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Hukou status and children's education in China*

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Abstract

Under China's household registration (hukou) system, children with rural hukou lack equal access to education in urban areas. This paper investigates the causal effect of hukou status on children's education by exploiting an exogenous change in hukou status induced by the hukou reform in 1998. Before the reform, children could only inherit their mother's hukou status. Post-1998, newborns and preschoolers gained the ability to inherit either their father's or mother's hukou status, creating a unique exogenous opportunity for children with urban fathers and rural mothers to obtain urban hukou. Using China's 2010 population census data, we employ a difference-in-differences strategy to examine the impact of hukou status on children's education. Our findings reveal that the younger cohorts exposed to the reform are 15.1 percentage points more likely to have urban hukou and 18.9 percentage points more likely to be at the appropriate grade level for their age. Moreover, the effect is more pronounced amongst girls and children from educated families or large cities.

Keywords: Hukou reform; grade-for-age; education equality; rural-urban disparity

JEL Classification: I24; I28; O15; R28

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1 Introduction

Since its establishment by the government in 1958, the household registration (hukou) system has categorically divided all Chinese citizens into agricultural (rural) and non-agricultural (urban) hukou (Song 2014; Pan 2017).¹ Hukou status determines an individual's access to government-provided public services and welfare programs, including public housing (Hui, Yu, and Ye 2014), social security (Huo and Lin 2022), and education (Zhang 2017). Particularly, children with rural hukou do not have equal rights to attend urban schools, which negatively impacts their human capital accumulation (Heckman 2005). The disparity in enrollment rates between rural and urban populations widens as the level of education increases, as illustrated in panel A of figure 1. Moreover, the gap in years of schooling between the urban and rural working-age population (aged 16-64) has not narrowed over time, as depicted in panel B of figure 1. These persistent urban-rural disparities in educational attainment underscore unequal access to education among urban and rural hukou holders. This paper investigates the impact of children's hukou status on their educational outcome by exploiting the hukou reform in 1998, which provides a natural experiment to identify the causality between hukou status and education.

(Insert Figure 1 here)

Since the 1950s, children were tied to their parent's birthplace. Newborns were granted the same hukou status as their mothers but not their fathers until the hukou reform in 1998 (Han, Li, and Zhao 2015). With China's economic reform in 1978, urban areas witnessed an

¹ The promulgation of the *Household Registration Regulations of the People's Republic of China* in 1958 marked the establishment of the dualistic rural-urban hukou system.

increasing demand for inexpensive labor, while rural residents sought opportunities in economically developed cities. To address the needs of economic development, population migration, and parents' desire for more control over their children's hukou status, the government issued a document on July 22, 1998, to reform the hukou system (Pan 2017). The new policy allowed parents to decide whether their children's hukou status would be inherited from their mother or father.² Specifically, children born after the reform could freely choose whether to inherit their father's or mother's hukou, and minors born before the reform could also apply to change their hukou status, with preschool-age children given priority by the government. Therefore, before the reform, preschool-age children with a rural mother and an urban father could only have rural hukou, whereas after the reform, they were given the option to have urban hukou. Access to an urban hukou may improve children's education by enhancing the quality of education, reducing the cost of education, and raising educational aspirations. This reform provides a unique opportunity to identify the causality between children's hukou status and educational outcomes in China.

Using China's 2010 population census data, we employ a difference-in-differences (DID) approach and find that the younger cohorts exposed to the reform are 15.1 percentage points more likely to have urban hukou and 18.9 percentage points more likely to be at the grade level appropriate for their age. Specifically, the reform increases children's probability of attending senior high school at the expected age by 26.2 percentage points. However, the reform shows no significant effect on educational attainment at the primary and junior high school levels.

² Several studies have investigated the impacts of the 1998 hukou reform. For example, Han et al. (2015) show that the change to the hukou inheritance law raises the rate of interprovincial marriages between local urban men and migrant women. Pan (2017) finds that directly granting urban hukou is associated with a reduction in the high school attendance of rural youth.

Additionally, girls benefit more from the reform than boys, and the educational impact is more pronounced among children from educated families or large cities.

This paper contributes to existing literature in three ways. Firstly, this study identifies the causal impact of hukou status on educational attainment by exploiting the 1998 hukou reform. Most existing studies overlook the endogeneity of hukou status (Wu 2010; Ye 2015; Huang, Xie, and Xu 2015). However, hukou identity can act as both a cause and a consequence of educational achievement, leading to potential issues of reverse causality.³ Furthermore, unobservable factors, such as parental willingness to pay for education, may affect both hukou status and educational achievement.⁴ To the best of our knowledge, Wu (2012) attempts to identify the causal impact of hukou on education. Nevertheless, the instrument, i.e., the mother's occupation when the child is aged 14, might be correlated with unobserved ability or preference.⁵

Secondly, instead of concentrating solely on the ultimate outcomes of education (Wu 2012), we introduce the *Grade-for-age (GFA)* variable to examine the comprehensive educational progress at various stages. Our study investigates the stage at which hukou transformation exerts a more critical role in promoting educational equity by exploring its effects on grade-for-age status at primary, junior high, and senior high schools, respectively.

³ Urban hukou facilitates individuals in attaining higher levels of education, and access to higher education serves as a means of converting from rural to urban hukou (Wu and Treiman 2004).

⁴ For example, some parents assist their children in acquiring an urban hukou by purchasing a house in the city. Families engaged in such practices typically possess more resources and are more willing to make other educational investments, such as extracurricular tutoring. Considering this, a child's hukou and education may be determined simultaneously.

⁵ Specifically, Wu (2012) uses endogenous switching regression models. The results show that if actual rural hukou holders were randomly assigned to urban hukou, they would have completed an average of 2.79 more years of schooling.

Thirdly, this study is the pioneering effort to evaluate the long-term effects of the hukou inheritance policy reform in 1998 from the perspective of educational equity. Unlike previous studies that primarily explored the immediate impact of this hukou reform on marital matches or short-term educational decisions (Han et al. 2015; Pan 2017), this study examines the long-term effects on the educational attainment of children from target families. Additionally, we investigate how the educational promotion effects of the reform evolve over time.

The remainder of this paper is organized as follows: Section 2 introduces the institutional background; Section 3 describes the data and key variables; Section 4 outlines the empirical strategy; Section 5 presents the main results and examines the validity of the DID strategy; Section 6 conducts various robustness checks, heterogeneous effect analysis, and discusses mechanisms; Section 7 concludes.

2 The reform of the hukou system in China

2.1 The hukou system and urban-rural education divide

Introduced during the 1950s, China's hukou system was created to regulate rural-to-urban migration. The overarching goal of the hukou system was to facilitate the industrialization process and support industry-oriented policies by ensuring sufficient food supply to urban areas and fostering the accumulation of capital.

Prior to the economic reform in 1978, the hukou system was rigorously enforced, severely restricting population mobility from rural to urban areas, and a change in hukou status was virtually impossible.⁶ Individuals with rural hukou were constrained to engage only in

⁶ For example, rural individuals could only obtain urban hukou by being employed by state-owned enterprises (SOEs), pursuing a college education, or joining the military. Subsequently, they were entitled to the advantages of accessing public services in urban areas (Song 2014).

agricultural production, and prohibited from working in urban areas, and hukou status was inherited from generation to generation. Children with rural hukou faced challenges in accessing quality educational resources in urban areas, contributing to the root cause of the urban-rural education gap.

After the economic reform, the influx of foreign capital and the development of labor-intensive industries generated a tremendous demand for low-skilled labor (Meng and Xue 2020). Subsequently, the hukou system was gradually relaxed to facilitate the migration of rural workers to cities. However, these workers retained their rural hukou and were considered as “guest workers,” lacking equal access to key public services, including education (Meng 2012).

With the socio-economic development, China has incrementally reformed its hukou system, working towards the unification of rural and urban hukou.⁷ However, even today, migrants and urban hukou holders experience unequal access to essential public services. Disparities persist in school and educational quality between rural and urban areas, contributing to the enduring rural-urban educational divide caused by the hukou system. Existing literature explores the following three channels behind such educational disparity.

Firstly, high-quality education in urban schools contributes to lower grade repetition and dropout rates. Since fiscal decentralization in the 1980s, local governments have been responsible for administering and financing basic education, resulting in substantial variation in educational expenditure across urban and rural areas (Hannum 2003). As shown in figure 2, although the ratio of rural to urban educational expenditure per student has risen dramatically since 2008, it remains significantly below 100%. The lower educational quality in rural schools

⁷ By 2012, this policy had been implemented in 12 out of 31 provinces in China, such as Hebei, Zhejiang, Jiangsu, and Guangdong.

has led to increased dropout rates or grade repetition (Brown and Park 2002). Access to urban public education means children are much less likely to fall behind once they have acquired urban hukou.

(Insert Figure 2 here)

Secondly, possessing an urban hukou can alleviate the financial burden of education for children. Although rural children may relocate to urban areas with their parents, the obstacle to accessing high-quality public schools persists due to the absence of local hukou. For example, in the Rural Urban Migration in China (RUMiC) survey conducted in 2008, 61.5% of migrant children reported extra school fees due to their non-local rural hukou. Over 20% of temporary migrant children incurred costs exceeding 2,000 CNY, constituting more than 11.82% of the average annual income. Additionally, 6% of temporary migrant children faced expenses exceeding 5,000 CNY, representing more than 29.54% of the average annual income (Zhang 2017).⁸ The hukou reform in 1998 facilitated the settlement of more rural women in urban areas (Han et al. 2015), allowing their children to share the same hukou status as their urban fathers, eliminating the need for extra schooling fees.

Thirdly, hukou conversion may influence an individual's education decisions by raising their educational aspirations. The financial returns to education for urban residents are higher compared to migrant workers with rural hukou. Thus, hukou status conversion can enhance young people's willingness to invest in education and stimulate their educational aspirations

⁸ The RUMiC is a large-scale survey on Chinese rural-urban migrants conducted by the Australian National University, Beijing Normal University, and the Institute for the Study of Labor (IZA). The data is publicly available at <http://idsc.iza.org/?page=27&id=58>. In 2008, migrant workers had an average annual income of around 16923.42 CNY or 2438.53 USD (with an average exchange rate of 6.94 CNY per 1 USD in 2008).

(Qu and Zhao 2017).⁹ Additionally, reforms in the hukou system offer extensive policy support for migrant children to access education in urban areas. The expectation of fair access to local senior high schools enhances the cognitive and non-cognitive outcomes of rural hukou students, contributing to the improvement of the educational attainment of the next generation (Guo and Zhao 2019).

2.2 The hukou reform in 1998

On July 22, 1998, the State Council approved the *Opinions on Solving Several Outstanding Problems in the Current Management of Hukou*. The primary objective was to revise the rules governing hukou inheritance for children. Prior to the reform, children could only inherit their mother's hukou, implying that regardless of their father's hukou status, they were entitled only to a rural hukou as long as their mothers held rural hukou, thereby restricting access to educational resources in urban areas. Since the reform, parents could decide whether their children's hukou status is inherited from their mother or their father, and it allows children born before the reform to change their hukou status. It is noteworthy that the reform does not alter the hukou policy for children over 18 years old.

Table 1 summarizes the specific regulations introduced by the hukou reform, varying for children born in different cohorts. Those born on or after July 22, 1998, had the option to voluntarily inherit their hukou status from either parent if they had not already registered. Even if they had initially registered under their mother's hukou status, they could apply for a transfer to their father's hukou status without any conditions. In contrast, children born before July 22,

⁹ There was a sharp rise in returns to education, increasing from about 4% in the early 1990s to nearly 11% in 2000, approximately reaching the level observed in western economies (Heckman 2003).

1998, who were yet to register, were required to register under their mother's hukou status. If they had already inherited their mother's hukou status, they could apply for a transfer to the father's hukou status, subject to certain age restrictions, with preschool children given priority. For example, the government of Guangdong province specified that applications to inherit the father's urban hukou would be approved in the following order of priority: preschool children, followed by minor children already in school. However, adult children were not allowed to transfer to their father's hukou status. As hukou status is linked to access to urban educational public goods, the reform primarily increased accessibility to urban quality educational resources for preschoolers in 1998 and those born after the reform.

