's childhood provinces, which we will control in our empirical specifications to account for the impact of economic development on mother's educational choice and child health outcomes.

4 Empirical Strategy

4.1 Instrumental Variables

We are interested in the impact of mother's education on a set of early childhood outcomes, which can be specified in the following equation:

$$y_{ijt} = \beta_0 + \beta_1 Medu_{ipk} + \beta_2 X_i + \beta_3 Z_{pc} + \zeta_p + \zeta_k + \zeta_{jt} + u_{ijt}, \tag{1}$$

where y_{ijt} is the outcome of the child i born in province j year t, $Medu_{ipk}$ represents the education of child i's mother whose childhood province is p and was born in year k.[16] Throughout this paper, we mainly focus on the continuous measure of years of schooling above grade 9. X_i represents a set of variables controlling for maternal characteristics for child i, including mother's ethnicity and maternal grandmother's education level. Z_{pc} refers to mother's provincial economic variables at their college-going year c, including GDP growth rate, employment growth rate, and population growth rate so that we can control for the impact of improved economic conditions on children's health and other outcomes. ζ_p, ζ_k, and ζ_{jt} denote mother's childhood province, birth year, and child's birth province-by-cohort fixed effects, respectively. We also include mother's cohort-specific trends by interacting the initial year provincial-level college degree population ratio and provincial college enrollment rate with mother's year of birth to account for potential diverging trends resulted from different initial conditions of higher education and population.

Even though with these fixed effects and cohort trends, we can absorb time-invariant

of mothers who were affected by HEE gave birth.

[16] We do not use mother's birth province because there could be migration during their childhood period. Meanwhile, we can not observe their hukou province in their college-going year. Therefore, we use the most recent observable province information before their college-going year to identify their location information.

unobserved heterogeneity across different provinces and common shocks across different cohorts, the estimate of β_1 may still be biased due to omitted variables. There might be factors that affect both mother's education and the potential outcome of the child. We employ an instrumental variables (IV) approach to address the endogeneity concerns utilizing the exogenous variation in mothers' education attainment induced by the HEE in China. At the province-year level, we search for instruments that are correlated with mother's education but are unlikely to affect the child's later outcomes. The instrument we use is the number of colleges in mother's childhood province p in her college-going year c.[17] The identification assumption is that there is no direct impact on these early childhood outcomes under mother's exposure to HEE except through the channel of maternal education. We do not control for paternal education, as it would introduce multicollinearity due to its high correlation with maternal education. While it is possible that fathers' educational attainment may also be influenced by the HEE, our instrument—based on the number of colleges in the mother's province during her specific college-going years—minimizes any direct impact on the father's education, particularly when parents were not from the same province or cohort. This approach aligns with previous studies, such as Arendt, Christensen, and Hjorth-Trolle (2021), which avoid controlling for paternal education when using similar instruments for educational reforms. Therefore, we are able to estimate a two-stage least squares model with the first-stage regression equation being

$$Medu_{ipk} = \pi_0 + \pi_1 NumCollege_{pc} + \pi_2 X_i + \pi_3 Z_{pc} + \xi_p + \xi_k + \xi_{jt} + \varepsilon_{ipk} \tag{2}$$

and the second-stage equation as

$$y_{ijt} = \beta_0 + \beta_1 \widehat{Medu}_{ipk} + \beta_2 X_i + \beta_3 Z_{pc} + \zeta_p + \zeta_k + \zeta_{jt} + u_{ijt}. \tag{3}$$

Our approach aligns with prior studies, such as Jürges, Reinhold, and Salm (2011), which examined educational expansion in Western Germany using the number of institutions as an instrument for educational attainment, recognizing that both new institutions and the expansion of existing ones contribute to broader access to higher education.

Whereas prior studies focused on compulsory educational reforms impacting educational attainment at early life stages, the college expansion reform specifically affects higher levels of educational attainment. Since those cohorts that were affected by compulsory education laws were also likely to be affected by later higher education reform, previous studies may overestimate the impact of adult education on children's outcomes using the earlier reform. We

[17] We first calculate the starting year of each education level by using the end year subtracting duration. We assume the mother's college year is the same year when high school is completed for those mothers without college. For those mothers who do not finish high school, we assign the end year of education as college-going year.

believe using the recent higher education expansion could capture a more accurate relationship between maternal education and children's outcomes by exploiting the variation in educational attainment induced by the number of colleges.

4.2 The Validity of the Instrument

The First-Stage Result of Number of Colleges on Mother's Education Table 2 summarizes the IV first-stage results following Equation (2). Panel A uses years of schooling above grade 9 as the dependent variable, while in panel B we switch to the commonly used educational attainment variable that measures total years of education. Column (1) controls for all individual characteristics and fixed effects. Column (2) adds a cohort-specific trend in terms of the college population ratio in the 1995 census. Column (3) additionally adds a cohort-specific trend related to the enrollment rate prior to the college expansion in 1998 and is the preferred specification. All three specifications reveal similar quantitative results of the impact of access to college. A one-unit increase in the number of colleges would raise 0.052 years of education beyond middle school level and 0.044 years of education on the regular basis. Though the coefficients seem to be small, given that the average years of schooling for the sample prior to the expansion is less than seven years, and the average increase in the number of colleges after 1999 is around 12, translating the impact to 0.6 years, equivalent to a 9.7% increase.[18] Güneş (2015) shows that mothers affected by compulsory education reform in Turkey increases years of schooling by 0.04 years and primary school completion by 1.4-1.7 percentage points. Liu and Wan (2019) find the impact of higher education expansion on years of schooling is around 0.09 years in China. Our estimate is within the range of the literature that finds a positive impact of educational reforms on educational attainment.

Therefore, the first stage confirms that there is a strong relationship between college expansion and maternal education and the magnitude is not negligible.

Placebo Test of Validity To further verify the validity of our instruments, we conduct a series of tests that randomly assign mother's college-going provinces and college-going years. This placebo test helps justify our variation in the number of colleges is random and causally affects maternal education. The results are in Table B1 and more details are discussed after the main regression analysis.

Endogenous Sorting A potential concern with our identification strategy is endogenous sorting, where families might have strategically relocated to regions with higher college densities

[18] In Table 1 we show that the number of colleges before expansion is 39.2 and the number of colleges after expansion is 51.4. $0.05 \times 12/6.166 \approx 9.7\%$.

during the period of the higher education expansion, potentially biasing our results. However, we believe this concern is minimal in our context for several reasons. First, the mothers affected by the higher education expansion policy were children at the time, and their place of residence was largely determined by their families rather than their own decisions. It is unlikely that families would have strategically migrated based on anticipated future college opportunities, as this would have required foresight beyond what is reasonable to expect.

To provide empirical support for this argument, we analyze migration patterns using data from the 2000 decennial census and the 2005 mini-census. As shown in Table B2, the proportion of youth (aged 12 to 15) who moved across provinces in the five years preceding each census was only 0.47% in 2000 and 0.81% in 2005. These figures indicate that inter-provincial migration among youth during this period constituted a very small share of the population, suggesting that endogenous sorting was not a widespread phenomenon.

4.3 Threats to Identification

Even though there is strong evidence linking college expansion and improved educational attainment in China at various levels (Xing, 2014; Liu and Wan, 2019) and it is unlikely that this swift policy reform was anticipated and endogenously determined by provincial socioeconomic conditions (Feng and Xia, 2022),[19] concerns still arise as to whether the expansion of college is correlated with other preexisting conditions at the province level. For instance, do places that lag behind in health care receive more investment in higher education out of the hope of bringing more construction to improve health facilities as well? On the other hand, there could be some contemporaneous shocks at the province-year level that may not be absorbed by our fixed effects of mother's province and cohort, leading to the biased estimates of the effect of maternal education on child outcomes.

In this section, we address those potential threats to identification in two ways. First, we show that the concern of reverse causality, or the selection of college expansion policy that college expansion was targeted at provinces with better economic conditions and stronger growth—are not well-supported. Then we combine data from other sources around major economic reforms at the same time to ease the worry that other confounding factors rather than the expansion of higher education leads to the improvement in child outcomes.

[19] Ding (2021) also confirms this by a validity test showing that college enrollment is not correlated with provincial-level GDP and employment growth. Cai, Ding, and Du (2024) shows that both in-province enrollment and out-province enrollment in the early years of the expansion are not related to economic conditions at the province level.

4.3.1 Selection in Provincial Economic Conditions

To address concerns about policy selection and reverse causality—specifically, that college expansion could target provinces with better economic conditions or lead to a reallocation of resources away from other important sectors such as healthcare—we conduct a series of pre-trend tests. We collect data on healthcare-related indicators, provincial GDP, population, and urban employment, as well as additional measures reflecting public infrastructure and social services. We then examine the trend performance of provinces with larger versus smaller expansions across these dimensions. A province is classified as a high-expansion province if its change in the number of colleges after 1999 is above the median. Figure 5 illustrates these overall trends. While we do not detect significant differences between the two types of provinces, we further explore the dynamic evolution of these economic variables and healthcare facilities over time through an event-study analysis:

$$Y_{jt} = \gamma_0 + \sum_{k=1995, k\neq 1998}^{2005} \gamma_k D_j \times \mathbf{1}[t = k] + \phi_j + \phi_t + u_{jt}, \tag{4}$$

where Y_{jt} is the economic variable of interest, D_j equals one if province j is a high-expansion province, and $\mathbf{1}[t = k]$ is an indicator function for year k. ϕ_j and ϕ_t are province and year fixed effects, respectively.

The corresponding event-study plot is shown in Figure 6, where we plot the estimated coefficients γ_k for all years relative to 1998. As shown in the nine figures, we do not observe evidence that the expansion is selecting into provinces with better economic performance or healthcare conditions, providing supportive evidence that higher education expansion is independent of province-level pre-trend conditions. Furthermore, concerns about general equilibrium effects, such as resources being diverted from other sectors to education investment, appear less relevant based on these findings.

4.3.2 Contemporaneous Reforms and Shocks

We recognize that our identification strategy could be compromised by contemporaneous province-year level effects correlated with college expansion, particularly during the late 1990s—a period marked by significant economic reforms in China. These reforms, potentially influencing human capital investment and educational attainment, necessitate careful consideration in our analysis. Although our focus is on individuals from rural areas—who may be less directly impacted by urban-centered reforms—we still undertake tests to examine any correlation between these reforms and maternal education, and to assess their potential effects.

Trade Policies China's early 2000s WTO accession not only enhanced firm performance and innovation (Brandt et al., 2017; Ma, 2024) but also increased Chinese families' income and wealth, leading to more children pursuing higher education in the U.S. (Khanna et al., 2023). Conversely, a recent study suggests that the 1980s and 1990s open door policy negatively impacted female education (Jiang, Kennedy, and Zhong, 2023), as employment opportunities enticed women to terminate their schooling prematurely. Lin and Long (2020) presents mixed findings regarding the WTO accession's impact on Chinese students' educational attainment. We incorporate this aspect into our quantitative analysis to test the correlation between college expansion and trade volumes. Our results, shown in Table B3 column (1), indicate a one percent increase in export is correlated with 1.4 colleges and not statistically significant.

State-Owned Enterprise Reform There might also be concerns centered around the reforms on state-owned enterprises as the breaking of "iron rice bowl" could influence the labor market and household finance (He et al., 2018), hence changes the decision for educational investment. We follow our previous analysis and examine if there exists a relationship between the two reforms at the province level. The second column in Table B3 reveals no significant correlation; only 0.024 additional college construction correlates with an increase of 10,000 workers at the provincial level.

Housing Reform Initiated in the late 1990s, the shift towards a market-oriented housing system from a predominantly state-allocated one (Man, 2011) led to substantial urban housing price surges, significantly influencing household saving and consumption patterns (Chen, Yang, and Zhong, 2020). For rural families, these increases could directly make urban living—and thereby, access to urban educational resource—more costly. Indirectly, the thriving urban housing market might have drawn investments and savings from rural areas, potentially diverting resources from education. Our findings suggest that a one percent increase in residential housing sales value correlates with a mere 0.016 college, a negligible effect amidst the post-1998 housing market boom.