(Insert Table 1 here)

The central government mandated the nationwide roll out of the new policy, specifying that all provinces should implement the new policy from July 22, 1998. Each province was required to formulate relevant policies, considering local economic and social development levels, as well as the financial capability and affordability of the local government.¹⁰ Importantly, no local government was permitted to add additional restrictions when implementing the policy. The dates of document publication and the first affected cohort at the provincial level are reported in table A1. Specifically, the implementation of the hukou reform is characterized by three key features. (1) Despite differences in the timing of policy announcements, all provincial governments, except Heilongjiang, Tianjin, and Shanghai, adopted July 22, 1998, as the effective date (refer to column 2 of table A1). As individuals' birth dates are reported in months, the effective dates for 22 provinces and Heilongjiang are

¹⁰ Province here includes province, autonomous region, and provincial-level municipality.

considered the same, i.e., July 1998. (2) Considering the high population pressure in megacities such as Beijing and Shanghai, these municipalities were allowed to implement the reforms later. Specifically, four municipalities directly under the central government did not enact the new regulation until July 2003. (3) Information on the effective dates of policy implementation in six provinces – Tibet, Xinjiang, Hainan, Yunnan, Jiangsu, and Qinghai – is missing.¹¹

3 Data and key variables

3.1 Data

Our primary dataset is derived from a 0.095 percent sample of the 2010 Chinese national population census. The information on the first marriage date of adults enables the identification of couples. To establish family relationships, we utilize the variable “relationship to the household head”, allowing us to match children with their parents and siblings appropriately.¹² This process results in a total of 406,213 successfully matched parent-child relationships. Subsequently, the entire sample is categorized into four distinct family types based on the hukou status of parents, as outlined in table A2.

Among these family types, children benefit from the reform if their fathers have urban hukou and mothers have rural hukou (type 1); those with mothers having urban hukou are not affected by the reform (type 2). Households with rural fathers and urban mothers (type 3) are less common due to the prevailing marital practice of “marrying up” in China. In our sample,

¹¹ As per the directives of the central government, the implementation of the reform was mandated across all provinces. The absence of the document on the webpage does not imply the absence of the reform in these provinces; rather, it indicates the unavailability of the exact date of the reform. As a robustness check, we include individuals from these six provinces in the regression and the results align with the findings from the baseline regression.

¹² We exclusively keep households where the head is either the father or mother. Otherwise, it is challenging to accurately determine the exact number of siblings.

only 1.16% of children have rural fathers and urban mothers. Additionally, children with rural fathers and rural mothers (type 4) are deemed an inappropriate control group as they are affected differently by various reforms. For example, the government implemented a series of educational reforms targeting rural students after 1998, including mergers and closures of rural schools and free compulsory education reform. Therefore, the treatment group comprises children with urban fathers and rural mothers (accounting for 2.48%), and the control group comprises children with urban parents (accounting for 26.33%), which yields an initial sample size of 117,009 children.

Regression sample. The regression sample must adhere to five specified conditions outlined in table A3. (1) Given the change in marital sorting pattern following the hukou reform in 1998 (Han et al. 2015), we retain samples with parents whose first marriage took place on or before 1998, resulting in 94,567 observations. (2) To ensure that children in the sample have reached primary school age by the survey conducted in November 2010, we set August 2004 as the lower limit for children's birth dates. (3) Individuals aged 7-17 years when the reform began are excluded due to unclear treatment status. Instead, we select individuals aged 18-30 years in August 1998 as the older cohort, as their hukou status is assumed to be unaffected by policy intervention, leaving 51,750 observations. (4) We drop the observations with missing key variables, including the child's age, gender, ethnicity, residence, number of siblings, parents' age and education, and government's public spending on education, resulting in 51,197 remaining observations. (5) Samples from municipalities and provinces with unclear policies, namely Beijing, Tianjin, Shanghai, Chongqing, Tibet, Xinjiang, Hainan, Yunnan, Jiangsu, and Qinghai, are deleted, leading to a final sample size of 41,034. Eventually, after

imposing these sample restrictions, the sample sizes for the treatment and control groups are 3,604 and 37,430, respectively.

3.2 Key variables

Educational outcome. As the first cohort fully exposed to the hukou reform was 12 years old when the census was conducted in 2010, we were unable to obtain information on the individuals' completed years of schooling. Additionally, the survey only inquired about an individual's highest level of education, while details regarding the child's precise grade were unavailable. Therefore, data limitations prevent us from measuring the extent of how far behind they are in their education. We can only determine whether they are entering an age-appropriate stage of education.

According to human capital theory, the opportunity cost of education is small in the early stages of the life cycle. Therefore, enrolling at the appropriate age during childhood is considered optimal. Furthermore, earlier enrollment provides individuals with a potentially longer time frame to realize financial gains in the labor market, leading to higher lifetime earnings (Becker 1993). In the United States, grade retention makes it more challenging for a child to achieve long-term success, and they are less likely to graduate from high school and enroll in college (Andrew 2014). In China, a one-year delay in primary school enrollment reduces the probability of high school enrollment by 6 percentage points for rural children (Chen 2015). As delayed enrollment is widespread in rural areas, grade-for-age status is an essential and important educational indicator in the Chinese context.

Grade-for-age serves as an important measure of educational achievement, and is widely used in the literature. Kearney and Levine (2019) use grade-for-age to measure “whether a

child is enrolled in school - or graduated high school for those aged over 18 - at a grade appropriate for his or her age". This educational outcome has also been used by Oreopoulos, Page, and Stevens (2006) and Silles (2017). In our study, we adopt a similar measure. Specifically, we use birth date and education level to determine whether children are in their expected grade, assuming they started school in the first eligible year and progressed normally (Qureshi and Gangopadhyaya 2021).¹³ For example, if 6-year-old children are in or have entered primary school, or 12-year-old teenagers are in or have entered junior high school, they are considered to have achieved the desired level of education, resulting in a grade-for-age value of 1. Otherwise, if they have not reached the expected grade, the value is 0, indicating delayed enrollment, grade retention, or dropout.¹⁴

Figure 3 illustrates that between 1968 and 1992, children in the treatment group were approximately 30 percentage points less likely than urban children to be in the anticipated grade.¹⁵ This gap demonstrates a convergence trend from 1992, with little difference for children born after 1998.¹⁶ As discussed in the previous section, children born in 1992

¹³ According to the *Compulsory Education Law* of China, children are mandated to enroll in primary school upon reaching the age of six. Hence, they are expected to be enrolled in junior high school at the age of 12 and senior high school at the age of 15.

¹⁴ The age is adjusted based on the school academic year. For example, children born between September 2003 and August 2004 are expected to enroll in primary school in September 2010 and are considered to be the same age.

¹⁵ The x-axis indicates an individual's birth year, while the y-axis indicates the mean grade-for-age value of all individuals born in that year.

¹⁶ There are two possible reasons why the grade-for-age of children from urban families born after 1992 has also been improved. First, as of the fall of 2008, students in urban areas were eligible for the free compulsory education reform. Individuals born after September 1993 (under age 15) in urban areas were affected by the reform. Second, the government set a limit on the number of repeaters nationwide in 1994. Thus, the grade-for-age of both urban and rural children has been improved due to the change in the retention regulations.

represent the first cohort affected by the hukou reform. Therefore, this figure provides direct evidence on the effect of hukou status on education.¹⁷

(Insert Figure 3 here)

Reform exposure. According to documents gathered from provincial governments, children born on or after July 22, 1998, had the opportunity to inherit their father's hukou without conditions, with a priority for hukou conversion given to preschool children. However, adults were not eligible to apply for hukou conversion. Therefore, children born in or after August 1998, with a rural hukou mother and an urban hukou father, are considered fully exposed to this reform. Those born between September 1991 and July 1998 are categorized as partially exposed, while those born in or before August 1980 are classified as non-exposed. We define individuals born between September 1991 and August 2004 as the *Younger Cohort* and those born between September 1967 and August 1980 as the *Older Cohort*. Additionally, the reform would not affect children whose parents both had urban hukou, and we regard these children as the control group.

Other control variables. The census data also collect other individual-level demographic information such as gender, ethnicity, date of birth, and education level. Table 2 reports summary statistics for the treatment and control group samples. First, children in the treatment group are 18.4 percentage points less likely to be in the anticipated grade than their urban

¹⁷ Similarly, we calculate the difference in the probability of grade-for-age between treated children and children whose parents both with rural hukou. However, the educational gap between these two groups does not satisfy the parallel trend before the reform. Since 2000, the government has developed a series of education policies for rural areas, such as the “Two Exemption and One Subsidy” reform, which waives the cost of tuition and textbooks and subsidizes the living expenses of students living in school dormitories, was initially introduced in 2003 for students from extremely poor families. In the spring of 2005, the reform was extended to all primary and secondary school students in poor counties nationwide (Tang, Zhao and Zhao 2020). In contrast, the educational policies applicable to children from urban households have changed less. Therefore, children from rural families are not a good control group.

counterparts, with a mean of 0.479 and 0.663 for the two groups, respectively. The mean difference of grade-for-age between groups for the older cohort is 0.256, and this value decreases to 0.070 for the younger cohort exposed to the reform (see panel A of table 2). Second, in the treatment group, the mean values of the older cohort and younger cohort with urban hukou are 0.277 and 0.392, respectively, suggesting the reform does provide more opportunities for the younger cohort to obtain urban hukou (see panel B of table 2). Third, we can observe that compared with urban children, those from the treatment group are older, comprise a higher percentage of males, and a lower proportion living in the urban area (see panel C of table 2).¹⁸ Fourth, the treated children have more siblings, and their parents are generally older and less educated (see panel D of table 2).¹⁹

Although China has basically achieved its goal of universal compulsory education by 2000, the urban-rural educational gap has remained substantial. To address the urban-rural educational disparity, the government has adopted preferential educational policies toward students in rural areas since 2000. Specifically, the government has introduced a series of education policies targeting rural and poor areas, such as mergers and closures of rural schools, two exemption and one subsidy, and free compulsory education (Hannum, Liu, and Wang 2022; Tang et al. 2020; Xiao, Li, and Zhao 2017). The rising public education spending per student in rural areas at the province level after 2000 may improve the educational outcomes of rural

¹⁸ We construct individuals' residence types based on their residence in the 2010 Chinese Population Census. Individuals were required to report their residence type at the time of the survey in 2010. The binary variable *residence* takes the value of 1 if the individual resides in a neighborhood committee and 0 if he/she resides in a village committee.

¹⁹ We also compared the pre-reform differences between children in the treatment group and children in the other two types of families, shown in table A4. Compared to children in the treatment group, children with rural fathers and rural mothers are less likely to be in the right GFA, have a higher probability of holding rural hukou or living in rural areas, and have more siblings; in contrast, children with rural fathers and urban mothers are more likely to be in the right GFA and have a higher probability of holding urban hukou or living in urban areas.

children more than that of urban students. Therefore, we control the government's public spending on education, i.e., *per student education expenditure* (see panel E of table 2).²⁰

(Insert Table 2 here)

4 Empirical strategies

4.1 Difference-in-differences model

In this study, we apply a difference-in-differences (DID) strategy to investigate the causal effect of access to urban hukou on educational attainment. The specific DID model takes the following form:

$$EDU_{ijpym} = \alpha_0 + \alpha_1 Young_i * Treat_j + \alpha_2 Young_i + \alpha_3 Treat_j + X_{ijpym}\zeta + \lambda_m + \mu_{pym} + \varepsilon_{ijpym} \quad (1)$$

whereby i, j, p, y , and m denote individual, family type, province, birth year, and birth month, respectively. EDU_{ijpym} indicates the grade-for-age status of individual i from family type j born in province p in year y in month m . $Young_i$ is a dummy variable indicating whether the child belongs to the younger cohort. $Treat_j$ is a dummy variable indicating a child's household type, which is determined by the hukou status of parents. $Treat_j = 1$ indicates the treatment group in which the child's father holds an urban hukou and the mother holds a rural hukou; $Treat_j = 0$ indicates the control group in which a child has parents who both hold urban hukou. X_{ijpym} is a vector of covariates, which include individual and family

²⁰ The data sources are the *Educational Statistics Yearbook of China* and the *China Educational Finance Statistical Yearbook*. First, we calculate the average government expenditure on education per student in urban and rural areas, respectively. Second, we match government expenditure on education when the individual was in grades 1-9, according to individuals' hukou status, i.e., individuals with urban hukou receive urban per student education spending, and individuals with rural hukou receive rural per student education spending. Finally, the average value of government education expenditure during nine years of compulsory education is calculated for each individual.

background characteristics (the child’s gender, ethnicity, residence, number of siblings, and the parents’ age and education) and contemporaneous government’s public spending on education.²¹ α_1 is the parameter of interest and captures the causal effect of hukou on education. Our primary measure of interest is exposure to the hukou reform, not the actual transmission of the hukou status. In this sense, our approach identifies an effect of intention-to-treat (ITT) and not an effect of treatment-on-the-treated (TOT).

Even if children are born in the same year, whether or not they meet the school-age requirement is related to their birth month. Children born between September and December cannot enter primary school in the year of their sixth birthday (Tang et al. 2020). Therefore, we include λ_m as children’s birth month fixed effects to capture the systematic difference between those born earlier and those born later in the same birth cohort. In addition, province-birth cohort-birth month fixed effects μ_{pym} are included to allow different provinces to have different cohort trends as well as different birth month trends in the same birth year.²² Since provincial governments were responsible for formulating and enacting the hukou reform, and the timing of enacting documents varied across provinces, standard errors are adjusted for clustering at the province-year level (Bertrand, Duflo, and Mullainathan 2004).²³

²¹ Both the father’s and mother’s years of schooling are included in the model as continuous variables.

²² Note that month is a dummy variable indicating whether the individual’s birth month is in September or later; in such cases, its value is set to 1, because children born before September 1st are eligible to enter primary school in the year of their sixth birthday.

²³ We also report the p -values for clustering at the province level in the baseline regression. To avoid the asymptotic inconsistency generated by using a small number of clusters, standard errors are corrected for a small number of clusters via wild bootstrapping with 500 replications (Cameron, Gelbach, and Miller 2008). The wild-bootstrap p -values are reported in square brackets in table 4.

4.2 Event study

The key to the validity of the DID identification strategy is that the treatment and control groups meet the parallel trend assumption, i.e., individuals in the two groups would have the same cohort trends in the educational outcomes if the reform were not present. In addition, the baseline model estimates the aggregate effect of the reform on children's education, which does not reflect the variability of the policy effects across birth cohorts. Therefore, we exploit an event study approach to test the parallel trend hypothesis and the dynamic effects of the policy (Duflo 2001). The following equation gives the generalization of the baseline model:

$$EDU_{ijpym} = \beta_0 + \sum_{l=1967}^{2004} (d_{il} * Young_i * Treat_j) \beta_{1,l} + \beta_2 Young_i + \beta_3 Treat_j + X_{ijpym} \gamma + \lambda_m + \mu_{pym} + \varepsilon_{ijpym} \quad (2)$$

whereby d_{il} is a dummy that indicates whether individual i is born in year l . $\beta_{1,l}$ is an estimate of the impact of the reform on a given cohort l . The definitions of remaining variables are the same as equation (1). We apply individuals born between 1967-2004 to conduct the event study analysis. To this end, we generate a series of dummies based on two-year intervals of birth year.²⁴ The reference group is the cohorts aged 18-19 when the reform was implemented (i.e., born in 1979-1980), who are completely ineligible for the reform.

In addition, concurrent educational reforms may have differential impacts on the educational outcomes of individuals in different birth cohorts, for example, the Compulsory Education Law (CEL) and China's Higher Education Expansion (CHEE). Both of these educational reforms were implemented at the province level. The effective date of the CELs

²⁴ Due to the limited number of observations for each birth year, we aggregate birth cohorts into two-year intervals to increase the power of the estimation (Kearney and Levine 2019).

varies across provinces, from 1984 to 1994 (Cui, Liu, and Zhao 2019). Although the CHEE started in 1999, the expansion rate varies across provinces (Liu and Wan 2019; Wang et al. 2022). However, the province-birth cohort-birth month fixed effects μ_{pym} could absorb the effects of these educational reforms.

Another concern about the DID strategy is that other educational policies or socioeconomic environmental changes that occur during the same period may influence educational decisions or educational outcomes. Such events include the one child policy from 1979, the closures and mergers of rural schools which was started in 2001, the free compulsory education reform in rural China that was started in 2006, and the Four Thousand Billion Stimulus Plan from 2008-2009 in response to the financial crisis. Section 6.1 details the robustness checks used to address these concerns.

5 Results

5.1 Baseline results

Before presenting our formal results from estimating equation (1), we first present the impact of the reform on the hukou status of children in the treatment group. Figure 4 depicts the estimates of timing dummies with a 95% confidence interval in the regression of children's hukou status (urban=1) on time dummy variables (28 years pre-reform and 12 years post-reform), personal and family background characteristics, and province dummies.²⁵ The reference group comprises the cohorts born 30 years before 1998. The estimated coefficients (0.223) are significantly different from zero, starting with the 6-year-old cohort in 1998,

²⁵ On the x-axis, positive numbers indicate the age in 1998, while negative numbers denote the number of years after the reform that the person was born.

followed by a significant jump for those born two years after 1998. Therefore, newborns and preschoolers at the time of the reform were more likely to be policy compliers and generally inherited urban hukou from their fathers.

(Insert Figure 4 here)

Then, we investigate how the reform affects the hukou status using a similar framework as equation (1), and using hukou status (urban=1) as the dependent variable. Results are reported in table 3. In column 1, we only control for individual characteristics of the child, including gender, ethnicity and residence. In column 2, we add family background characteristics such as the number of siblings, age of parents, and educational level of parents. In column 3, we further control the *per student education expenditure*. The birth month and province-birth cohort-birth month fixed effects are included in all regressions. The reform resulted in a 15.1 percentage point higher probability of obtaining an urban hukou for the younger cohort relative to the older cohort in the treatment group than in the control group.

(Insert Table 3 here)

Table 4 reports the baseline results of the DID estimation. The coefficient on *Young* $\times$ *Treat* can be interpreted as the causal effect of exposure to the reform on children's grade-for-age status. Column 3 demonstrates that children exposed to the reform are 18.9 percentage points more likely to be at the grade level appropriate for their age.²⁶ To interpret the magnitude of the coefficient, we need to be aware that 39.2 percent of the younger cohort in

²⁶ As the treatment status is defined based on the hukou types of parents in 2010, the treatment group may include individuals whose fathers obtained an urban hukou in and after 1998, and their children may already be attending school in rural areas. Hence, the baseline results serve as a lower bound on the true treatment effect. The estimation results, taking into account the potential effect of parental migration or hukou conversion, are discussed in section 6.1.5.

the treatment group obtained an urban hukou and 74.4 percent of them achieved the anticipated grade. Therefore, the conversion of hukou type from 0 to 1 would increase the grade-for-age status by 48.2 percentage points ($0.189 / 0.392 = 0.482$), which reflects a 64.8 percent ($0.482 / 0.744 = 0.648$) improvement in the probability of age-appropriate enrollment.²⁷

Note that the treatment and control groups are defined based on parents' hukou status in 2010 rather than the hukou status when the reform was implemented. If a rural woman who married an urban man obtained an urban hukou in cities, her children would be considered as the control group. In this case, our estimates can be regarded as the lower bound of the effect of hukou reform on children's grade-for-age. However, migration for marriage is not very common in China. For instance, the 2010 Chinese Population Census indicates that only 4.42% of rural women left their place of household registration for marriage. Moreover, the 2010 Chinese General Social Survey (CGSS) suggests that only 2.29% of rural females obtained an urban hukou by marriage in adulthood. Similarly, the China Health and Retirement Longitudinal Study (CHARLS) in 2014 shows that approximately 1.6% of rural women obtained an urban hukou following their spouses' hukou type. Therefore, the estimation bias due to changes in the mother's hukou status tends to be small in our study.

(Insert Table 4 here)

To explore the educational stage in which the hukou plays the most significant role, we construct three dummy variables indicating whether individuals enter or have entered primary, junior, and senior high school at the expected age. Results are shown in columns 4-6 of table

²⁷ We follow Kearney and Levine (2019) in constructing this measure.

4.²⁸ It is noteworthy that the impact of the reform on the educational outcome is most significant in senior high school, where grade-for-age status is estimated to increase by 26.2 percentage points. In contrast, the reform has a much smaller impact on the junior high school level with a value of just 1.6 percentage points. The estimated coefficients are not statistically significant at the primary and junior high school levels. Since 1986, the universalization of compulsory education in China has alleviated the disparity of educational opportunities at the primary and junior high school levels. However, most high-quality senior high schools are located in urban areas, and many rural children must move to urban areas to pursue post-compulsory education. Therefore, it is reasonable that the reform of the hukou system has mainly promoted educational equity at the high school level.²⁹

If it holds that obtaining an urban hukou improves educational outcomes, we can expect the positive impact of the reform on education to be greater in regions with significant urban-rural educational disparities. To explore the effects of the reform in areas with different urban-rural education gaps, we calculate the ratio of years of schooling for urban and rural adults over 25 years old, this age group is expected to have completed their education, at the prefecture level. Further, we define prefectures equal to and above the median as having a *Large* gap and those below the median as having a *Small* gap. As shown in columns 1 and 2 of table 5, the reform increases the probability of a child being grade-for-age by 20.2 and 16.0 percentage points in prefectures with large and small education gaps, respectively. In particular, the effect that achieving hukou status conversion has on junior high school enrollment is only significant

²⁸ The expected ages of entry into primary, junior high, and senior high school are 6, 12, and 15 years old, respectively.

²⁹ We also combine matching and DID methods to investigate the effect (Heckman, Ichimura, and Todd 1997). As shown in table A5, the matched DID estimates are similar to the main estimation results.

in the group with a sizeable urban-rural gap (see column 5 of table 5). It is reasonable that the more significant the education gap between urban and rural areas within the same prefecture, the higher the added value of education within the local urban hukou.

(Insert Table 5 here)

5.2 Validity of DID strategy and dynamic effect

5.2.1 *Parallel cohort trends and dynamic effect*

The key hypothesis of the identification strategy is that the educational outcomes of the two groups of children would have met parallel trends if there had been no hukou reform. Figure 5 shows no significant trend before the event except a drop in 1984, which provides supporting evidence for the parallel-trend assumption.³⁰ Figure 5 also illustrates a dynamic effect of the hukou reform, i.e., the later the child is born, the greater the policy exposure and so the more prominent the improvements in education. For one thing, the rate of grade-for-age shows a significant increase in 1992, and an upward trend over time, because children born in 1992-1997 are partially exposed, and the later the birth, the higher the probability of obtaining an urban hukou. For another, the significant increase in the estimates after 1998 suggests a more remarkable educational improvement for those birth cohorts fully exposed to the hukou reform.

(Insert Figure 5 here)

³⁰ We lack a robust explanation for the drop in 1984, leaving it as an open question for future investigation.

5.2.2 Placebo tests

In order to ascertain that progress in educational outcomes for treated children is indeed due to the hukou reform rather than other structural changes, we perform two placebo tests.

Firstly, we assume that the hukou reform was implemented 8-13 years earlier than the actual reform year.³¹ Based on the pseudo-policy timing, we construct a fake birth cohort exposed to the policy. For example, when we assume that the reform occurred in 1990, those exposed to the policy were born from September 1983 to August 1996 (*Placebo Young* = 1), and the corresponding nonexposed cohorts were born from September 1959 to August 1972 (*Placebo Young* = 0). We then re-estimate the DID model based on the interaction of *Placebo Young* and *Treat* as in equation (1), and all other model specifications remain unchanged. Figure 6 demonstrates that the estimated coefficients of all interaction terms are not statistically different from 0.

(Insert Figure 6 here)

Secondly, the placebo treatment group is defined as children from the same cohorts whose fathers have rural hukou and mothers have urban hukou. When the father has rural hukou, irrespective of whether the 1998 hukou reform grants the child the freedom to settle in the father's place of hukou registration, the parents generally have no desire for their children to obtain rural hukou. In short, the reform does not have an exogenous shock on the hukou status of children with rural fathers. Therefore, we construct the "*Placebo treat*" dummy using children with rural fathers and urban mothers as the treated samples and re-estimate equation

³¹ We shift the implementation year backward by 8 years as delayed enrollment is quite common in rural China. For instance, children who were already 7 years old when the reform started may not have entered primary school, making them preschool-age children still affected by the reform.

(1). Figure 7 shows the estimation results are almost distributed on both sides of the line at 0, as consistent with our expectations.

(Insert Figure 7 here)

6 Robustness checks, heterogenous effects, and mechanisms

6.1 Controlling for confounding factors

To eliminate the possibility of competing explanations from other confounding factors and shocks, we re-estimate the effect of the hukou reform, taking into account other contemporaneous policies and socioeconomic factors.

6.1.1 *One child policy*

Since the 1980s, the one child policy has been strictly enforced, especially in urban China. For example, the penalty rate increased rapidly from 0.8% to 3.0% of annual household income on average between 1989 and 1992 (Huang, Lei, and Sun 2021). As suggested by the quantity-quality trade-off theory, the one child policy may improve the educational attainment of individuals, and exposure to stricter fertility restrictions is associated with higher education levels (Qin, Zhuang, and Yang 2017; Huang et al. 2021). If the enforcement coincides with the timing of the hukou reform, the omission of the one child policy may bias our results. As the enforcement of the one child policy varies across counties and years, we additionally control for county-birth cohort fixed effects to capture the impacts of the family planning policy. As shown in panel A of table 6, after controlling for county-birth cohort fixed effects, the coefficients of interest are similar to the baseline results.