***Hukou* Reform** The *hukou* (household registration) system has long been a major barrier to rural-urban migration in China, impacting rural migrants' access to public services, including education, in urban locales. *Hukou* reforms, especially those easing rural-urban migration restrictions, could significantly affect educational attainment by allowing more rural residents to access urban educational resources (Huang et al., 2022). Given the varied implementation and impact of these reforms across provinces, we investigate the intensity of *hukou* reforms at the provincial level to test their correlation with college expansion. The findings, presented in the

last column of Table B3, do not indicate a strong correlation between higher education expansion and the intensity of *hukou* reforms.

5 The Main Empirical Results

In this section, we present the empirical results of maternal education on children's outcomes. First, we show that the number of colleges has a strong predictive power on maternal education. Then we proceed with the instrumental variable estimation and find that, on average, there is a significant effect of mother's education on children's birth outcomes, especially for low and very low birth weight. We also find meaningful improvements in the time a child takes to start speaking, counting, and urinating without assistance. Next, we conduct robustness checks and placebo tests to provide further supportive evidence that our main result is causal. Last, we investigate the heterogeneous impacts of maternal education on male and female children's outcomes as well as the impact on children of different birth order.

5.1 The Impact of Mother's Education on Child Outcomes

We present our main results of IV estimations on birth and health outcomes as well as social and motor skills in Table 3. Panel A shows the OLS estimates and Panel B reports the corresponding IV results.

Birth and Health Outcomes Table 3 columns (1) to (6) report the impact of mother's education on child birth outcomes and health outcomes before age one. We examine how years of schooling above grade 9 affect different birth outcomes and present the results using alternative measures of education in the robustness checks. An inspection of the first two columns in panel A reveals that there is no significant effect of mother's education on low birth weight, even though the direction of the impact is expected. A one-year increase in schooling after grade 9 will decrease low birth incidence by only 0.2 percentage points and very low birth weight by 0.02 percentage points. However, given that the average of very low birth weight children is only 0.3 percent of the whole sample, it is not a surprising result. Our OLS result does not find years of schooling are correlated with the incidence of reduction of macrosomia but having more education also significantly reduces the chance of the child being born early by increasing gestational age by 0.017 months.[20] There is also a positive correlation between mother's education and the probability reporting the child being sick or hospitalized in the first year after birth. It is

[20] It is worth noting that CFPS does not report gestational age in weeks but in months. The conventional threshold for premature birth is 37 weeks, which is the first week of the 9th month.

likely due to the selection problem that more educated mothers have better care for their children, and they are also more cautious of any illness.

Panel B presents the result from the instrumental variable estimation. The F statistics indicate there is a strong power of our first stage estimation as they exceed 10 (Andrews, Stock, and Sun, 2019). One more year of schooling after grade 9 reduces low birth weight incidence by 1.9 percentage points, equivalent to a 33 percent reduction compared to the mean. This effect aligns well with the existing literature. For example, Currie and Moretti (2003) find that an additional 1.6 years of schooling reduces the incidence of low birth weight by 6 percentage points in the U.S. Additionally, Cui, Liu, and Zhao (2019) find that a mother's education reduces the likelihood of her child being underweight by 4.1 percentage points (a 33.6 percent reduction), with a focus on rural mothers in China. We also observe a significant reduction in very low birth weight, with maternal education decreasing its incidence by 0.3 percentage points. Although this effect is small in magnitude, it is notable given the low baseline, as only 0.3% of children in the sample are born with very low birth weight.

However, we do not find a significant impact on other birth outcomes, such as macrosomia or gestational age. The absence of an effect on macrosomia is consistent with findings from Cui, Liu, and Zhao (2019), who report no effect of maternal education on the likelihood of children being overweight. Additionally, we conduct a multiple hypothesis test using the Romano-Wolf p-value adjustment method (Romano and Wolf, 2005*a*,*b*; Clarke, Romano, and Wolf, 2020) for these birth and health outcomes under the influence of maternal education, and the p-values suggest consistent results with our main findings.

While a detailed discussion on why education improves birth outcomes will follow, some studies suggest that increased education, particularly through college expansion, facilitates rural-to-urban migration (Ding, 2021), potentially enhancing access to healthcare and other services that contribute to better outcomes for infants. Although both rural and urban areas in China now benefit from relatively high-quality maternal healthcare and nutrition, driven by a cultural emphasis on caring for pregnant women and babies, significant disparities in access to services have persisted. These gaps, however, have narrowed considerably in recent decades (Wu et al., 2012). Consistent with the literature, we do not find a substantial effect of increased maternal education on infant health in the first year, as measured by sickness or hospitalization (Lindeboom, Llena-Nozal, and van Der Klaauw, 2009).

Social and Motor Skills Columns (7) through (10) in Table 3 show the impact of maternal education on early childhood social and motor skills. We focus on how long it takes the child to start walking independently, speaking a full sentence, counting numbers from one to ten, and urinating without assistance. Coefficients from Panel A imply a strong correlation between

mother's education and children's social and motor skills. Having one more year of schooling after grade 9 will reduce the time to start walking by 0.11 months, speaking by 0.36 months, counting by 1.35 months, and urinating without assistance by 0.9 months. The IV estimates are consistent with the OLS results but differ in magnitude. We find the impact on time a child takes to walk and speak are larger than the OLS, which reduces 0.3 and 0.7 months for the two skills respectively, equivalent to a 2 and 3 percent drop for one year of mother's education above grade 9. Children with more educated mothers also take less time to count and learn how to independently toilet though the latter effect is noisier. The Romano-Wolf p-values from a multiple hypothesis test further confirm that all four social and motor skills development outcomes are significantly impacted by maternal education. This set of results shows the important transmission of mother's education to a child's skills in the early stage, which is also found in a recent work by Priyanka and Sara (2023) where they find Bangladesh women's early exposures to educational programs improved motor skills for their children. More educated mothers possibly pass their increased human capital to their children by teaching them to perform these activities earlier than others. We show this correlation in the mechanism analysis.

5.2 Specification Checks

In this section, we perform several specification checks to test if our main result is robust to using alternative measures of mother's education and different samples. We also test if our instrumental variable estimation provides plausible causal effect by a set of placebo checks.

First, we replace our key variable of mother's education years above grade 9 with the commonly used total years of schooling. The result is presented in Table 4 Panel A. Similar to our main results, we do not see using maternal education across all levels significantly changes our estimates. Nonetheless, we do find consistently significant results for low birth and cognitive skills of walking, speaking, and counting. The magnitudes of these significant estimates are also very close to our main results. This may indicate that there is a positive linear relationship between maternal education and early childhood outcomes in health and social and motor skills as the return to one year of maternal education is stable over different levels. Additionally, we examine the impact of college completion by using a binary variable indicating whether a mother completed college education. The results, presented in Table 4 Panel B, indicate that college education significantly reduces the incidence of low birth weight and very low birth weight. We also find that college completion lowers the time taken for a child to reach developmental milestones, including walking by approximately 2 months, speaking by 4.6 months, and counting by 8.6 months.

Interestingly, the magnitude of these effects is substantially larger than that of an additional year of schooling beyond the compulsory level. Specifically, the estimated impact of one additional year of education above the compulsory level is around 0.31, 0.68, and 1.22 months for walking, speaking, and counting, respectively. Given that completing college typically entails an additional 6 to 7 years of education after the compulsory level, these findings suggest a cumulative and substantial improvement in early childhood development outcomes with college completion.

However, it is important to clarify that these findings do not imply that college completion alone is driving the results. The higher education expansion policy likely increased years of schooling at multiple levels, including high school. Thus, the observed effects are part of a broader impact of extended education beyond compulsory schooling. The consistency between the college completion results and the years of schooling results supports the interpretation that both high school and college education contribute to the positive outcomes observed.[21]

Next, we restrict the sample to those mothers who were born after 1975. The restricted sample helps avoid the confounding impact of the Compulsory Schooling Law (CSL) implemented in 1986. CSL was gradually rolled out across provinces starting in 1986. The earliest eligible birth cohort is mothers who were born in 1970, and the latest eligible birth cohort is the mothers who were born in 1976 (Ma, 2017). All children born after 1975 were fully exposed to CSL. Panel C in Table 4 reports the IV results using the restricted sample. We find similar results as in Table 3. Maternal education after compulsory education stage decreases the likelihood of an infant's very low birth weight and improves the development of social and motor skills of mothers.

In Panel D, we conduct a placebo test by only using sample with mothers whose college-going year is before 1999 to conduct our empirical analysis. The idea is that number of colleges at the province-year level experiences the largest variation after 1999 and should be driving the result. Essentially, those earlier cohorts of mothers serve as a placebo group because the access to colleges was quite limited and the educational attainment was low. We should not expect the impact of college expansion to have an meaningful impact on these mothers and affect child outcomes. The results confirm our hypothesis. All coefficients are insignificant and the first stage F statistics are smaller compared to the main sample.

As we briefly discussed earlier, to further verify if our instrument is valid, we conduct a series of placebo tests by randomizing mother's college-going provinces and years. Specifically, we randomly assign childhood province to mothers and move the college going year backward and forward up to 2 years. As can be seen from Table B1, throughout all the results there is

[21] We also estimate separate models comparing high school completion versus no high school and college completion versus no high school. While both specifications yield effects of similar magnitude—particularly for birth outcomes—only the college completion estimates are statistically significant. This pattern suggests that while extended schooling at both levels may contribute to improved outcomes, the effects of college education appear more precisely estimated.

only one outcome showing statistical significance, suggesting what we find in the main result is causal. In the case of an anticipation effect—where students exposed to the expansion in their early education years could choose to stay in school longer to increase their chances of college admission—the expansion likely had a broader impact on educational attainment. However, to test this, we matched the instrument (number of colleges) to the end of middle school year because compulsory education in China ends after middle school. We did not find a strong first-stage effect, supporting the robustness of our primary approach. The result is in Table B4. We also conduct additional analysis using mothers from urban areas, with results presented in Table B5. The urban subsample shows a substantially weaker first-stage F-statistic compared to the rural sample, alongside a smaller sample size. Given these findings, our focus on the rural sample is justified, as it allows us to more accurately identify the causal effects of maternal education. These results highlight the importance of focusing on rural areas, where there is greater variation in education and where the instrument performs more reliably.

5.3 Heterogeneous Impacts of Mother's Education on Child Outcomes

Child Gender We do not control child gender in our main IV specification because it is not reasonable to believe child gender will reversely affect mother's education. However, given there still exists a large gender gap in both education and labor market outcome in China (Hu, Guo, and Ding, 2022), it is natural to examine if maternal education affects birth and health outcomes as well as social and motor skills differently for male and female children. We split our sample into sons and daughters and conduct our IV estimation for these two groups separately.

Table 5 shows the corresponding results. Sons have lower probability of being low birth weight and daughters have lower probability of being very low birth weight with more educated mothers. In contrast to our main results, mothers with one more year of above compulsory education tends to report sons having sickness by 5.5 percentage points and hospitalization before age one by 9 percentage points. We do not find such effect on daughters with more educated mothers. This discrepancy in behaviors of mothers in response to child health conditions may potentially contribute to the diverging future health outcomes of children, especially considering the impact is larger on sons with mothers having more years of schooling. However, daughters are likely to experience macrosomia if their mothers have more education. Columns (7) to (10) show a less significant impact of maternal education on the differences of social and motor skills within each gender group, but their magnitudes are close to our main estimates.

To further assess whether these effects of maternal education differ significantly by gender, we conducted Wald tests to compare the coefficients for sons and daughters. The p-values from these tests indicate that the differences in the reporting of sickness and hospitalization during

age one are statistically significant between sons and daughters. However, for other health outcomes and cognitive skills, we do not find statistically significant gender-based differences in the effects of maternal education. While our focus is not on understanding gender preference or discrimination in maternal education, we acknowledge that this remains an important area for future investigation.

Birth Order The lack of statistical power in the previous results by gender may stem from the smaller sample size or there is another source of variation that leads to the significant impact in the main result but not in the subsample. Rural mothers in our sample are likely to be affected by the one-child policy but may still be allowed to have a second child if the first is a girl in some provinces. Given that child rearing is a learning process and birth order could also interact with maternal education to differentially affect child outcomes, we investigate if this is indeed the case.

Table 6 reports the estimation results for the first-born and second-born or above child separately. Panel A shows the impact of mother's years of schooling above grade 9 on the first-born child. One more year of education reduces low birth weight by 2.5 percentage points, very low birth weight by 0.4 percentage points, and both are statistically significant. The first born children also different in their social and motor skills if mothers have different education years. One year of maternal education shortens the time of starting to walk by 0.4 months, speak by 0.9 months, and count by 1.1 months. All three skills have similar results compared to the main estimates, and we do not find statistically significant results for higher parity children. What we find shows that it is the first born children who are driving the main result. In addition, we find gestational age slightly decreases for a higher birth order child. However, the second or above birth order children are 17.7 percentage points less likely to report have any sickness before age one and this effect is statistically significant.