6.1.2 Mergers and closures of rural schools

Due to the decline in rural school-age children, the State Council issued the *Decisions on the Reform and Development of Primary Education* in 2001 to adjust the layout of schools in rural areas. From 2000 to 2010, the number of rural primary schools saw a 59.38% decrease from 416,198 to 169,045; the number of regular junior high schools decreased from 35,023 to 15,112, a reduction of 56.85%, which led to an increase in dropout rates (Educational Statistics Yearbook of China 2001, 2011). As the school closure process almost coincided with the hukou reform in 1998, the validity of identification could be challenged. We use the change in the number of schools per student from 2000 to 2010 to measure the intensity of primary and junior high school closures, and include the interactions between the intensity of school closure at the prefecture level and birth cohort dummies in the model.³² After controlling for the accessibility of schools, the results reported in panel B of table 6 are consistent with the baseline.

6.1.3 Free compulsory education reform

In order to promote educational equity, the Chinese government began to implement Free Compulsory Education (FCE) reform in rural areas in 2006. The policy specified that tuition and miscellaneous fees for primary and secondary school students should be exempted. The reform was to be implemented in western rural areas in 2006, central and eastern rural areas in

³² The number of primary and junior high schools, as well as the number of students at the city level in 2000 and 2010 are obtained from the *China City Statistical Yearbook* in 2001 and 2011. As a robustness check, we calculate the proportion of school reductions from 2000 to 2010 to measure the policy intensity, and results remain unchanged after controlling for the school reduction.

2007, and urban areas in 2008 (Xiao et al. 2017).³³ Individuals born after September 1991 were the main beneficiaries of the 1998 hukou reform. They were under 15 years old in 2006, attending primary or junior high school, and were exposed to the FCE reform. Therefore, the previous estimation results may be confounded by the effect of the FCE reform. To allay this concern, we control the number of semesters that an individual is supposed to be exposed to the FCE reform and its interaction term with place of residence. Our baseline results are robust to considering the school subsidy program, as shown in panel C of table 6.

6.1.4 Four Thousand Billion Stimulus Plan

After the global financial crisis in 2008, the Chinese government launched the Four Thousand Billion Stimulus Plan in November of that year to boost economic growth and maintain stable employment. The funds were mainly spent on housing, transportation, and rural infrastructure construction, which provided many jobs for migrant workers in related industries. Education is a rational decision considering budget constraint, costs, expected benefits, and the perceived probabilities of successful outcomes. The stimulus package increases the opportunity cost of education for children and thus may increase the dropout rate in rural areas, relaxes the household budget constraints, and may improve the probability of enrollment. To control for the impact of socioeconomic factors on individual education decisions, we exclude individuals

³³ The specific timing of introducing the FCE reform in each province is as follows. In rural areas, Tianjin, Inner Mongolia, Shanghai, Fujian, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang began implementation in March 2006; Beijing, Jiangsu, Zhejiang, and Guangdong in September 2006; Hebei, Shanxi, Liaoning, Jilin, Heilongjiang, Anhui, Jiangxi, Shandong, Henan, Hubei, and Hunan in March 2007. Urban areas in all provinces began implementation in September 2008.

in the treatment group who were aged 16 years or above in 2008 and re-estimate equation (1).³⁴

The regression results based on the subsample suggest that the effect of the hukou reform is not confounded by the economic crisis in 2008 (see panel D of table 6).

(Insert table 6 here)

6.1.5 Other county-birth cohort specific reforms

China has undergone a series of reforms since 2000, including its accession to the WTO in 2001, the initiation of a hukou reform in 2001, and the enactment of the Rural Land Contracting Law in 2003. It is important to note that individuals of the same birth cohort in the same county are exposed to the same reform intensity, such as migration opportunity, and share the same probability of obtaining urban hukou. These reforms are likely to influence the migration status and hukou types of parents as well as the educational outcomes of children, potentially leading to a biased estimate of the hukou reform. To address this concern, we restrict the treatment group to children with non-migrant parents and include the county-father's birth cohort fixed effects, which help control for region-birth cohort specific shocks.³⁵ As shown in panel E of table 6, our main results are robust to the inclusion of region-birth cohort specific reforms. Moreover, as expected, the magnitude of the estimates is larger than that in the baseline results.

³⁴ We use 16 as a cut-off age since according to the law, state organs, social bodies, enterprises, institutions, non-governmental not-for-profit organizations, and private businesses are prohibited from employing children under 16 years of age (Tang et al. 2020).

³⁵ A non-migrant parent is defined as an individual whose place of birth, hukou registration, and current residence coincide in the 2010 population census, and who has not departed from their hukou registration location.

6.2 Other robustness checks

This subsection carries out five robustness tests. Firstly, we adjust the age of entry into the primary school to 7 years old because the delayed entry may underestimate the probability of grade-for-age status (Cui et al. 2019). The results in panel A of table 7 show that the magnitude and significance of the coefficients are generally consistent with the main results, suggesting that an age-specific setting does not drive our findings.

Secondly, individuals who benefit from the hukou reform may have spillover effects on their siblings. Therefore, we create a new variable, *Siblings' exposure*, i.e., the total number of siblings who are supposed to be exposed to the reform, and then control it in the regression. After considering the spillover effect, our key results remain robust, as shown in panel B of table 7.

Thirdly, China's hukou system has been gradually deregulated since the 1980s, meaning that migrant workers could bring their children to urban areas and enroll them in local schools (Zhang 2017). To exclude this interference of migration, we remove individuals that leave their original place of hukou registration; our findings do not change after re-estimation (see panel C of table 7).

Fourthly, we change the range of the older cohort from 18-30 to 7-17 years old. As panel D of table 7 shows, the reform's effects reduce at junior and senior high school levels because a proportion of the older cohort also achieves a hukou conversion. However, the findings are broadly consistent with the baseline regression.

Finally, the reform policies in some large cities were implemented late, and some local governments refused to address the issue of urban hukou for those who violated the one child

policy. Therefore, we remove samples from 15 sub-provincial cities and individuals with siblings. The coefficient estimation results are consistent with the baseline regression after making stricter restrictions on the sample (see panel E of table 7).

(Insert Table 7 here)

6.3 Heterogeneous effects

This section explores the heterogeneous effects of the 1998 hukou reform on children's educational outcomes. Specifically, we analyze from three perspectives: gender of children, parental education level, and city type.

6.3.1 Gender of children

There is a strong son preference in rural China and resource allocation within a family is often biased in favor of boys. Moreover, girls' education is more sensitive to direct costs, opportunity costs, and household economic constraints (Hannum 2003). After obtaining an urban hukou, rural children do not need to pay extra fees to attend urban schools, thus reducing education costs. As a consequence, there may be gender differences in term of hukou reform on promoting educational equity. The results of separate regressions using subsamples of boys and girls are listed in panel A of table 8. The effect on educational outcome is particularly pronounced amongst girls, with an 80.9 percent reduction in the probability of falling behind in school, compared with the 57.4 percent for boys.³⁶ In addition, girls are 9.5 percentage points higher than boys in terms of senior high school education attainment. These results suggest that the hukou reform can help reduce the gender gap in education.

³⁶ The economic implication of the coefficients is calculated in the same way as in the baseline regression, except that the mean of the *grade-for-age* and *hukou* variables are grouped by gender when they are counted.

6.3.2 Parental education level

Parents with higher levels of education have a stronger financial capacity and are more efficient at investing in their child's human capital because they have the knowledge to transfer education to their children (Becker et al. 2018). Furthermore, knowledgeable adults have higher educational expectations of their children (Spagat 2006). Therefore, the effect of the hukou reform may differ depending on parents' cultural capital. A family is defined as *Educated* if either parent has attended senior high school or above, and *Less-educated* otherwise. As shown in panel B of table 8, the reform increases the grade-for-age status by 32 percentage points for children with educated parents; however, the figure is only 6.5 percentage points amongst children of whom neither parent have a high school education. The hukou reform effect is complementary to the parental effect, which means educated parents can better seize the educational opportunities that the reform brings to their children.

6.3.3 City type

Inequality in educational opportunities in China exists between urban and rural areas; differences also exist between cities of different hierarchies because large cities are better funded and have more qualified teachers (Tani, Xu, and Zhu 2021).³⁷ Since there are significant differences in educational opportunities and quality between different city types, we conjecture that the reform's effect is heterogeneous across cities. We define the dummy variable *Capital* that distinguishes provincial capitals from smaller cities and towns. As shown in panel C of table 8, children in capital cities show a 5.3 percentage points higher improvement

³⁷ Migrant students who move to larger cities have 10 percentage points higher cognitive gains than their peers who move to smaller cities.

level in grade-for-age status than their counterparts in smaller cities. The increase in the likelihood of being at the suitable grade level is 70.1 and 56.8 percentage points for children in capital cities and non-capital cities, respectively.³⁸ In short, obtaining an urban hukou can improve educational outcomes in either large or small cities, with larger impacts for an urban hukou in capital cities.

(Insert table 8 here)

6.4 Mechanisms

As noted in Section 2.1, holding the urban hukou typically implies a better quality of education, lower cost of education, and higher educational expectations. We estimate the impacts of the hukou reform on three channel variables in a DID framework:

$$Y_{ijpyw} = \gamma_0 + \gamma_1 Young_i * Treat_j + \gamma_2 Young_i + \gamma_3 Treat_j + X_{ijpyw}\zeta + \delta_p + \eta_y + \tau_w + \varepsilon_{ijpyw} \quad (3)$$

whereby i, j, p, y , and w denote individual, family type, province, birth year, and survey wave, respectively. Y_{ijpyw} indicates potential channel variables, including quality of education, cost of education and educational aspirations. The definition of $Young_i$ and $Treat_j$ are the same as those used in equation (1). X_{ijpyw} refers to the individual's gender, ethnicity, and the parents' age and years of schooling. δ_p , η_y , and τ_w denote a full set of the province, birth year, and the survey wave fixed effects, respectively.

Due to the lack of detailed education information in the census data, we apply data from the China Family Panel Studies (CFPS) and the Chinese General Social Survey (CGSS) to

³⁸ The economic implication of the coefficients is calculated in the same way as in the baseline regression, except that the mean of the *grade-for-age* and *hukou* variables are grouped by city type when they are counted.

investigate the potential channels through which hukou status affects children's education. Both CFPS and CGSS are nationally representative. Furthermore, we cannot solely rely on a single dataset for mechanism variables such as education quality and expenditures for two reasons. First, the CFPS only gathers information on the quality of education and educational expenditures for students enrolled in school at the time of the survey, i.e., the young cohort. Second, the CGSS collects information on the quality of education and educational expenditures for all household respondents, the vast majority of whom are 18 years of age and older. Consequently, we need to combine the older cohort (aged 30-43 years in 2010) derived from the CGSS and the younger cohort (aged 6-19 years in 2010) derived from the CFPS.³⁹

6.4.1 Quality of education

First, urban children have increased access to better schools in cities and thus have better educational outcomes. Given that the 9-year compulsory education is primarily financed by the local government in China, the quality of education depends on the fiscal capacity of the local government.⁴⁰ Hence, we apply the "school location" as a proxy for the quality of education. The *school location* equals 1 for cities and 0 for counties and villages. We pool the younger cohort from the CFPS 2010-2020, which investigates the location of schools for students under age 16, and the old cohorts from the 2003 and 2008 waves of the CGSS, which contain the detailed retrospective educational history of respondents (e.g., the location of schools at each

³⁹ Before examining the mechanisms, we first test whether the samples from the two surveys are nationally representative. For this purpose, we compare the demographic characteristics of samples from the two surveys with those of the samples from Census 2010 data. The results in table A6 demonstrate that the demographic characteristics, hukou status, and educational attainment of samples from CFPS 2010 and CGSS 2010 are comparable to those of the Census 2010.

⁴⁰ In urban areas, primary schools are administered and funded by the district government, and secondary schools are administered and funded by the city governments. In rural areas, public investment in compulsory education is primarily the responsibility of county governments.

stage of education), and estimate equation (3). The result in column 1 of table 9 indicates that the hukou reform significantly increased the probability of enrolling in urban schools for the younger cohort in the treatment group by 20.8 percentage points. The hukou reform increases access to better schools.