This set of results has important implications in terms of understanding the impact of maternal education on child outcomes. While extensive literature has focused on birth and health outcomes, which we also identify in this paper, we uncover the heterogeneous effects in birth outcomes and cognitive skills across birth order. The nontrivial effects for first-born children from mothers with different educational attainment suggest that children born from households with more educated mothers have the advantage of getting better social and motor skills, but adults do learn from their first child and could potentially reduce the cognitive gaps for later children. The large decrease (25 percent) in the probability of reporting having any illness for higher birth order kids also shows that mothers may know more about how to take care of their children through the learning process of the first child. Our finding is also consistent with the recent study that shows negative birth order effects on parenting behaviors for adolescents in contemporary China (Kim and Wang, 2023).

It is important to note, however, that this does not imply that later-born children are inherently less capable or less receptive to cognitive development. Instead, the insignificant effects on later-born children suggest that differences in maternal education levels do not significantly impact their outcomes. This could be due to the shared family environment, established parenting practices, or other factors that uniformly influence later-born children. Research shows that first-born children often receive more direct attention and resources, particularly as parents gain experience in child-rearing, which could explain the stronger observed effects for first-borns (Black, Devereux, and Salvanes, 2005*b*).

Maternal Grandmother's Education To explore whether the effects of maternal education are concentrated among mothers who come from less educated households, we split the sample based on the maternal grandmother's education level. Panel A of Table 7 presents the results for children whose maternal grandmother has primary school education or below, while Panel B shows results for those whose maternal grandmother has middle school education or above. We find that the positive impacts of maternal education on child outcomes are largely concentrated among children whose grandmothers have lower levels of education. In this group, higher maternal education significantly reduces the incidence of low birth weight and very low birth weight and accelerates certain cognitive skills. In contrast, we find no significant effects of maternal education for children whose grandmothers have middle school education or higher. This evidence suggests that the positive effects of maternal education may be more influential in households with lower intergenerational educational attainment.

In line with existing literature on intergenerational transmission of education (e.g., Black, Devereux, and Salvanes (2005*a*)), our findings suggest that the impact of maternal education on child outcomes is moderated by the educational attainment of previous generations. Specifically, the positive effects of maternal education on child health and cognitive skills are more pronounced among children whose maternal grandmothers have lower levels of education. This pattern indicates that in families with lower intergenerational educational attainment, increasing maternal education may play a larger role in enhancing the family environment and improving access to resources.

These findings also contribute to the broader literature on social mobility and dynastic human capital transmission. As shown in Adermon, Lindahl, and Palme (2021), much of the persistence in human capital across generations is transmitted through the parental generation. Our results highlight that maternal education can serve as a key lever for breaking the cycle of low educational attainment and improving child outcomes in historically disadvantaged households.

6 Mechanisms

6.1 Maternal Education and Mother's Outcomes

Our main results show that, on average, there is meaningful evidence of intergenerational transmission of education on child outcomes through the college expansion, and more educated mothers from rural areas are less likely to have low birth weight children and can better prepare their children's social and motor skills earlier than less educated mothers. In this section, we seek to understand what factors could explain those results by studying several mechanisms. We first examine if college expansion promotes assortative marriage in China as a common cause found in the literature. Next, we investigate if increased access to education improves labor market outcomes so that mothers have more resources to take care of their children. Then we test if there exist any place-based factors behind these effects. Next, we examine if maternal education influences mother's age at first birth. Last, we look into whether access to college changes the health behaviors of affected mothers.

Assortative Marriage Columns (1) and (2) in Table 8 provide evidence of assortative marriage in terms of educational attainment. The full sample analysis shows one more year of schooling increases spousal education by 0.9 years. Mother's education is also causally related to the discrete measure of the spouse's education. On average, a one year increase in mother's education leads to 12 percentage points increase in father's attendance of high school. These results are consistent with existing studies that find assortative marriage in China (Nie and Xing, 2019).

Labor Market Outcomes Columns (3) and (4) present the results of maternal education on mothers' working status and income. While the estimates suggest a large effect, they are not statistically significant. Specifically, one additional year of education increases the probability of employment by 5 percentage points and raises income by 17.2 percent. These estimates are consistent with findings from other studies examining labor market outcomes of higher education expansion (Shi and Xing, 2010).

The lack of a statistically significant impact on labor market outcomes is not entirely unexpected, given the context. The income variable used in this analysis captures not only wage income but also other sources of income, as many mothers report having jobs without wage income. Additionally, our analysis of household income, presented in Table 8 column (5), shows that one more year of education beyond the compulsory level increases household income by 25 percent, suggesting that the positive effects of maternal education may manifest more strongly at the household level rather than solely through mothers' own earnings. This finding aligns with the presence of assortative marriage, where more educated mothers tend to marry similarly

educated spouses, contributing to overall household economic well-being.

Moreover, the analysis in Table 8 column (6), reveals that while education does not significantly increase overall employment, it is associated with a decline in the likelihood of working in agricultural jobs. This indicates that higher education may enable mothers to transition into non-agricultural sectors, which could influence family dynamics and resources. Additionally, column (7) shows that, although not statistically significant, mothers with more education tend to work fewer hours. While we do not have a direct measure of time spent with children and this noisy effect does not provide conclusive evidence, it suggests a possible trend where more education could lead to greater time availability for mothers. This potential shift might influence how mothers allocate time toward investing in their children, a topic we explore further in the next section. Lastly, it is important to note that our sample is limited to mothers, potentially leading to an underestimation of the overall effect of education on labor market outcomes due to this selectivity.

Our analysis of maternal labor market outcomes indicates that while maternal education increases the likelihood of employment, it does not lead to longer working hours. This raises the important question of how maternal education influences childcare responsibilities. Although we do not have detailed time-use information on childcare, CFPS includes a question regarding the main caregiver in the past month. Appendix Table B6 presents the distribution of different caregiver types, indicating that employed mothers are less likely to be the main caregiver, while paternal grandparents are nearly twice as likely to take on this role compared to the caregivers of mothers without employment.

To address this, we examined whether maternal education affects the likelihood of mothers being the primary caregiver, specifically among employed and unemployed mothers. The results, presented in Appendix Table B7, show that more educated mothers are less likely to be the primary caregiver, but this effect is statistically significant only among unemployed mothers. This finding aligns with research indicating that economically constrained or non-employed mothers often rely more on family members, particularly grandparents, for childcare (Compton and Pollak, 2014). Prior studies have shown that in the absence of substantial formal childcare options, family members—especially grandparents—remain an essential support system, which is consistent with caregiving norms in China. The implications of this finding suggest that increases in maternal education may shift childcare responsibilities toward extended family members, potentially influencing early childhood outcomes in nuanced ways.

Location Recent literature suggests place-based factors could affect health outcomes (Deryugina and Molitor, 2021; Finkelstein, Gentzkow, and Williams, 2021). As we have confirmed in our previous results, mothers who came from rural areas were largely affected by the college

expansion and transmitted human capital to the outcomes of the next generation. Most Chinese universities are located in large cities, and attending college requires migrating to those cities (Xing and Zhang, 2017; Cai, Ding, and Du, 2024). Is it because they are likely to stay in cities after they receive a college education, so they have better health services that improve children's outcomes? We test if mother's current hukou registration status is affected by her education. Column (5) in Table 8 shows it is indeed this case. One more year of education, on average, increases the probability of currently having urban hukou status by 7.9 percentage points.

While the CFPS data do not include information on health care quality or the nutrition of pregnant women, we leverage another dataset that provides insights into dietary and nutrition differences between rural and urban China during the study period. The China Health and Nutrition Survey (CHNS) is a longitudinal survey that tracks individuals over time and contains detailed information on nutritional intake. Appendix Figure A6 presents the plots of four key dietary metrics: carbohydrate, fat, energy, and protein. Although the gap in energy and carbohydrate intake between rural and urban areas is small and has narrowed in recent years, significant differences in fat and protein consumption persist across the two regions throughout the study period. Together, this provides a more comprehensive understanding of how education-induced migration may influence early childhood health outcomes.

Adult Health and Risky Behaviors Existing studies have shown that improved access to education, either through compulsory education law or college, likely changes adults' health (Huang, 2015), and risky behaviors such as reducing smoking and drinking (Cowan and Tefft, 2020) which improved their own health conditions. Recent research also suggests that economic growth plays a role in reducing smoking rates, particularly among middle-aged and elderly men in China (Yang, 2022). Meanwhile, parents with worse health status may put fewer resources on their children, and therefore, this might be negatively related to health or early social and motor skills development for the next generation.

However, we do not find such channels of effect in the Chinese context. Column (9) presents that there is little impact of the mother's own education on her self-reported health as good, although the positive magnitudes are consistent with the literature (Huang, 2015). Columns (10) and (11) show that there is no causal effect of education on health behaviors for mothers. Considering that the average percentage of smoking is only 0.6 percent for the full sample, it is not surprising to see the null effect. In addition, the null impact of education on self-reported health and health behaviors is also consistent with the existing findings in Turkey (Dursun, Cesur, and Mocan, 2018) and Romania (Malamud, Mitrut, and Pop-Eleches, 2023).[22]

[22]We also examine whether mother's education has any impact on the probability of a child born in hospital and breastfeeding length. There is no evidence that mother's education leads to any changes to these two outcomes,

Age at First Birth Our analysis shows that more educated mothers tend to have their first child later, with an additional year of education delaying age at first birth by 0.49 years.[23] This is consistent with established findings in the literature, where higher educational attainment is associated with delayed childbearing (McCrary and Royer, 2011; Miller, 2011)

Delaying the age at first birth is generally linked to better birth outcomes. Younger mothers, particularly those in their teens, are at higher risk for adverse outcomes like low birth weight and preterm birth (Fraser, Brockert, and Ward, 1995). In contrast, more educated, older mothers tend to have healthier birth outcomes due to factors like greater economic stability and better access to healthcare.

In our sample, the delay in childbearing for more educated mothers may contribute to improved prenatal care and better preparedness for motherhood, which positively influences early childhood outcomes. These findings further emphasize the role of maternal education in enhancing child health and development.

6.2 The Impact of Maternal Education and Child Care

The previous section has identified various channels through which more educated mothers improve early childhood outcomes. In this section, we seek to utilize several questions related to how parents care about child development and their investment in children to provide suggestive evidence of why increased educational attainment of mothers may lead to the better cognitive skills development.

Observer's Perceptions CFPS survey observers are asked to report how they perceive the degree that adults care about the educational achievement and communication skills during the interview. The OLS results are listed in the first two columns in Table 9. Mothers with one more year of schooling above grade 9 is 4.2 percentage points more likely to be rated by the observer that the adults in the households care about child education and 3.4 percentage points more likely to be perceived as care about child communication skills.

Even though the observer is randomly assigned and is independent from the educational attainment of the mother, we cannot rule out other possibilities that could potentially correlate the perception and maternal education since the education background was available to the

which could be helpful to early childhood health outcomes.

[23] In addition, we find that an additional year of education beyond the compulsory level reduces the number of children by 0.14, and mothers who completed college have nearly one fewer child than those who did not, suggesting that more educated mothers tend to have fewer children—potentially allowing for greater per-child investment in health and development. These results should be interpreted with caution, as fertility decisions during the study period were heavily influenced by China's family planning policies. The results are presented in Appendix Table B8.

observer during the interview. Nonetheless, this still provides informative evidence of how a more educated mother invests differentially in her children.

Child Investment Why do we find the main results that children with more educated mothers take a shorter time to obtain social and motor skills? It could be that these households invest more in children by various early childhood activities such as reading and playing, which would provide important policy implications to early childhood development. CFPS asks parents if they frequently read for children, buy books, play out with children, and use toys to teach children as well as taking kids to training courses. Even though we do not know the exact timing of this information as they are only asked for parents with children age between 3 and 5 at the survey time, they still provide insights about how more educated mothers invest in children.