6.4.2 Cost of education

Second, urban hukou allows students to attend local urban schools without paying sponsorship fees and thus reduces education costs, which tends to decrease school dropout. To investigate this channel, we use the “extra-paid educational expenses” to measure the cost of education. We pool the younger cohort from the CFPS 2010-2020 and the old cohorts from the CGSS 2003.⁴¹ Since the dependent variable has many zeros (only 7.27% of the sample had ever paid sponsorship fees to enroll in a school), we apply a Tobit model here. As shown in column 2 of table 9, the reform reduces the extra educational expenses for the younger cohort in the treatment group by 3,587 CNY, although not statistically significant. Furthermore, we use a decomposition method developed by McDonald and Moffitt (1980) and decompose the Tobit coefficient into two parts: (1) the effect of the hukou reform on the amount of sponsorship fees for those who paid sponsorship fees (intensive margin); and (2) the effect of the hukou reform on the probability of paying positive sponsorship fees (extensive margin). In our study,

⁴¹ The CGSS contains the information on *extra-paid educational expenses* at each educational stage only in 2003.

84.77% is attributable to the extensive margin, i.e., the waiver of sponsorship fees, and only 15.33% is attributable to the reduction in educational costs.⁴²

6.4.3 Educational aspirations

Third, since the returns to education are higher in urban than rural areas and individuals in urban areas have more information on returns to education, the hukou reform can promote educational attainment by raising educational aspirations. We measure educational aspiration by whether the highest educational attainment a student wants to achieve is a three-year college and above. The *educational aspiration* takes the value of 1 if an individual desires college or above and 0 otherwise. Both the younger and older cohorts are from the CFPS 2010-2020, as the survey has detailed records of educational aspirations for all age groups of respondents. The estimate in column 3 of table 9 demonstrates that the hukou reforms raised the probability that an individual expects to obtain college and above education by 13.4 percentage points.

Overall, the empirical evidence supports for these three mechanisms. Specifically, the hukou reform has led to a significantly higher probability of attending urban schools and a significantly higher educational aspiration for the younger cohort in the treatment group. Moreover, the hukou reform has reduced sponsorship fees for the treated cohorts, although the effect is not precisely estimated.

(Insert Table 9 here)

⁴² In our study, 7.27% of the observations paid non-zero sponsorship fees on choosing schools, i.e., the fraction of the sample above zero $F(z)=0.0727$. Thus, the fraction of mean total response resulting from marginal changes in the value of (positive) expenditures $1-zf(z)/F(z)-f(z)^2/F(z)^2 = 0.1533$, whereas 0.8467 would be generated by changes in the probability of spending anything at all.

7 Conclusion

This study identifies and estimates the causal link between hukou status and educational attainment using the change in the hukou inheritance law in 1998, which allows children with urban fathers and rural mothers to change from rural to urban hukou. The findings indicate that the reform increases the probability of children's grade-for-age status throughout their educational career, especially at the senior high school level, which implies a decrease in discontinuation of schooling after the primary or junior high school level. Furthermore, we explore three possible mechanisms and find that educational quality and educational aspirations play a crucial role in improving educational attainment.

In addition, we observe heterogeneity in the policy effects of hukou reform on promoting educational equity. First, urban hukou facilitates educational attainment for girls more than boys, thus making hukou reform beneficial in reducing the gender gap in education. Second, children with educated parents benefit more from the reform, reflecting the lack of intergenerational mobility in education and the trend toward class solidification. Third, the educational value-added of urban hukou in capital cities is larger than that in small cities, providing a new perspective on educational inequality in China.

Our findings provide important policy implications for promoting rural-urban educational equity and enhancing human capital accumulation in China. First and foremost, it is essential to remove the link between children's access to education and their hukou identities and increase government funding for education in rural areas, aiming to eliminate the pre-market discrimination caused by the hukou system (Song 2014). Secondly, children from disadvantaged families encounter substantial selection barriers, highlighting the importance of

policymakers providing them with more information and educational assistance (Mare 1980). Otherwise, the reform might disproportionately benefit those with higher socioeconomic status, reducing intergenerational education mobility. Finally, it is crucial to acknowledge educational inequities between cities of different tiers. As rapid urbanization in China continues, unless high-human capital extends beyond capital cities (Spagat 2006), it could become a new source of social stratification in the future.

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Tables

TABLE 1
SPECIFIC RULES FOR THE HUKOU REFORM IN 1998

Date of birth (1)	Age range (2)	Hukou registration policy (3)
Born on or after July 22, 1998	Newborns	Voluntarily inherit the hukou status of their father or mother, with no conditions attached.
Born before July 22, 1998	Preschoolers (Aged 1-6)	Register in the mother's domicile place first. Permission to apply for transfer to the father's hukou status and given priority.
	Minor children (Aged 7-17)	Register in the mother's domicile place first, gradually changing to the father's domicile place but not given priority.
	Adults	Not eligible for hukou transformation.

Note. The State Council approved the *Opinions on Solving Several Outstanding Problems in the Current Management of Hukou* on July 22, 1998. We summarize the specific rules of the hukou reform based on various local legal and administrative documents.

TABLE 2
SUMMARY STATISTICS

	Control group (N=37,430)		Treatment group (N=3,604)		Difference
	Mean	Std. Dev.	Mean	Std. Dev.	Col.1 - Col.3
	(1)	(2)	(3)	(4)	(5)
A. Outcome variable					
Grade-for-age:	0.663	0.473	0.479	0.500	0.184***
Older cohort	0.361	0.480	0.106	0.307	0.256***
Younger cohort	0.814	0.389	0.744	0.436	0.070***
B. Treatment variable					
Hukou (Urban = 1):	1.000	0.000	0.345	0.475	0.655***
Older cohort	1.000	0.000	0.277	0.448	0.723***
Younger cohort	1.000	0.000	0.392	0.488	0.608***
C. Individual characteristics					
Age	20.854	10.579	22.346	10.965	-1.492***
Gender (Male = 1)	0.566	0.496	0.625	0.484	-0.059***
Ethnicity (Han = 1)	0.962	0.192	0.955	0.207	0.007**
Residence (Urban = 1)	0.899	0.302	0.368	0.482	0.530***
D. Household characteristics					
Number of siblings	0.405	0.640	0.694	0.773	-0.289***
Father's age	49.900	11.954	51.353	12.089	-1.452***
Father's years of schooling	11.222	3.296	9.675	2.710	1.547***
Mother's age	47.696	11.334	49.370	11.529	-1.674***
Mother's years of schooling	10.373	3.432	7.767	2.920	2.606***
E. Government's public spending on education					
Per student education expenditure:	2.098	1.301	1.673	1.313	0.424***
Older cohort	0.762	0.263	0.556	0.197	0.206***
Younger cohort	2.768	1.079	2.466	1.185	0.301***

Note. The data source is the 0.095% sample of the 2010 Chinese Population Census. The control group consists of children with an urban father and an urban mother; the treatment group consists of children with an urban father and a rural mother. Individuals born from September 1991 to August 2004 are defined as the *Younger Cohort*; individuals born from September 1967 to August 1980 are defined as the *Older Cohort*. The paired *t*-test is applied for mean differences in variables of the control and treatment groups.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE 3
EFFECTS OF THE REFORM ON HUKOU STATUS

	Hukou status		
	(1)	(2)	(3)
Young $\times$ Treat	0.091*** (0.019)	0.093*** (0.020)	0.151*** (0.024)
Treat	-0.667*** (0.014)	-0.668*** (0.014)	-0.592*** (0.017)
Gender (Male=1)	0.003** (0.001)	0.003* (0.001)	0.003** (0.001)
Ethnicity (Han=1)	0.001 (0.004)	0.001 (0.004)	0.000 (0.004)
Residence (Urban=1)	0.078*** (0.004)	0.079*** (0.004)	0.070*** (0.004)
Number of siblings		-0.004*** (0.001)	-0.001 (0.001)
Father's age		-0.001* (0.000)	-0.000* (0.000)
Father's years of schooling		-0.001** (0.000)	-0.001** (0.000)
Mother's age		-0.000 (0.000)	-0.000 (0.000)
Mother's years of schooling		0.000 (0.000)	0.000 (0.000)
Per student education expenditure			0.589*** (0.082)
Observations	41,024	41,024	41,024
R ²	0.663	0.663	0.726

Note. The dependent variable is children's hukou status (urban hukou=1). Birth month and province-birth cohort-birth month fixed effects are included in all regressions. Standard errors (in parentheses) are clustered at the province-year level.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE 4
EFFECTS OF THE REFORM ON EDUCATIONAL OUTCOMES

	Grade-for-age			Primary school	Junior high school	Senior high school
	(1)	(2)	(3)	(4)	(5)	(6)
Young × Treat	0.151*** (0.013) [0.000]	0.185*** (0.013) [0.000]	0.189*** (0.013) [0.000]	0.001 (0.002) [0.544]	0.016 (0.010) [0.036]	0.262*** (0.020) [0.000]
Treat	-0.180*** (0.011)	-0.164*** (0.011)	-0.158*** (0.011)	-0.000 (0.002)	-0.020*** (0.008)	-0.199*** (0.017)
Gender (Male=1)	-0.031*** (0.004)	-0.031*** (0.004)	-0.031*** (0.004)	0.000 (0.001)	-0.003 (0.002)	-0.035*** (0.005)
Ethnicity (Han=1)	-0.033*** (0.011)	-0.019* (0.011)	-0.019* (0.011)	0.000 (0.001)	0.003 (0.007)	0.011 (0.016)
Residence (Urban=1)	0.111*** (0.007)	0.065*** (0.006)	0.064*** (0.006)	0.001 (0.001)	0.016*** (0.004)	0.145*** (0.010)
Number of siblings		-0.026*** (0.004)	-0.026*** (0.004)	-0.000 (0.000)	-0.010*** (0.002)	-0.037*** (0.005)
Father's age		0.001 (0.001)	0.001 (0.001)	-0.000** (0.000)	0.001** (0.000)	0.000 (0.001)
Father's years of schooling		0.019*** (0.001)	0.019*** (0.001)	0.000* (0.000)	0.003*** (0.000)	0.022*** (0.001)
Mother's age		0.002*** (0.001)	0.002*** (0.001)	-0.000 (0.000)	-0.001 (0.000)	0.002* (0.001)
Mother's years of schooling		0.012*** (0.001)	0.012*** (0.001)	0.000 (0.000)	0.002*** (0.000)	0.017*** (0.001)
Per student education expenditure			0.049** (0.019)	0.002 (0.002)	0.011 (0.017)	0.211*** (0.053)
Observations	41,024	41,024	41,024	41,024	33,743	25,248
R ²	0.414	0.447	0.448	0.063	0.197	0.247

Note. The dependent variables in columns 1-3 are grade-for-age status. The dependent variables in columns 4-6 are dummies indicating whether individuals enter or have entered primary, junior high, and senior high school at the expected age. Birth month and province-birth cohort-birth month fixed effects are included in all regressions. Standard errors (in parentheses) are clustered at the province-year level. The *p*-values (in square brackets) reflect the estimated significance of clustering at the province level and are computed using the wild bootstrap with 500 replications.

* *p* < .10.