The results are presented in columns (3) through (10) in Table 9.[24] Apparently, one more year of education above grade 9 leads parents 6.1 percentage points more likely to read for children, 7.2 percentage points more likely to buy books, and 6.1 percentage points more likely to play frequently with children. Households with more educated mothers are more likely to use toys to improve children's cognitive skills, though this could be correlated with more resources as well. But we do not find significant differences in attending training courses, which serves as a good argument that financial constraint may not play an important role in this context, especially given that we do not find substantial changes in maternal employment or working hours.

Our findings align with existing literature indicating that higher maternal education is associated with enhanced home environments and increased engagement in stimulating activities (Guryan, Hurst, and Kearney, 2008). Carneiro, Meghir, and Parey (2013) find that maternal education not only increases income but also fundamentally changes how mothers interact with their children, creating richer and more supportive home environments. This suggests that while higher household income may provide additional flexibility, the primary mechanism at play is a shift in parental attitudes and behavior towards greater direct engagement with their children.

Moreover, although our results do not show significant effects on maternal employment or working hours, we do observe a significant increase in household income. This suggests that increased income from higher maternal education may support these behavioral changes by alleviating financial constraints and enabling educated mothers to allocate resources more effectively towards their children's development. However, the lack of significant differences in maternal working hours indicates that increased income does not come at the cost of reduced time availability, reinforcing the idea that the observed improvements are primarily driven by

[24] While our main analysis relies on an IV approach to address endogeneity, the results presented in this section use OLS due to the smaller subsample of families with children aged 3 to 5, for whom child investment information is collected. As a result, we present these findings as suggestive evidence, highlighting patterns of parental behavior associated with maternal education rather than making causal claims.

changes in parental priorities and engagement behaviors.

Furthermore, the mixed findings on the impact of cash transfers to mothers on children's health are puzzles to economists. For instance, Field and Maffioli (2025) observed that cash transfers alone did not lead to improvements in children's nutrition and reduction of stunting, but effective social behavior communication significantly reduced stunting. Similarly, Priyanka and Sara (2023) show that education-specific cash transfers yield long-term spillover benefits in the next generation. These findings underscore that financial resources alone may not be sufficient to improve child outcomes; changes in parental knowledge and behavior are crucial. In our study, we find that although more educated mothers do not necessarily experience significantly better employment outcomes or longer hours of work, they demonstrate a greater understanding of how to make effective investments in their children's development.

7 Conclusion

Although there is a large body of literature examining the impact of maternal education on various outcomes, there are only a few studies focusing on early childhood outcomes in developing countries. Especially, current literature lacks evidence of mothers' senior-secondary or above education attainment on child outcomes in children's earlier lifetime. Understanding whether maternal education impacts child outcomes and through which channels these outcomes are affected is extremely important. From the fetal origins hypothesis, helping mothers would be one important way to help their children throughout their life course (Almond and Currie, 2011). Making child-bearing age women more educated is a cost-effective way to improve child health (Black et al., 2017).

This paper analyzes the impact of maternal education on early childhood health outcomes and social and motor skills. Using the higher education expansion in China as the exogenous shock to mother's education beyond the compulsory schooling level, this paper finds that, for mothers from rural areas, one year increase in education leads to 2 percentage points decrease in the probability of the child being low birth weight, 0.3 percentage points reduction in the incidence of very low birth weight, 0.3 months earlier to walk independently, 0.7 months earlier to speak a full sentence, and 1.3 months earlier to count from one to ten. Our heterogeneous results indicate that these effects are likely driven by the first-born children. We test several channels through which maternal education could affect child outcomes. The results show that education leads to assortative marriage, rural-urban migration, and delayed fertility decision, which could contribute to the improvement of children's health outcomes and social and motor skills development. More educated mothers are also perceived by survey observer as pay more attention to children's education and communication skills. These mothers are also more likely

to invest in other activities with children.

Similar to the findings in studies that examine both higher level education attainment (Currie and Moretti, 2003; Carneiro, Meghir, and Parey, 2013) and lower level of educational attainment of the mother (Chou et al., 2010; Güneş, 2015; Huang et al., 2018), results in this paper indicate that education above the compulsory level in China has a large impact on infant birth weight and early development of social and motor skills. The mechanism analyses are also consistent with the existing literature on the impact of higher education expansion in China, which vastly improves the socioeconomic status with the increase in education (Li, Whalley, and Xing, 2014; Ding, 2021).

One consideration regarding the HEE is its potential effect on both the quality and cost of education due to the rapid intake of students and increased tuition fees. Higher student-teacher ratios may have lowered educational quality, while rising tuition fees could have restricted access for some students, particularly those from less affluent backgrounds. These factors suggest that our estimates of the impact of maternal education on child outcomes may be conservative, as the observed effects occurred under conditions of potentially reduced quality and increased costs. As noted in Duflo (2001), expansions in educational access often introduce constraints that may bias estimated impacts downward. Future research could build on these findings by incorporating data on per-student spending, quality indicators, and financial aid availability to better understand the relationship between educational expansion and child outcomes.

As pointed out in Black et al. (2017), 250 million children younger than 5 years old who live in low- and middle-income countries (LMICs) have not reached their development potential. Insufficient attention placed on nurturing care during a child's rapid brain development and learning under the age of three is the major concern in many LMICs. A variety of early childhood development programs has been adopted in these countries, while the findings in this paper demonstrate that improving mothers' post-compulsory education will be a meaningful way to improve children's early childhood development and thus further help children's health conditions and human capital accumulation. One thing that needs to be noted is that the sample of mothers we used in the main analysis is mainly from the early cohort who benefited from the higher education expansion. We show that mothers with more education years after compulsory education stage have seen considerable improvement in the outcome variables of interest. It would be reasonable to believe that college attainment should have an even more significant impact on these outcomes, and it deserves further studies in the future.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT 4 in order to proofread the manuscript. After using this tool/service, the authors reviewed and edited the content as needed

and take full responsibility for the content of the publication.

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8 Figures

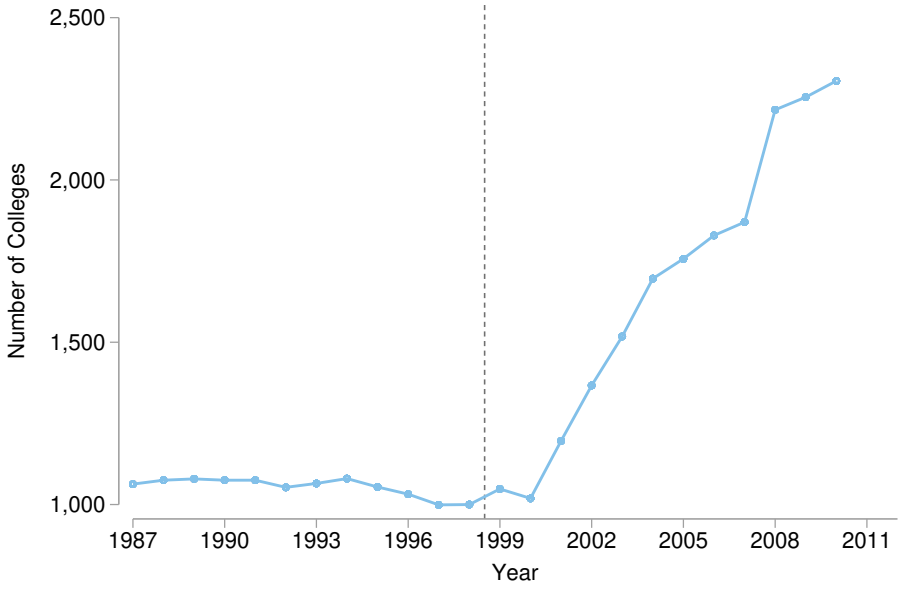


Figure 1: National Number of Colleges

Notes: This figure plots the number of colleges at the national level from year 1987 to 2010. The data are from China Yearly Statistical Book.

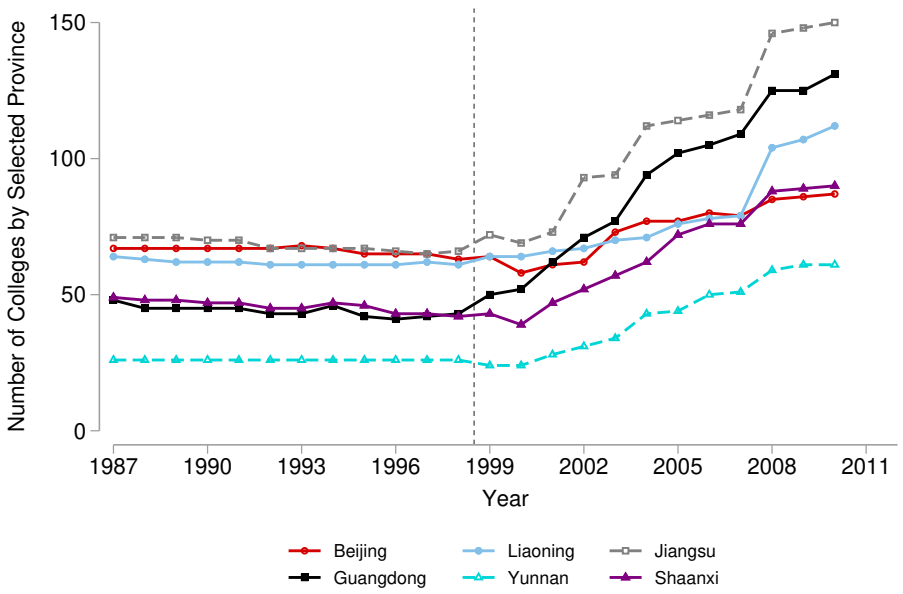


Figure 2: Number of Colleges by Selected Provinces

Notes: This figures plots the number of colleges from year 1987 to 2010 in selected province. The data are from China Yearly Statistical Book and Educational Statistical Book of China. There are six regions in mainland China. Each province presented above is a representative province in different regions.

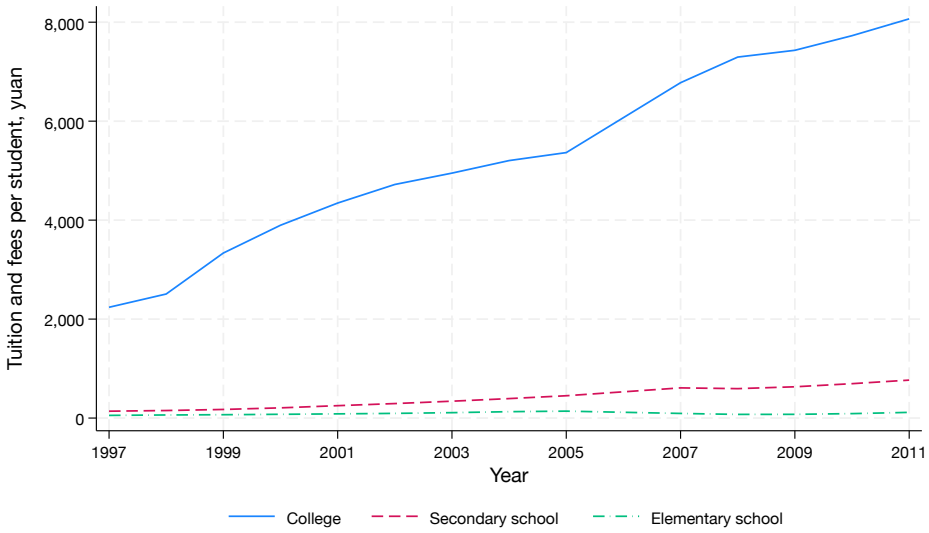


Figure 3: Education Costs

Notes: This figures plots the cost of education across different levels over time in China. Data are from China Yearly Statistical Book.

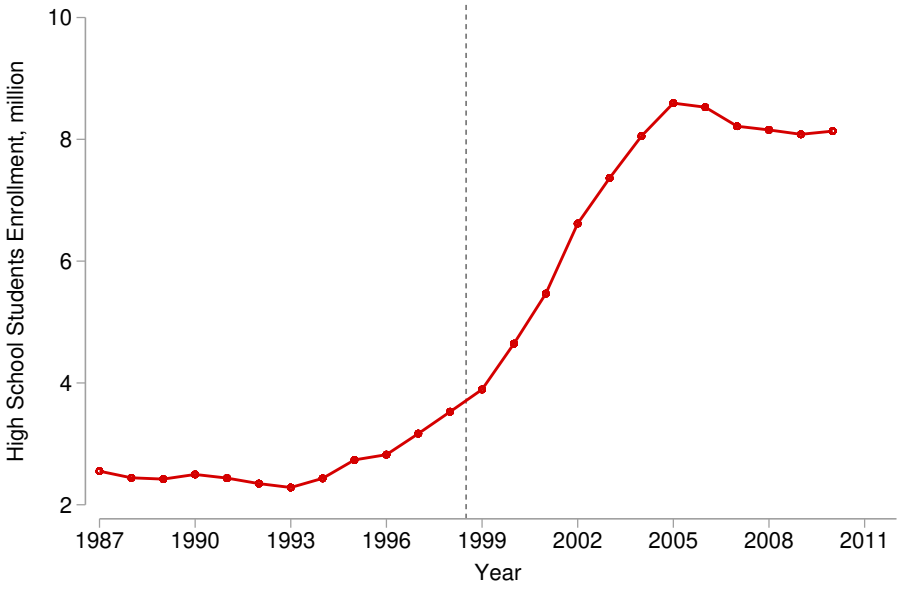
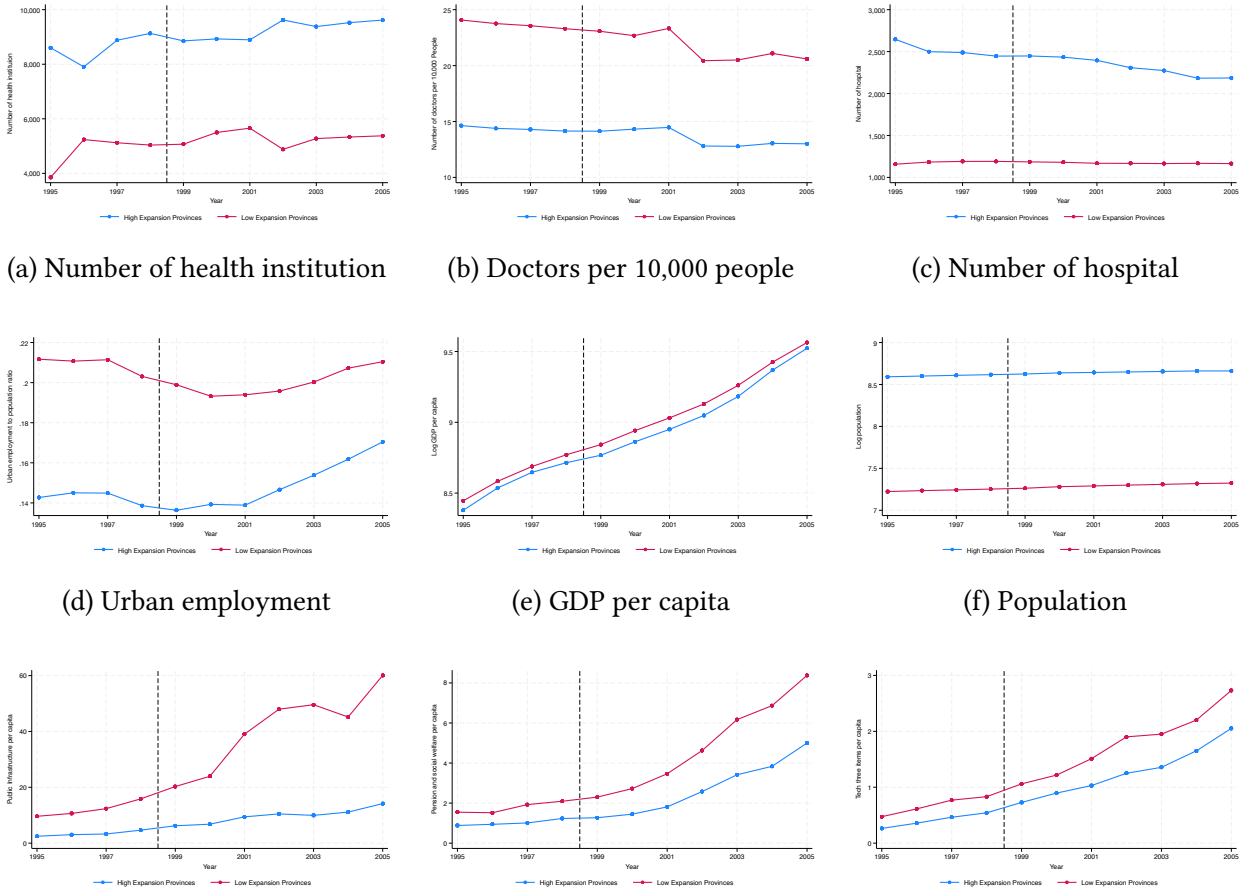


Figure 4: National High School Students New Enrollment

Notes: This figures plots the total number of high school admissions from year 1987 to 2010. The data are from Educational Statistical Book of China.



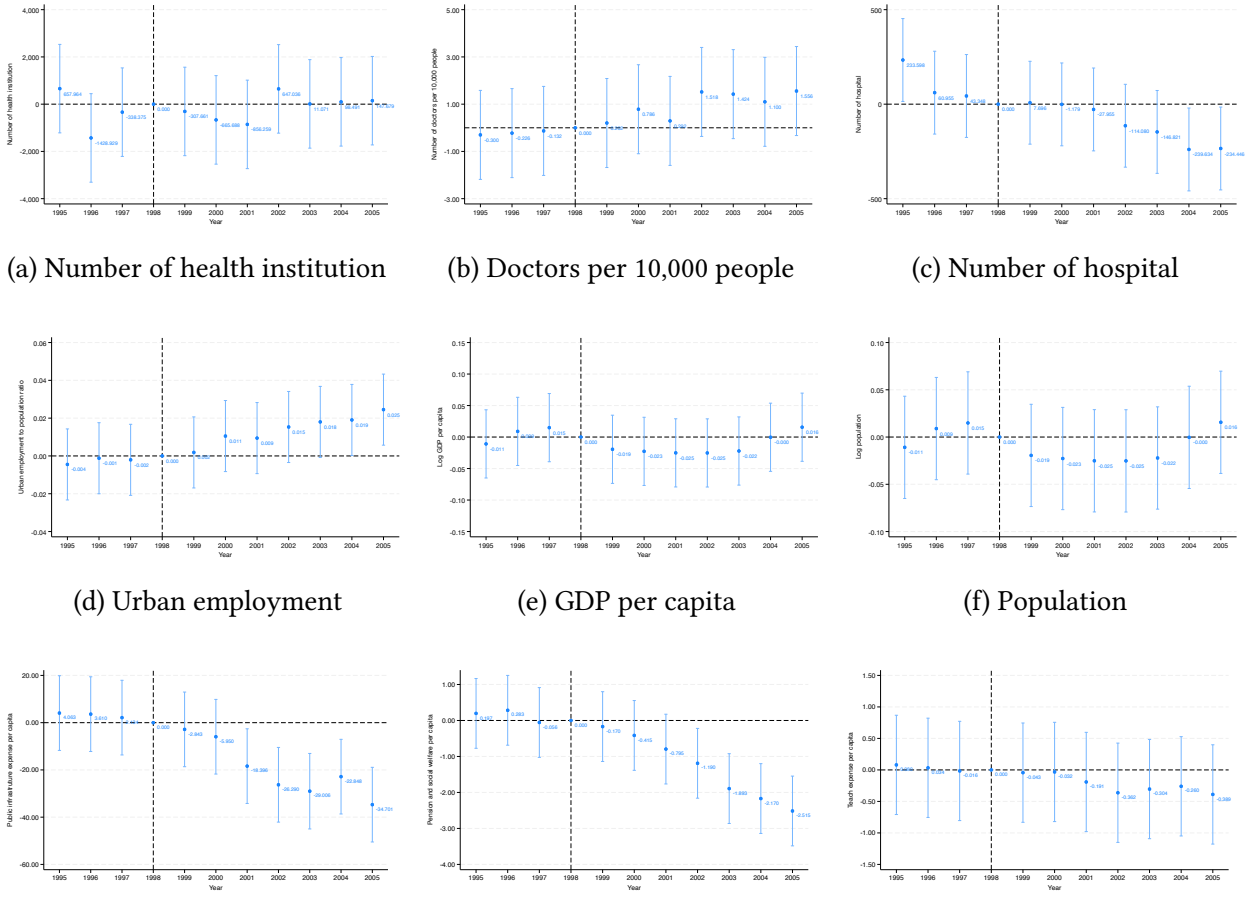
(a) Number of health institution (b) Doctors per 10,000 people (c) Number of hospital

(d) Urban employment (e) GDP per capita (f) Population

(g) Infrastructure investment (h) Pension and social welfare (i) Technology expenditure

Figure 5: Pre-Trend Evidence

Notes: This figure presents the trend evidence of major economic variables between high-expansion and low-expansion provinces before and after 1999. High-expansion provinces are defined as those with an increase in the number of colleges between 1999 and 2005 above the median, while low-expansion provinces are defined as those with an increase below the median. Data are from the China Statistical Yearbook.



(a) Number of health institution (b) Doctors per 10,000 people (c) Number of hospital

(d) Urban employment (e) GDP per capita (f) Population

(g) Infrastructure investment (h) Pension and social welfare (i) Technology expenditure

Figure 6: Dynamics of Trend Evidence

Notes: This figure presents the estimated coefficients of the differences of major economic variables at the provincial level between high-expansion and low-expansion provinces. High-expansion provinces are defined as those with an increase in the number of colleges between 1999 and 2005 above the median, while low-expansion provinces are defined as those with an increase below the median. Data are from the China Statistical Yearbook.

9 Tables

Table 1: Summary Statistics

	Full sample			Mother's college year before 1999			Mother's college year after 1999		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
A. Instrumental variable									
Number of colleges	4,803	42.254	17.376	3,590	39.154	14.604	1,213	51.426	21.260
B. Child birth and health outcomes									
Low birth weight (LBW)	4,120	0.058	0.235	3,017	0.058	0.233	1,103	0.061	0.239
Very low birth weight (VLBW)	4,120	0.003	0.056	3,017	0.004	0.060	1,103	0.002	0.043
Macrosomia	4,120	0.038	0.192	3,017	0.038	0.192	1,103	0.039	0.194
Gestage	4,784	9.288	0.580	3,573	9.300	0.576	1,211	9.252	0.592
Any sickness	4,093	0.691	0.462	3,115	0.672	0.469	978	0.751	0.433
Any Hospitalization	4,084	0.606	0.489	3,109	0.583	0.493	975	0.677	0.468
C. Social and motor skills									
Walk	4,275	14.448	4.714	3,407	14.609	4.905	868	13.815	3.815
Speak	4,045	20.592	8.143	3,314	20.765	8.354	731	19.806	7.057
Count	3,682	35.384	14.992	3,093	36.158	15.270	589	31.323	12.694
Independent toilet	3,834	33.228	13.108	3,177	33.871	13.421	657	30.120	10.963
D. Explanatory variables									
Mother education years	4,803	6.536	4.202	3,590	6.127	4.102	1,213	7.745	4.263
Mother education years above grade 9	4,803	0.518	1.502	3,590	0.370	1.278	1,213	0.957	1.961
Mother ethnicity as Han	4,803	0.865	0.342	3,590	0.865	0.341	1,213	0.864	0.343
Grandma education	4,803	0.893	0.310	3,590	0.922	0.269	1,213	0.806	0.395
E. Mother childhood province characteristics									
Population growth rate	4,803	0.012	0.008	3,590	0.014	0.008	1,213	0.007	0.009
Employment growth rate	4,803	0.028	0.066	3,590	0.030	0.058	1,213	0.021	0.086
GDP growth rate	4,803	0.162	0.080	3,590	0.178	0.081	1,213	0.117	0.053

Notes: This table shows the summary statistics for the outcome variables, instrumental variable and main explanatory variables. The sample presented in this table is from the CFPS 2010 survey data for the main analysis.