** *p* < .05.

*** *p* < .01.

TABLE 5
EFFECTS OF THE REFORM ON EDUCATIONAL OUTCOMES WITH LARGE OR SMALL URBAN-RURAL
EDUCATION GAP

	Grade-for-age (GFA)		Primary school		Junior high school		Senior high school	
	Large	Small	Large	Small	Large	Small	Large	Small
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Young $\times$ Treat	0.202*** (0.019)	0.160*** (0.018)	0.006 (0.004)	-0.005** (0.002)	0.034** (0.016)	0.001 (0.012)	0.274*** (0.029)	0.243*** (0.026)
<i>p</i> -value	[0.111]		[0.030]		[0.110]		[0.451]	
Mean of dependent variable	0.743	0.745	0.995	0.998	0.915	0.911	0.642	0.692
Mean of hukou	0.399	0.387	0.399	0.387	0.367	0.384	0.480	0.366
Observations	21,942	19,004	21,942	19,004	18,193	15,503	13,690	11,513
R ²	0.434	0.492	0.116	0.069	0.207	0.222	0.267	0.267

Note. We measure the urban-rural education gap by calculating the ratio of years of schooling for urban and rural adults aged over 25 in 2010. The prefectures equal to and above the median are defined as having a *Large* gap, whilst those below the median are defined as having a *Small* gap. The *p*-values (in square brackets) reflect the difference between the two groups. The mean of dependent variables and *hukou* (urban=1) are calculated based on the younger cohort in the treatment group. Regressions control for a set of individual (gender, ethnicity, residence), household (number of siblings, parent's age, and years of schooling), and government's public spending on education (per student education expenditure) variables. Birth month and province-birth cohort-birth month fixed effects are included in all regressions. Standard errors (in parentheses) are clustered at the province-year level.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE 6
ROBUSTNESS CHECKS: CONFOUNDING FACTORS

	Grade-for-age (1)	Primary school (2)	Junior high school (3)	Senior high school (4)
A. One child policy				
Young × Treat	0.144*** (0.022)	-0.001 (0.003)	0.021 (0.013)	0.196*** (0.033)
Observations	34,985	34,985	28,980	21,081
R ²	0.580	0.320	0.431	0.460
B. Mergers and closures of rural schools				
Young × Treat	0.186*** (0.013)	0.001 (0.002)	0.016 (0.010)	0.260*** (0.020)
Observations	40,959	40,959	33,692	25,226
R ²	0.449	0.065	0.200	0.249
C. Free compulsory education reform				
Young × Treat	0.135*** (0.021)	0.002 (0.006)	0.051*** (0.018)	0.221*** (0.043)
Observations	41,024	41,024	33,743	25,248
R ²	0.450	0.063	0.198	0.248
D. Four Thousand Billion Stimulus Plan				
Young × Treat	0.198*** (0.013)	0.002 (0.002)	0.013 (0.012)	0.261*** (0.022)
Observations	37,656	37,656	30,375	21,880
R ²	0.448	0.066	0.197	0.242
E. Other county-birth cohort specific reforms				
Young × Treat	0.253*** (0.054)	-0.012 (0.011)	-0.003 (0.031)	0.316*** (0.099)
Observations	30,763	30,763	24,178	16,771
R ²	0.628	0.365	0.481	0.555

Note. In panel A, we additionally control for county-birth year fixed effects. In panel B, we further control the interactions between the intensity of school closure at the city level from 2000 to 2010 and birth cohort dummies. In panel C, we further control the number of semesters that an individual is supposed to be exposed to the FCE reform. As employers are prohibited from employing children under 16, panel D excludes individuals in the treatment group who were 16 or above in 2008. In panel E, we use the treatment group with non-migrant parents and additionally control for county-father's birth cohort fixed effects. Regressions control for a set of individual (gender, ethnicity, residence), household (number of siblings, parent's age, and years of schooling), and government's public spending on education (per student education expenditure) variables. Birth month and province-birth cohort-birth month fixed effects are included in all regressions. Standard errors (in parentheses) are clustered at the province-year level.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE 7
ROBUSTNESS CHECKS: OTHERS

	Grade-for-age (1)	Primary school (2)	Junior high school (3)	Senior high school (4)
A. Redefining dependent variables				
Young × Treat	0.209*** (0.013)	0.001 (0.002)	0.029*** (0.009)	0.265*** (0.022)
Observations	41,004	40,656	30,939	22,442
R ²	0.521	0.042	0.080	0.250
B. Considering spillover effects				
Young × Treat	0.185*** (0.013)	0.001 (0.002)	0.018* (0.010)	0.260*** (0.020)
Siblings' exposure	0.033*** (0.007)	-0.001 (0.001)	-0.010* (0.005)	0.009 (0.010)
Observations	41,024	41,024	33,743	25,248
R ²	0.448	0.063	0.198	0.247
C. Removing migrant children				
Young × Treat	0.177*** (0.017)	-0.002 (0.003)	0.018 (0.014)	0.240*** (0.027)
Observations	25,686	25,686	20,930	15,180
R ²	0.472	0.096	0.224	0.266
D. Redefining older cohort to 7-17 years old				
Young × Treat	0.217*** (0.013)	-0.000 (0.001)	-0.012 (0.008)	0.120*** (0.018)
Observations	56,251	56,251	48,970	40,475
R ²	0.286	0.056	0.208	0.198
E. Removing 15 sub-provincial cities and individuals with siblings				
Young × Treat	0.158*** (0.022)	-0.005 (0.004)	0.003 (0.016)	0.261*** (0.035)
Observations	14,073	14,073	11,574	8,097
R ²	0.507	0.121	0.237	0.312

Note. In panel A, the dependent variables are redefined by adjusting the age of entry into a primary school to 7 years. In panel B, we further control Siblings' exposure to the hukou reform. In panel C, we remove samples that leave the place of hukou registration. In panel D, the age range of the older cohort is changed from 18-30 to 7-17 years old. In panel E, we remove samples from 15 sub-provincial cities and individuals with siblings. Regressions control for a set of individual (gender, ethnicity, residence), household (number of siblings, parent's age, and years of schooling), and government's public spending on education (per student education expenditure) variables. Birth month and province-birth cohort-birth month fixed effects are included in all regressions. Standard errors (in parentheses) are clustered at the province-year level.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE 8
HETEROGENEOUS EFFECTS

	Grade-for-age		Primary school		Junior high school		Senior high school	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Gender of children								
	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy
Young $\times$ Treat	0.232***	0.170***	-0.000	0.002	0.040**	0.005	0.335***	0.240***
	(0.022)	(0.016)	(0.005)	(0.003)	(0.019)	(0.013)	(0.033)	(0.027)
<i>p</i> -value	[0.019]		[0.707]		[0.120]		[0.029]	
Mean of dependent variable	0.755	0.735	0.995	0.998	0.915	0.910	0.680	0.662
Mean of hukou	0.380	0.403	0.380	0.403	0.368	0.384	0.343	0.393
Observations	17,534	23,429	17,534	23,429	14,225	19,487	10,273	14,944
R ²	0.433	0.475	0.150	0.086	0.218	0.215	0.285	0.256
B. Parental education level								
	Educated	Less-educated	Educated	Less-educated	Educated	Less-educated	Educated	Less-educated
Young $\times$ Treat	0.320***	0.065***	-0.001	0.003	0.017	0.018	0.347***	0.178***
	(0.025)	(0.016)	(0.004)	(0.003)	(0.015)	(0.014)	(0.032)	(0.029)
<i>p</i> -value	[0.000]		[0.397]		[0.988]		[0.000]	
Mean of dependent variable	0.786	0.713	0.996	0.998	0.930	0.900	0.738	0.620
Mean of hukou	0.418	0.373	0.418	0.373	0.385	0.370	0.393	0.352
Observations	23,946	17,025	23,946	17,025	18,804	14,915	12,947	12,277
R ²	0.366	0.491	0.097	0.110	0.227	0.211	0.228	0.220
C. City type								
	Capital	Not capital	Capital	Not capital	Capital	Not capital	Capital	Not capital
Young $\times$ Treat	0.216***	0.163***	0.007	-0.002	0.017	0.018	0.260***	0.249***
	(0.025)	(0.015)	(0.006)	(0.003)	(0.019)	(0.011)	(0.039)	(0.023)
<i>p</i> -value	[0.068]		[0.252]		[0.986]		[0.740]	
Mean of dependent variable	0.743	0.745	0.996	0.997	0.913	0.912	0.678	0.668
Mean of hukou	0.415	0.385	0.415	0.385	0.395	0.370	0.397	0.360
Observations	15,502	25,452	15,502	25,452	12,879	20,820	9,858	15,346
R ²	0.431	0.487	0.194	0.069	0.237	0.217	0.273	0.261

Note. In panel A, we run separate regressions for the subsamples of boys and girls. Panel B defines a family as *Educated* if either parent has attended senior high school or above and Less-educated otherwise. Panel C defines the *Capital* dummy variable that distinguishes municipalities and provincial capitals from smaller cities. The *p*-values (in square brackets) reflect the difference between the two groups. The mean of dependent variables and hukou (urban=1) are calculated based on the younger cohort in the treatment group. Regressions control for a set of individual (gender, ethnicity, residence), household (number of siblings, parent's age, and years of schooling), and government's public spending on education (per student education expenditure) variables. Birth month and province-birth cohort-birth month fixed effects are included in all regressions. Standard errors (in parentheses) are clustered at the province-year level.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE 9
MECHANISM ANALYSIS

	School location (Located in cities = 1)	Extra-paid educational expenses (CNY: thousand)	Educational aspiration (College degree or above = 1)
	(1)	(2)	(3)
Young × Treat	0.208*** (0.041)	-3.587 (5.306)	0.134** (0.052)
Observations	12,994	2,820	5,336
R ²	0.173	—	0.162

Note. In column 1, the dependent variable is *school location*, which equals 1 for cities and 0 for counties and rural areas. In column 2, the dependent variable is *extra-paid educational expenses*, a proxy for the cost of education. In column 3, the dependent variable is *educational aspiration*, which equals 1 if an individual expects to obtain college or above degree and 0 otherwise. All regressions control for a set of individual and household characteristics, including age, gender, ethnicity, parents' age, and years of schooling. Wave, province, and birth year fixed effects are included in all regressions. Standard errors clustered at the province-birth year level are in parentheses.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

Figures

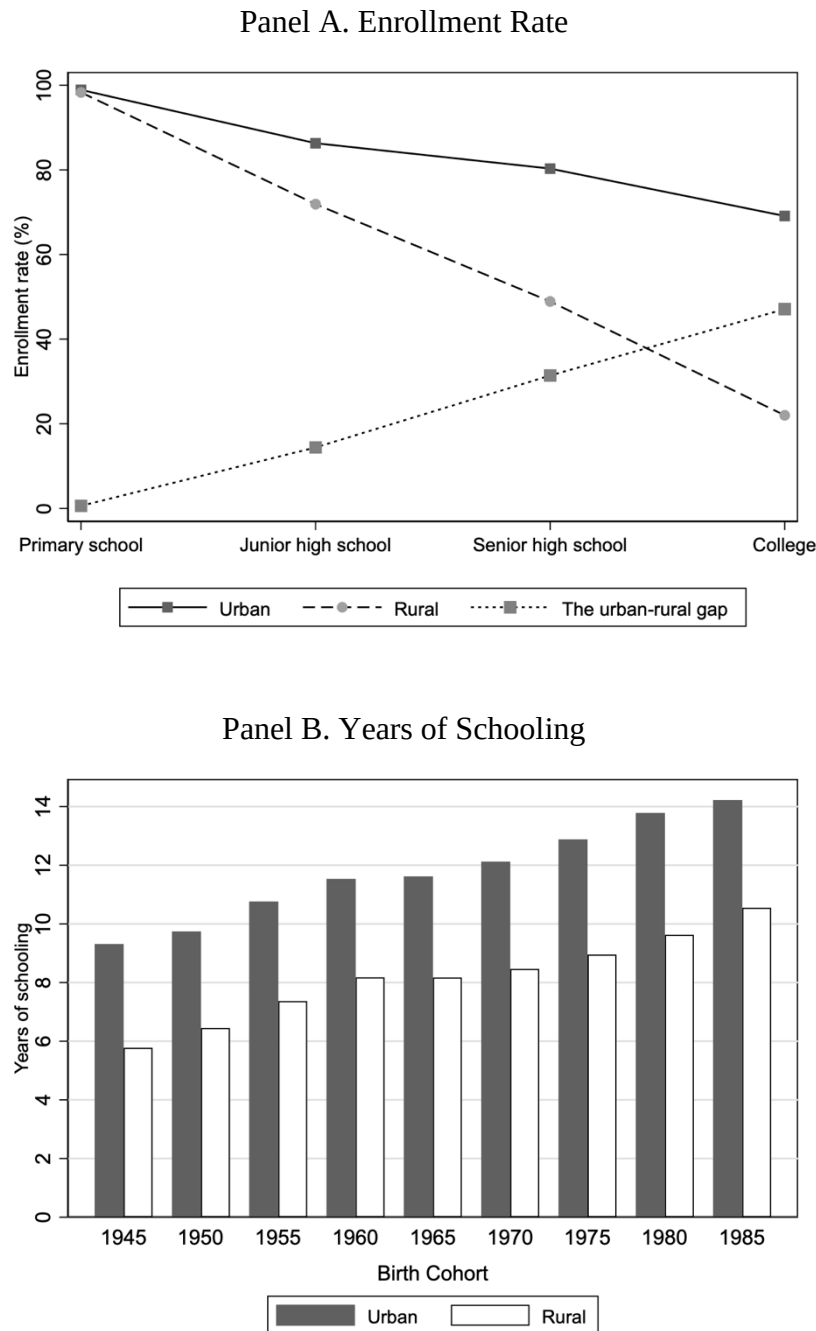


Figure 1. The urban-rural education gap in China.

Note. Panel A illustrates the urban-rural gap in enrollment rates. The enrollment rate is the proportion of children enrolled in school among the appropriate school-age population. The appropriate school age is 6-11, 12-14, 15-17, and 18-21 for primary, junior high, senior high, and college students, respectively. Panel B presents the urban-rural difference in the average years of schooling for the working-age population (aged 16-64) born in different cohorts. For example, the label 1945 represents people born between 1945 and 1949; the label 1950 represents people born between 1950 and 1954. Source: The 0.095% sample of the 2010 Chinese Population Census.