Table 2: First Stage Result: The Impact of Number of Colleges on Mother's Education

	(1)	(2)	(3)
Panel A: Education years above 9th Grade			
Number of colleges	0.052***	0.051***	0.052***
	(0.007)	(0.007)	(0.007)
Panel B: Education years			
Number of colleges	0.050***	0.048***	0.044***
	(0.014)	(0.014)	(0.014)
Mother's cohort×College population ratio in 1995		✓	✓
Mother's cohort×Enrollment rate in 1998			✓
Observations	4,803	4,803	4,803

Notes: This table shows the first stage results of the number of colleges on mother's education years after grade 9. The data are from CFPS 2010 and cross-sectional weights are used in the regression. All regressions control for mother's characteristics, including ethnicity and grandmother's education level. Provincial-level employment rate, GDP growth rate, and population growth rate. In addition, mother's birth year fixed effect, mother's childhood province fixed effect, and child's birth province by year fixed effects are included. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: The Impact of Mother's Education on Child Outcomes

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. OLS										
Medu	-0.002	-0.0002	-0.003	0.017**	0.012*	0.015**	-0.112***	-0.361***	-1.350***	-0.915***
	(0.003)	(0.0003)	(0.002)	(0.007)	(0.006)	(0.006)	(0.042)	(0.104)	(0.168)	(0.161)
Observations	4,116	4,116	4,116	4,784	4,083	4,074	4,272	4,039	3,670	3,826
B. IV										
Medu	-0.019*	-0.003**	0.004	-0.004	-0.017	0.005	-0.297**	-0.708*	-1.304*	-0.751
	(0.010)	(0.001)	(0.006)	(0.048)	(0.028)	(0.026)	(0.143)	(0.386)	(0.741)	(0.545)
Kleibergen-Paap F	54.05	54.05	54.05	49.81	66.84	66.52	44.61	40.68	46.89	47.48
Observations	4,116	4,116	4,116	4,784	4,083	4,074	4,272	4,039	3,670	3,826
Model p-value	0.065	0.038	0.506	0.933	0.550	0.860	0.039	0.067	0.079	0.169
Romano-Wolf p-value	0.097	0.097	0.652	0.920	0.565	0.834	0.028	0.055	0.055	0.063
Sample Mean	0.057	0.003	0.038	9.288	0.691	0.606	14.451	20.600	35.428	33.261
Sample SD	0.235	0.056	0.192	0.580	0.462	0.489	4.714	8.146	14.990	13.097

Notes: This table presents the main results of OLS and IV estimations. Dependent variables are shown in the top row. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Romano-Wolf p-values for multiple hypothesis tests are reported for the IV results. We conduct three separate tests for birth-related outcomes (columns 1 through 4), age-one health conditions (columns 5 and 6), and social and motor skills (columns 7 through 10). Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

Table 4: Specification Checks

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. Total education years										
Total education years	-0.021*	-0.003**	0.005	-0.005	-0.018	0.005	-0.307**	-0.675*	-1.216*	-0.749
	(0.012)	(0.002)	(0.007)	(0.057)	(0.030)	(0.028)	(0.150)	(0.405)	(0.717)	(0.559)
Kleibergen-Paap F	12.46	12.46	12.46	9.493	14.77	15.03	11.75	13.17	14.63	13.37
Observations	4,116	4,116	4,116	4,784	4,083	4,074	4,272	4,039	3,670	3,826
B. College completion										
College	-0.134*	-0.021**	0.030	-0.028	-0.113	0.031	-1.994**	-4.602*	-8.576*	-4.842
	(0.074)	(0.011)	(0.045)	(0.336)	(0.189)	(0.178)	(0.989)	(2.458)	(4.775)	(3.469)
Kleibergen-Paap F	35.75	35.75	35.75	33.40	46.73	46.72	33.67	35.02	39.60	42.39
Observations	4,116	4,116	4,116	4,784	4,083	4,074	4,272	4,039	3,670	3,826
C. Restricted sample (born after 1975)										
Medu	-0.017	-0.003*	0.002	-0.001	-0.032	0.005	-0.244*	-0.757*	-1.293*	-0.555
	(0.012)	(0.002)	(0.007)	(0.054)	(0.029)	(0.028)	(0.137)	(0.442)	(0.762)	(0.558)
Kleibergen-Paap F	45.80	45.80	45.80	43.27	59.48	59.42	42.85	35.32	44.21	42.26
Observations	2,639	2,639	2,639	2,960	2,506	2,503	2,485	2,273	1,992	2,126
D. Restricted sample (mother's college-going year before 1999)										
Medu	0.177	0.053	-0.082	-0.188	0.040	0.014	0.010	2.580	-0.356	-2.383
	(0.120)	(0.035)	(0.060)	(0.174)	(0.102)	(0.103)	(0.938)	(2.125)	(4.891)	(2.917)
Kleibergen-Paap F	3.99	3.99	3.99	5.28	6.08	6.07	7.24	7.77	6.52	6.99
Observations	2,990	2,990	2,990	3,550	3,085	3,079	3,382	3,296	3,075	3,160

Notes: This table presents the robustness checks of our main IV estimations. Panel A uses total years of mother's education as the key independent variable. Panel B uses the binary variable of college completion as the independent variable. Panel C restricts the sample to mothers who were born after 1975. Panel D restricts the sample to mothers whose college-going year was before the expansion. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: The Heterogeneous Impact of Maternal Education by Child Gender

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. Sons										
Medu	-0.027*	-0.002	0.009	0.050	0.055*	0.092**	-0.319	-0.291	-0.793	-1.268*
	(0.016)	(0.002)	(0.011)	(0.039)	(0.030)	(0.038)	(0.287)	(0.507)	(0.838)	(0.734)
Kleibergen-Paap F	26.48	26.48	26.48	23.67	31.50	31.41	22.45	21.70	25.67	21.70
Observations	2,136	2,136	2,136	2,465	2,108	2,101	2,198	2,075	1,868	1,954
Sample Mean	0.052	0.001	0.045	9.284	0.689	0.615	14.485	20.862	35.937	33.403
Sample SD	0.221	0.038	0.208	0.580	0.463	0.487	4.807	8.242	15.049	12.936
B. Daughters										
Medu	-0.018	-0.004*	0.018**	-0.058	-0.034	0.008	-0.231	-0.191	-0.775	0.228
	(0.017)	(0.003)	(0.009)	(0.067)	(0.031)	(0.028)	(0.219)	(0.435)	(0.886)	(0.709)
Kleibergen-Paap F	54.14	54.14	54.14	50.29	49.45	48.19	41.20	42.55	48.30	51.28
Observations	1,891	1,891	1,891	2,231	1,883	1,881	1,987	1,886	1,726	1,791
Sample Mean	0.069	0.005	0.032	9.291	0.692	0.592	14.438	20.382	35.000	33.114
Sample SD	0.254	0.073	0.175	0.581	0.462	0.492	4.602	8.004	14.980	13.205
Diff (Son-Daughter)	-0.010	0.002	-0.009	0.108	0.089	0.084	-0.088	-0.101	-0.018	-1.497
Wald test p-value	0.677	0.501	0.522	0.166	0.038	0.077	0.806	0.880	0.988	0.142

Notes: This table presents the IV results of maternal education on early childhood health outcomes and social and motor skills by child gender. The last two rows present the difference of estimated coefficients between sons and daughters and the corresponding p-values of Wald tests. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: The Heterogeneous Impact of Maternal Education by Birth Order

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. First child										
Medu	-0.025*	-0.004*	-0.003	0.005	-0.001	0.007	-0.419**	-0.896*	-1.141*	-0.681
	(0.013)	(0.002)	(0.008)	(0.045)	(0.027)	(0.024)	(0.175)	(0.480)	(0.683)	(0.596)
Kleibergen-Paap F	44.73	44.73	44.73	45.17	62.23	62.21	38.17	36.1	41.41	41.08
Observations	2,898	2,898	2,898	3,292	2,828	2,821	3,015	2,870	2,705	2,753
Sample Mean	0.056	0.003	0.037	9.291	0.687	0.603	14.316	20.330	34.576	33.243
Sample SD	0.230	0.059	0.188	0.583	0.464	0.489	4.684	8.087	15.013	13.262
B. Second child or above										
Medu	-0.054	-0.004	0.044	-0.136*	-0.177**	-0.101	-0.22	-0.615	-1.427	-1.399
	(0.036)	(0.006)	(0.029)	(0.081)	(0.078)	(0.065)	(0.713)	(1.440)	(2.083)	(1.480)
Kleibergen-Paap F	19.24	19.24	19.24	13.57	10.02	10.05	5.801	5.963	5.186	6.559
Observations	1,140	1,140	1,140	1,421	1,188	1,186	1,186	1,097	900	1,004
Sample Mean	0.065	0.003	0.043	9.279	0.698	0.610	14.852	21.397	38.043	33.394
Sample SD	0.246	0.051	0.203	0.570	0.459	0.488	4.849	8.297	14.591	12.411

Notes: This table presents the IV results of maternal education years after middle school on early childhood outcomes by child birth order. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: The Impact of Mother's Education on Child Outcomes by Maternal Grandmother's Education

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. Primary school or below										
Medu	-0.026**	-0.004**	0.001	-0.003	-0.015	0.014	-0.313*	-0.525	-1.418*	-0.624
	(0.013)	(0.002)	(0.007)	(0.054)	(0.030)	(0.028)	(0.163)	(0.400)	(0.803)	(0.562)
Kleibergen-Paap F	40.05	40.05	40.05	37.40	54.41	54.11	39.54	34.67	38.08	42.98
Observations	3,613	3,613	3,613	4,262	3,639	3,631	3,843	3,654	3,323	3,461
Sample Mean	0.061	0.003	0.037	9.287	0.688	0.603	14.595	20.749	36.115	33.528
Sample SD	0.239	0.053	0.188	0.584	0.463	0.489	4.875	8.304	15.127	13.211
B. Middle school or above										
Medu	0.011	-0.008	-0.019	-0.039	0.040	0.027	0.433	0.940	0.648	1.253
	(0.024)	(0.007)	(0.025)	(0.066)	(0.080)	(0.082)	(0.489)	(0.989)	(1.572)	(2.127)
Kleibergen-Paap F	12.43	12.43	12.43	12.38	9.10	9.12	6.95	8.25	7.30	7.24
Observations	684	684	684	781	631	629	654	604	537	564
Sample Mean	0.045	0.006	0.054	9.271	0.691	0.612	13.873	20.356	32.136	32.459
Sample SD	0.208	0.076	0.226	0.564	0.462	0.488	3.877	7.653	13.332	12.032

Notes: This table presents the heterogeneous effects of maternal education on child outcomes based on grandmother's education. Panel A includes children whose maternal grandmother has primary school or below. Panel B includes children whose maternal grandmother has middle school or above. Dependent variables are shown in the top row. All regressions control for maternal ethnicity, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Mechanisms

	(1) Father's edu years	(2) Father's edu years>9	(3) Mother employed	(4) Mother's income	(5) Household income	(6) Ag job	(7) Work hours	(8) Urban hukou	(9) Self-reported good health	(10) Ever smoke	(11) Alcohol often	(12) Age at first birth
Medu	0.899***	0.121**	0.051	0.172	0.254**	-0.076***	-8.882	0.079***	0.010	0.0001	0.012	0.489***
	(0.270)	(0.029)	(0.034)	(0.207)	(0.117)	(0.027)	(5.988)	(0.023)	(0.012)	(0.005)	(0.011)	(0.139)
Kleibergen-Paap F	25.38	25.38	50.55	30.55	25.49	30.50	30.34	49.01	49.03	50.82	49.36	49.03
Observations	3,728	3,728	4,626	2,488	1,985	2,485	2,372	4,798	4,803	4,733	4,792	4,803
Sample Mean	7.850	0.186	0.546	7.076	9.489	0.615	186.815	0.111	0.898	0.006	0.022	25.069
Sample SD	3.747	0.389	0.498	3.512	1.959	0.487	87.69	0.314	0.302	0.078	0.146	3.397

Notes: This table presents the IV results of maternal education on various socioeconomic and adult health-related outcomes. The dependent variable in column (1) is a continuous measure of the mother's spouse's years of education. Column (2) uses a binary variable indicating whether the spouse has attended schooling beyond the compulsory stage. The dependent variable in column (3) is a binary indicator of whether the mother is employed. Column (4) represents mother's income if employed, and column (5) measures household income as the sum of both the mother's and father's income. Column (6) is a binary variable indicating if the mother has an agricultural job. Column (7) is mother's monthly working hours. Column (8) indicates whether the mother currently holds an urban hukou. Column (9) captures whether the mother self-reports having good health. Columns (10) and (11) are binary variables indicating whether the mother has ever smoked and whether she often drinks alcohol, respectively. Column (12) is the mother's age at first birth. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.