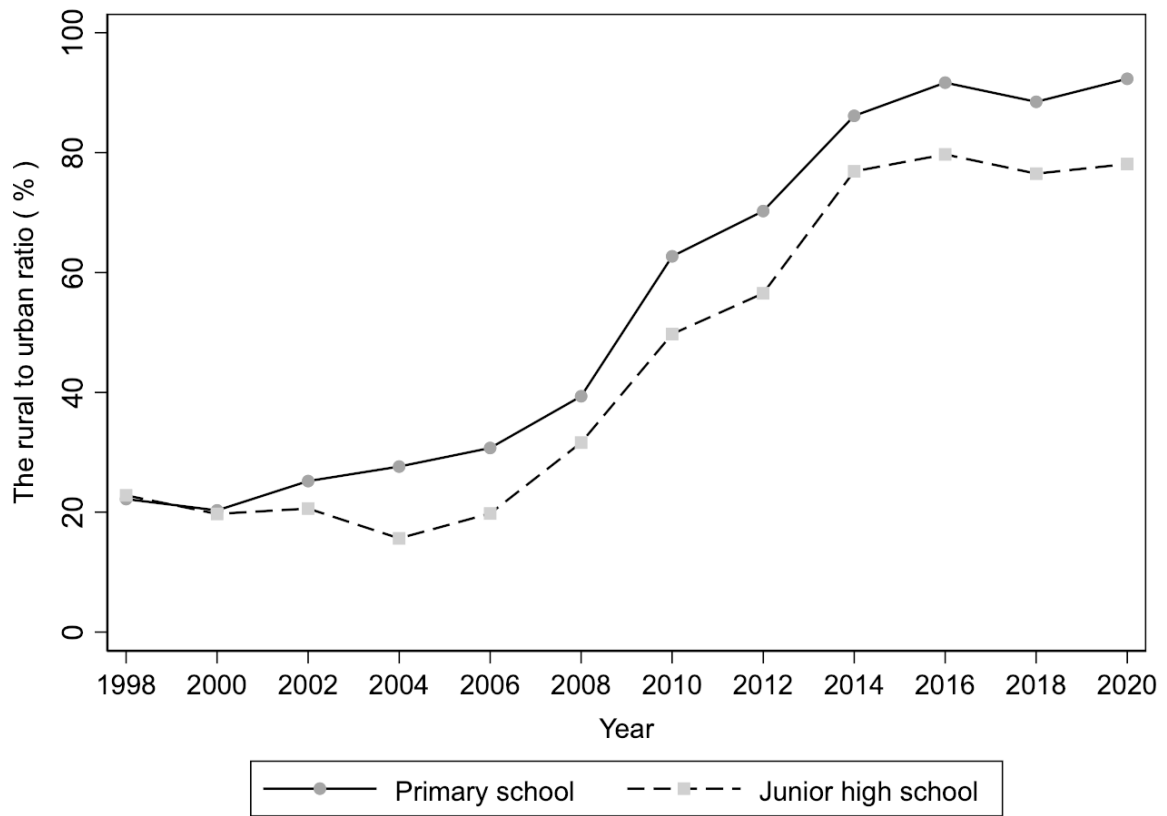


Figure 2. The urban-rural gap in education expenditure per student in China, 1998-2020.
 Note. The rural-urban ratio is the relative value of rural education expenditure per student divided by urban education expenditure per student. Source: Educational Statistics Yearbook of China (1999 - 2021).

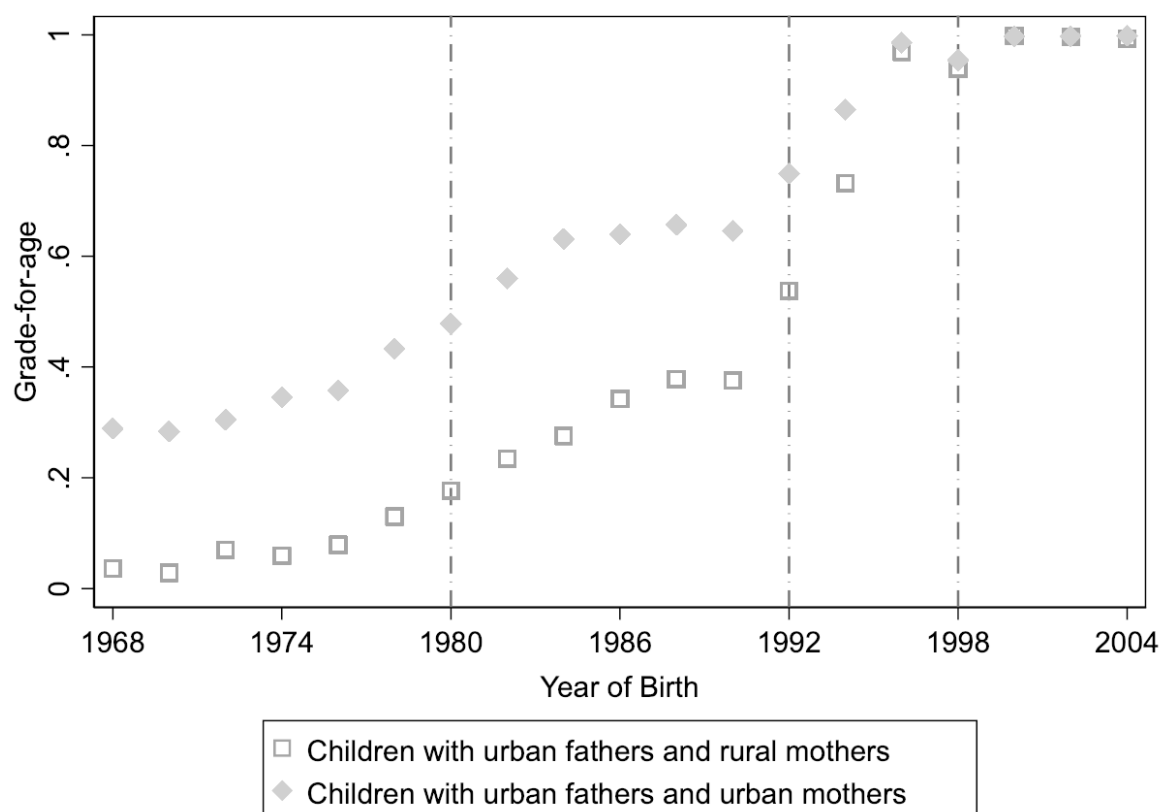


Figure 3. The educational outcomes of children from different family types.

Note. The x-axis indicates an individual's birth year, and the y-axis indicates the mean grade-for-age status of all individuals born in that year. Source: The 0.095% sample of the 2010 Chinese Population Census.

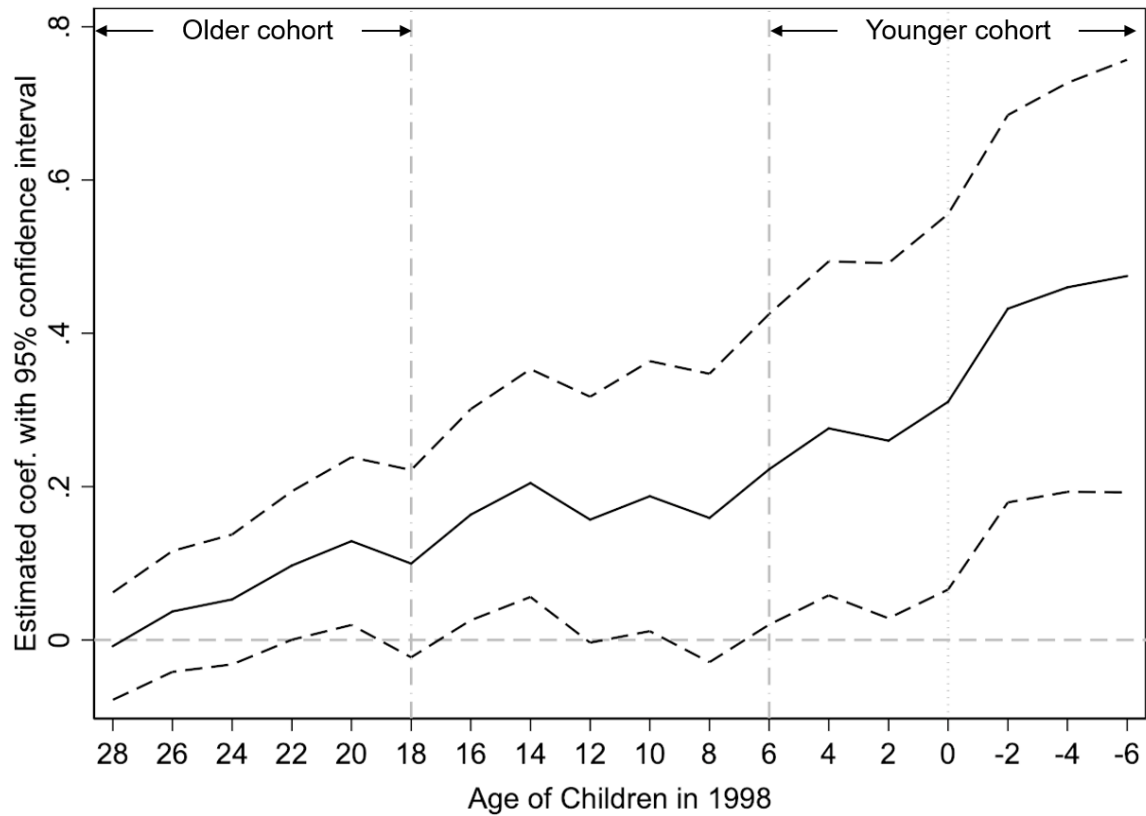


Figure 4. The effect of the 1998 reform on children's hukou status.

Note. The sample comprises individuals from households with urban fathers and rural mothers. The figure reports the estimates of timing dummies with a 95% confidence interval in the regression of children's hukou status (urban=1) on time dummy variables (28 years pre-reform and 12 years post-reform), personal and family background characteristics, and province dummies. Birth cohorts are aggregated into two-year intervals to increase the power of the analysis. On the x-axis, positive numbers indicate the age in 1998, while negative numbers denote the number of years after the reform that the person was born. Source: The 0.095% sample of the 2010 Chinese Population Census.

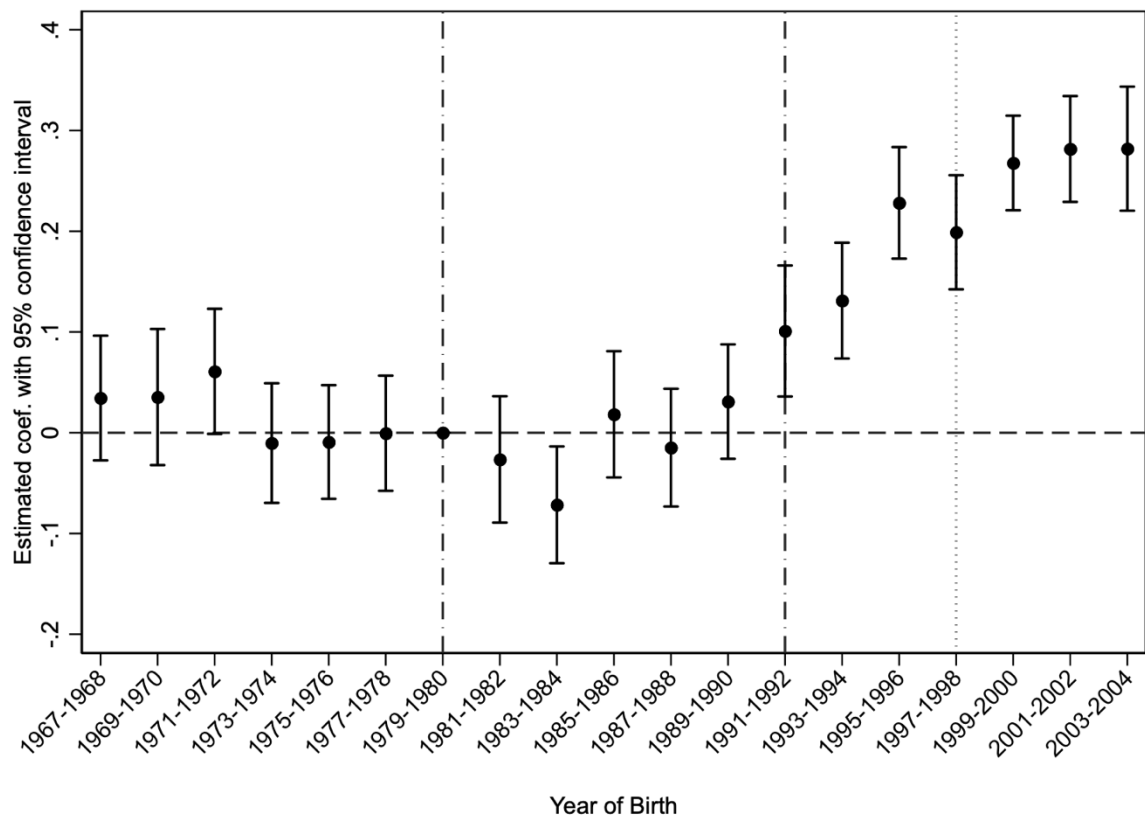


Figure 5. The event study of the reform in 1998.