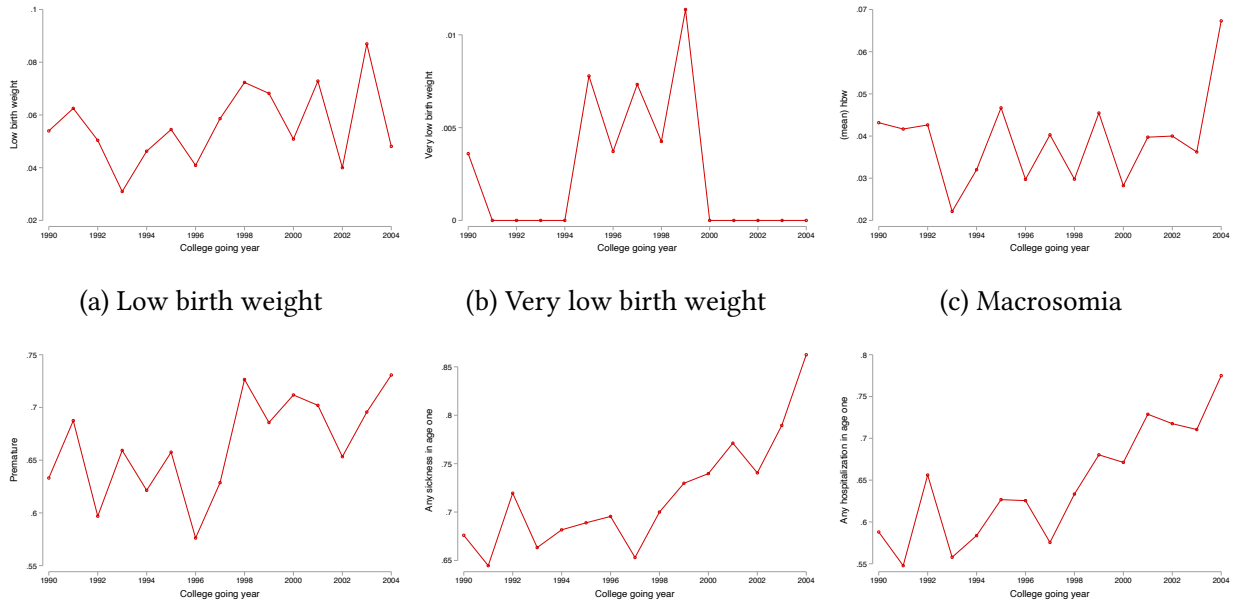
Table 9: The Correlation between Maternal Education and Activities with Children

	Observer's report if adults care about		Whether parents frequently							
	Education	Communication	Read	Buy books	Play out	Use toys to count	Use toys to tell color	Use toys to tell shape	Use toys to read	Take kids to training courses
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Medu	0.042***	0.034***	0.061***	0.072***	0.061***	0.059***	0.049**	0.031*	0.028**	0.012
	(0.006)	(0.006)	(0.012)	(0.015)	(0.011)	(0.015)	(0.021)	(0.018)	(0.012)	(0.008)
R^2	0.183	0.188	0.311	0.365	0.352	0.390	0.339	0.322	0.311	0.321
Observations	4,801	4,801	927	926	927	757	757	757	927	927

Notes: This table presents the OLS results of two sets of relationship between maternal education and observer's perception and activities with children. Columns (1) and (2) use survey observer's reported responses in terms of how much the household adults care about children's education and communication skills. Columns (3) to (10) use responses to questions as whether parents frequently do those activities with children and these questions are only asked for households with children age between 3 and 5 at survey time. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendices

A Additional Figures

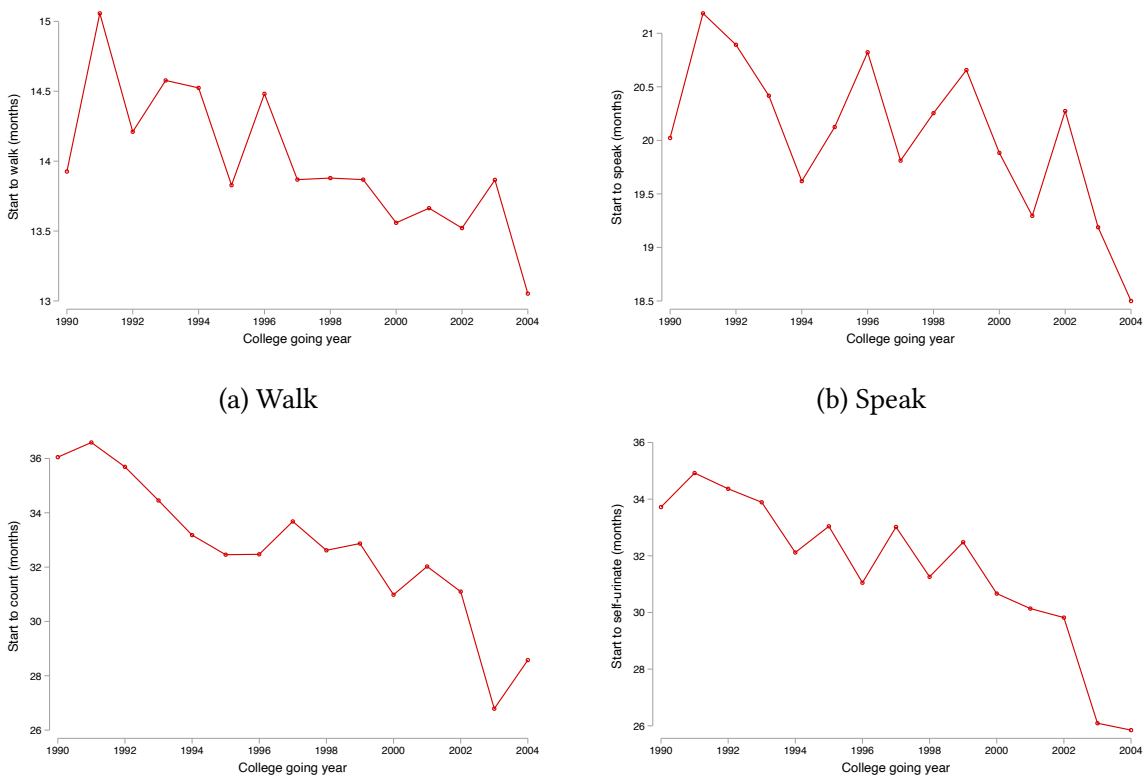


(a) Low birth weight (b) Very low birth weight (c) Macrosomia

(d) Prematurity (e) Any sickness (f) Any hospitalization

Figure A1: Child Birth and Health Outcomes by Mother's College-Going Year

Notes: This figures plots the child birth and health outcome variables by mother's college-going year. Data are compiled from CFPS 2010 and we collapse the average of each outcome variable by mother's college-going year.



(a) Walk

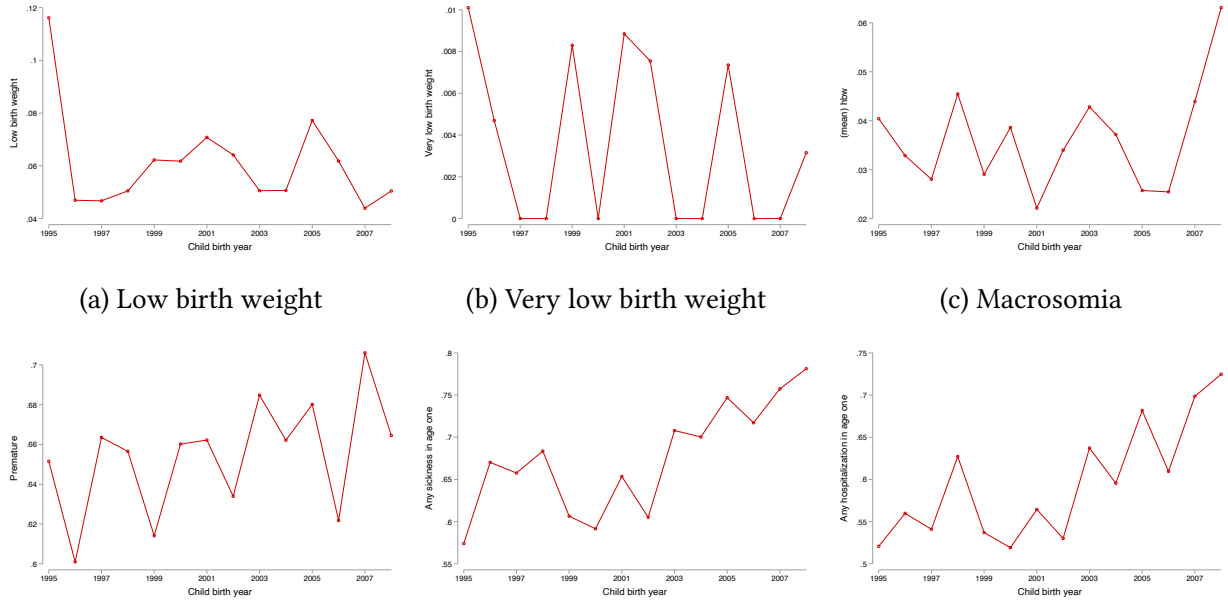
(b) Speak

(c) Count

(d) Independent toilet

Figure A2: Early Childhood Social and Motor Skills by Mother's College-Going Year

Notes: This figures plots the cognitive skills outcome variables by mother's college-going year. Data are compiled from CFPS 2010 and we collapse the average of each outcome variable by mother's college-going year.

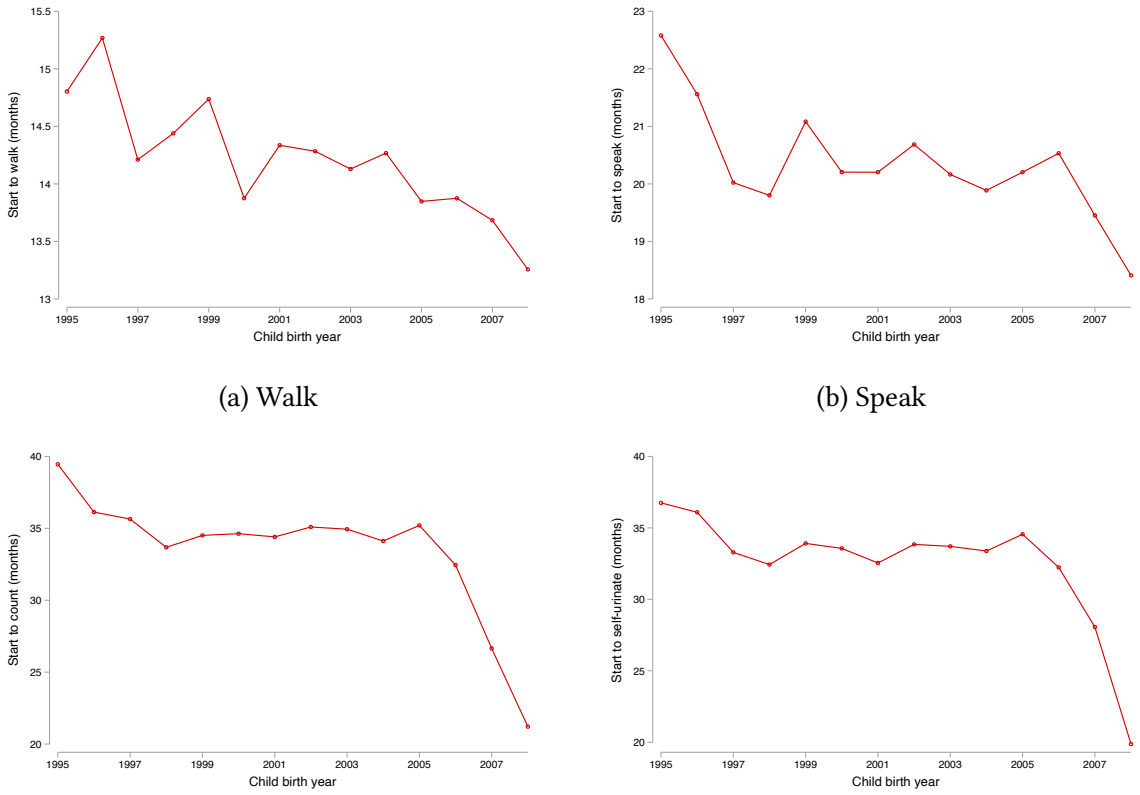


(a) Low birth weight (b) Very low birth weight (c) Macrosomia

(d) Prematurity (e) Any sickness (f) Any hospitalization

Figure A3: Child Health Outcomes by Child Birth Cohorts

Notes: This figures plots the health outcomes by child birth cohorts. Each panel presents a measure of health outcomes for the main sample in this study. The data are from CFPS 2010 child module.



(a) Walk

(b) Speak

(c) Count

(d) Independent toilet

Figure A4: Social and Motor Skills by Child Birth Cohorts

Notes: This figures plots the social and motor skills by child birth cohorts. Each panel presents a task in terms of average months to a child takes to begin for the main sample in this study. The data are from CFPS 2010 child module.

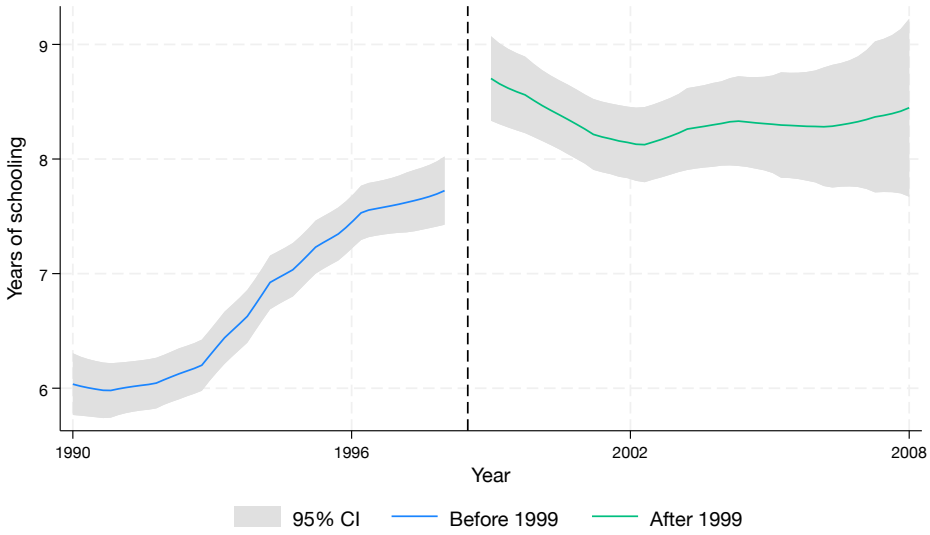
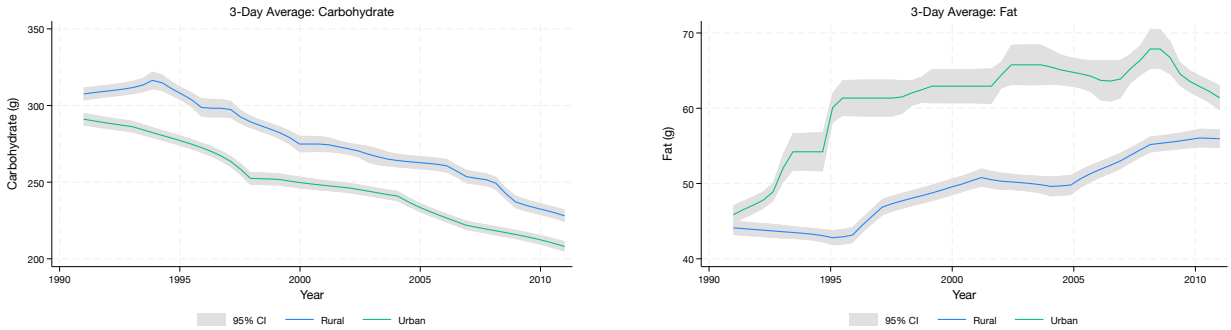


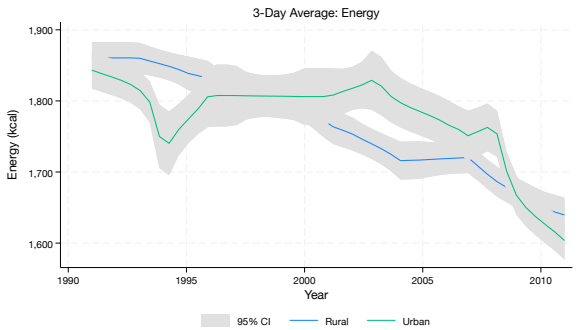
Figure A5: Years of Schooling Before and After the Expansion

Notes: This figures plots the local polynomial regression of mother's years of schooling on college-going year. Data are compiled from CFPS 2010.

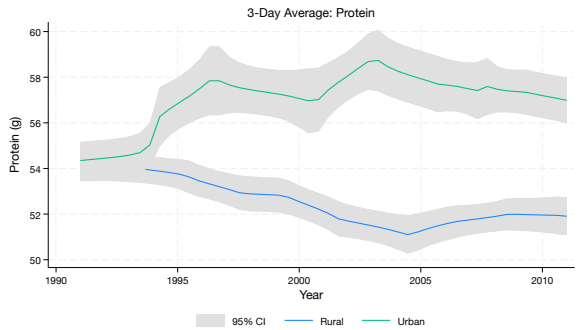


(a) Carb

(b) Fat



(c) Energy



(d) Protein

Figure A6: 3-Day Average Dietary Values

Notes: This figure presents trends in dietary nutrition values between rural and urban areas in China over time using local polynomial regressions. The data are sourced from the China Health and Nutrition Survey (CHNS) covering the period from 1991 to 2011. The sample consists of women born after 1975.

B Additional Tables

Table B1: Placebo Check with Random Province and College-Going Year

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. -2 Years										
Medu	-0.014	0.0001	-0.019	-0.019	0.026	-0.025	0.208	0.369	-0.458	0.569
	(0.019)	(0.003)	(0.017)	(0.059)	(0.045)	(0.038)	(0.349)	(0.842)	(1.372)	(1.383)
Observations	3,817	3,817	3,817	4,427	3,771	3,763	3,925	3,706	3,361	3,503
B. -1 Year										
Medu	-0.023	-0.006*	-0.002	-0.015	0.015	-0.015	-0.096	0.333	-0.508	-0.682
	(0.016)	(0.003)	(0.013)	(0.050)	(0.034)	(0.029)	(0.294)	(0.577)	(1.089)	(0.884)
Observations	3,590	3,590	3,590	4,124	3,515	3,508	3,622	3,407	3,075	3,212
C. +1 Year										
Medu	-0.008	-0.003	0.002	0.008	-0.022	0.005	-0.052	-0.303	-1.509**	0.229
	(0.015)	(0.002)	(0.009)	(0.040)	(0.030)	(0.030)	(0.263)	(0.458)	(0.702)	(0.651)
Observations	3,959	3,959	3,959	4,605	3,932	3,924	4,121	3,902	3,552	3,698
D. +2 Years										
Medu	-0.010	-0.003	0.002	0.039	-0.012	0.004	-0.226	-0.379	-0.812	0.316
	(0.013)	(0.002)	(0.009)	(0.033)	(0.030)	(0.030)	(0.220)	(0.403)	(0.640)	(0.596)
Observations	3,918	3,918	3,918	4,559	3,897	3,889	4,099	3,886	3,538	3,686

Notes: This table shows the placebo IV regressions. We randomly assign childhood province to mothers and move the college going year backward and forward up to 2 years. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at mother's province by cohort level, and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2: 5-Year Migration Rate

Census	2000	2005
Migrant	1,793	681
Non-migrant	375,855	83,274
Migration rate	0.47%	0.81%

Notes: This table shows the migration rates for women aged 12 to 15 who were enrolled in school, based on data from the 2000 decennial census and the 2005 mini-census of China. The "Migrant" row represents the number of individuals who moved within last 5 years, while the "Non-migrant" row indicates those who did not move. The "Migration rate" is calculated as the ratio of migrants to the total number of individuals in each respective census year. Data are sourced from the Integrated Public Use Microdata Series (IPUMS).

Table B3: Validity Tests of the Instrument: The Impact of Contemporaneous Reforms and Shocks on the Number of Colleges

	(1)	(2)	(3)	(4)
	Log Export Volume (10,000 US dollars)	Number of SOE Workers (10,000 person)	Log Residential Housing Sales Value (billions)	Hukou Reform Index
Number of colleges	1.469	0.024	0.016	-0.060
	(1.015)	(0.017)	(1.469)	(0.372)
R^2	0.519	0.531	0.424	0.510
Observations	300	300	150	240

Notes: This table presents the results of the validity tests of our instrument. We examine the the impacts of contemporaneous reforms and shocks on the number of colleges. Note the first row presents our independent variables which are the first differences of corresponding variables between the year of 1995 and 2005. The dependent variable is the first difference of the number of colleges at the province level between 1995 and 2005. The sample period is restricted from 1995-2005 as this period showed large changes in both the number of colleges and other reforms and shocks. The export volume, number of SOE workers, and residential housing sales data for each province were obtained from China's National Bureau of Statistics, and the residential housing sales data are available starting from the year 2000. The hukou reform index data are from Fan (2019) and averaged at the province level. All the regressions include provincial-level employment growth rate, GDP growth rate, population growth rate, and province and year fixed effects with robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B4: Timing of the Policy–Using End of Middle School Year for the Instrument

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Medu	0.067	0.015	-0.039	-0.198	-0.012	-0.103	1.439	0.887	26.881	13.777
	(0.077)	(0.012)	(0.039)	(0.175)	(0.180)	(0.198)	(2.083)	(4.571)	(137.827)	(56.383)
Observations	4,080	4,080	4,080	4,748	4,052	4,043	4,238	4,007	3,638	3,794
Kleibergen-Paap F	4.72	4.72	4.72	5.04	2.03	2.11	1.62	0.76	0.05	0.08

Notes: This table shows the IV regressions where the instrument is matched to the individual's end of middle school year. For mothers who have less than middle school education, we use their end of education year. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at mother's province by cohort level, and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B5: The Impact of Mother's Education on Child Outcomes–Urban Sample

	LBW	VLBW	Macrosomia	Gestage	Any sickness	Any hospitalization	Walk	Speak	Count	Independent toilet
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Medu	-0.057	-0.003	-0.059	0.194	-0.042	-0.021	0.481	-0.021	-0.540	0.793
	(0.040)	(0.006)	(0.056)	(0.117)	(0.065)	(0.078)	(0.897)	(1.892)	(1.972)	(2.515)
Kleibergen-Paap F	5.04	5.04	5.04	5.30	6.53	6.53	5.08	3.34	5.83	3.92
Observations	323	323	323	327	311	311	476	441	427	426
Sample Mean	0.046	0.003	0.050	9.410	0.688	0.630	13.229	19.510	26.665	30.580
Sample SD	0.211	0.056	0.217	0.634	0.464	0.484	3.424	6.974	10.905	11.745

Notes: This table presents the main results IV estimations for urban sample. Dependent variables are shown in the top row. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B6: Childcare Type

	Unemployed	Employed	Total
Child's paternal grandparents	9.72	20.45	15.53
Child's maternal grandparents	2.01	2.31	2.17
Child's father	2.39	5.33	3.98
Child's mother	82.15	64.95	72.84
Babysitter	0	0.07	0.04
Daycare	0.29	0.85	0.6
Other	3.44	6.04	4.84
Total	100	100	100

Notes: This table presents the percentage of each type of childcare in our sample.

Table B7: The Impact of Maternal Education on Childcare

	(1) Employed	(2) Unemployed
Medu	-0.050	-0.077*
	(0.034)	(0.039)
Kleibergen-Paap F	30.55	18.71
Observations	2,488	2,059
Sample Mean	0.654	0.817
Sample SD	0.476	0.386

Notes: This table presents the IV results of maternal education on whether mother is the main childcare provider. The dependent variable in a binary variable indicating mom as the main caregiver. Column (1) includes mothers with employment. Column (2) includes mothers without employment. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B8: The Impact of Maternal Education on Number of Children

	Number of Children (1)	Number of Children (2)
Medu	-0.137**	
	(0.060)	
College mom		-0.953**
		(0.438)
Kleibergen-Paap F	49.03	32.99
Observations	4,803	4,803
Sample Mean	0.713	0.266
Sample SD	0.453	0.442

Notes: This table presents IV estimates of the effect of maternal education on the number of children. All regressions control for maternal characteristics, including ethnicity and grandmother's education level, as well as provincial-level employment rate, GDP growth rate, and population growth rate. Additionally, the specifications include fixed effects for the mother's birth year, the mother's childhood province, the child's birth province by year, and province-specific trends. Robust standard errors are clustered at the mother's province by cohort level and shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.