Note. The figure reports the estimates of timing dummies with a 95% confidence interval in the regression of children's grade-for-age status on a sequence of dummies from 1967 to 2004, personal and family background characteristics, per student education expenditure, month dummies, and province-birth cohort-birth month dummies. The x-axis represents an individual's birth year. Birth cohorts are aggregated into two-year intervals to increase the power of the analysis. The control group consists of those born in 1979-1980 and is omitted in the regression. Source: The 0.095% sample of the 2010 Chinese Population Census.

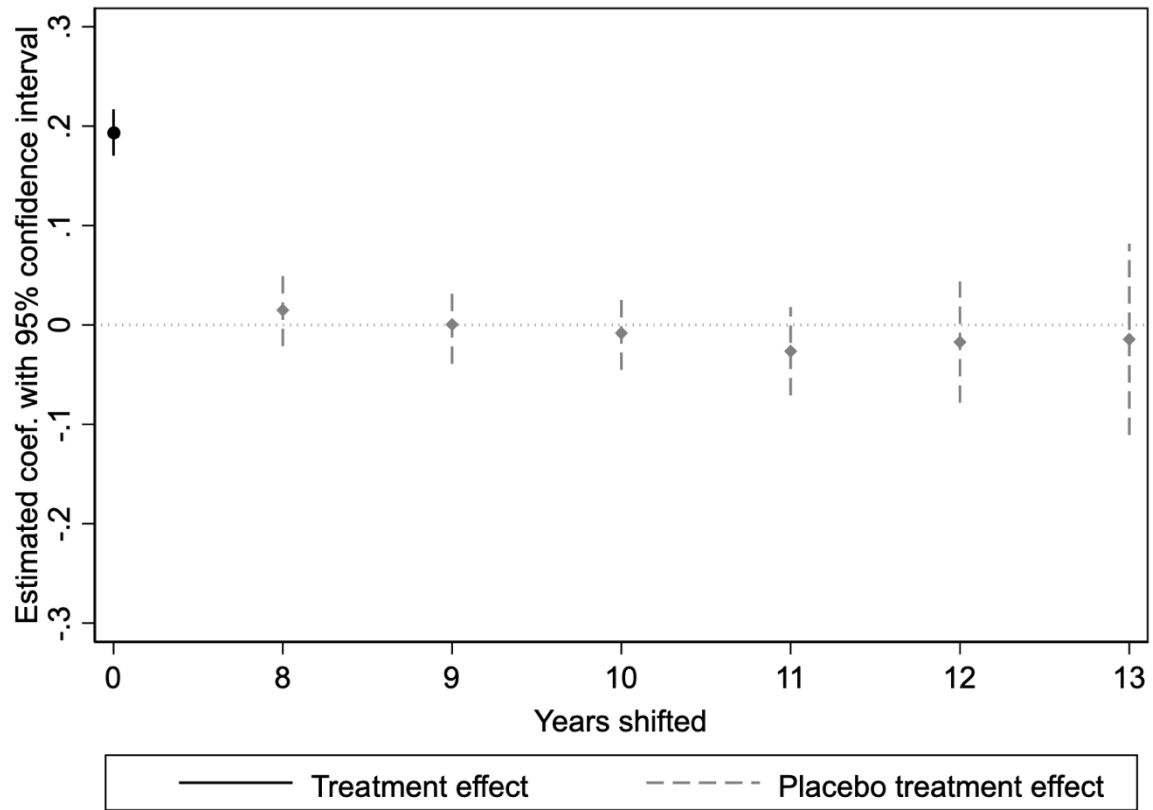


Figure 6. Estimated coefficients from the time-shifted placebo tests.

Note. The solid line denotes the true treatment effect estimated by equation (1). The dashed lines represent the estimates of the interaction of *Placebo Young* and *Treat* with a 95% confidence interval in the regression of DID models based on the pseudo-policy timing. The hukou reform is assumed to have occurred 8-13 years before the actual time. Source: The 0.095% sample of the 2010 Chinese Population Census.

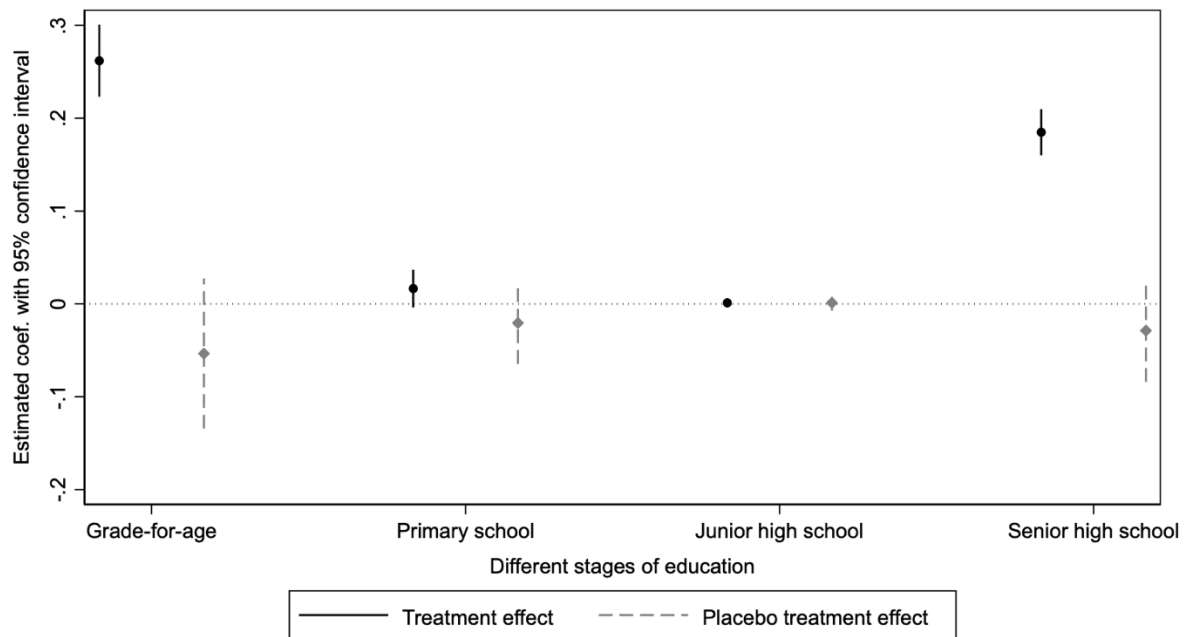


Figure 7. Estimated coefficients from the placebo tests using untreated samples.

Note. The solid lines denote the true treatment effects estimated by equation (1). The dashed lines represent the estimates of the interaction of *Young* and *Placebo Treat* with a 95% confidence interval. *Placebo Treat* = 1 if a child's father has rural hukou and the mother has urban hukou; = 0 if a child's parents both have rural hukou. Source: The 0.095% sample of the 2010 Chinese Population Census.

Appendix

TABLE A1
POLICY ISSUE DATE AND THE FIRST AFFECTED COHORT

Province (1)	Affected cohort born from (2)	The issue date (3)
Heilongjiang	Jul. 01, 1998	Aug. 19, 1998
Ningxia	Jul. 22, 1998	Sep. 11, 1998
Guangdong	Jul. 22, 1998	Oct. 23, 1998
Inner Mongolia	Jul. 22, 1998	Nov. 4, 1998
Jilin	Jul. 22, 1998	Nov. 13, 1998
Zhejiang	Jul. 22, 1998	Dec. 10, 1998
Henan	Jul. 22, 1998	Dec. 18, 1998
Shaanxi	Jul. 22, 1998	Dec. 22, 1998
Sichuan	Jul. 22, 1998	Dec. 22, 1998
Fujian	Jul. 22, 1998	Dec. 25, 1998
Shanxi	Jul. 22, 1998	Dec. 25, 1998
Guangxi	Jul. 22, 1998	Dec. 30, 1998
Hebei	Jul. 22, 1998	Mar. 22, 1999
Hunan	Jul. 22, 1998	Mar. 22, 1999
Anhui	Jul. 22, 1998	Jan. 22, 1999
Hubei	Jul. 22, 1998	Apr. 26, 1999
Shandong	Jul. 22, 1998	Jun. 6, 1999
Jiangxi	Jul. 22, 1998	Sep. 30, 1999
Gansu	Jul. 22, 1998	Mar. 31, 2000
Liaoning	Jul. 22, 1998	Mar. 31, 2000
Guizhou	Jul. 22, 1998	Apr. 30, 2000
Beijing	Jul. 22, 1998	Feb. 26, 2001
Chongqing	Jul. 22, 1998	Aug. 27, 2003
Shanghai	Aug. 07, 2003	Aug. 21, 2003
Tianjin	Aug. 07, 2003	Aug. 08, 2003
Hainan	—	—
Jiangsu	—	—
Qinghai	—	—
Tibet	—	—
Xinjiang	—	—
Yunnan	—	—

Note. Authors' construction based on various local legal and administrative documents. Province here includes province, autonomous region, and provincial-level municipality. The issue date in column 3 refers to the date that provinces/municipalities enacted the hukou reform. The information on the effective dates of the policy implementation in six provinces – Tibet, Xinjiang, Hainan, Yunnan, Jiangsu, and Qinghai – is missing.

TABLE A2
COMPOSITION OF FAMILY TYPES

Family type (1)	Hukou status (Father, Mother) (2)	Percent (%) (3)	Sample size (4)
Type 1	(Urban, Rural)	2.48	10,067
Type 2	(Urban, Urban)	26.33	106,942
Type 3	(Rural, Urban)	1.16	4,706
Type 4	(Rural, Rural)	70.04	284,498
Total		100.00	406,213

Note. The data source is the 0.095% sample of the 2010 Chinese Population Census. Couples are identified based on the date of the first marriage. The variable “relationship to the household head” is then used to match children with their parents and siblings.

TABLE A3
SAMPLE SCREENING PROCESS

Basis of sample selection (1)	Sample size (2)
Retain Type 1 (treatment group) and Type 2 (control group) families	117,009
Retain the sample with parents whose first marriage occurred in 1998 and before	94,567
Restrict age range	51,750
Drop the sample with missing key variables	51,197
Delete the sample from municipalities and provinces with unclear policies	41,034

Note. The data source is the 0.095% sample of the 2010 Chinese Population Census.

TABLE A4

Comparison of children born before the reform

	Treatment group (<i>N</i> =3,604)		Children with rural fathers and urban mothers (<i>N</i> =1,632)		Children with rural fathers and rural mothers (<i>N</i> =114,000)		Difference	Difference
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Col.1-Col.3	Col.1-Col.5
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Grade-for-age	0.367	0.482	0.574	0.495	0.336	0.473	-0.207***	0.031***
Hukou (Urban = 1)	0.321	0.467	0.717	0.451	0.012	0.110	-0.395***	0.309***
Age	25.223	10.108	19.080	8.139	21.190	9.035	6.143***	4.033***
Gender (Male = 1)	0.650	0.477	0.591	0.492	0.604	0.489	0.059***	0.046***
Ethnicity (Han = 1)	0.955	0.206	0.960	0.197	0.950	0.217	-0.004	0.005
Residence (Urban = 1)	0.329	0.470	0.563	0.496	0.097	0.296	-0.234***	0.232***
Number of siblings	0.676	0.785	0.690	0.777	0.975	0.918	-0.014	-0.299***
Father's age	53.852	11.776	46.304	9.201	48.869	10.741	7.548***	4.982***
Father's years of schooling	9.497	2.703	9.108	2.542	8.031	2.228	0.388***	1.466***
Mother's age	51.814	11.196	44.588	8.883	47.070	10.167	7.226***	4.744***
Mother's years of schooling	7.458	2.956	8.999	2.896	7.000	2.728	-1.541***	0.458***

Notes: Based on individuals born between September 1967 and July 1998 from the 0.095% sample of the 2010 Chinese Population Census. Treatment group refers to children with urban fathers and rural mothers.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE A5
EFFECTS OF THE REFORM ON EDUCATIONAL OUTCOMES WITH MATCHED SAMPLES

	Grade-for-age (1)	Primary school (2)	Junior high school (3)	Senior high school (4)
Young × Treat	0.094*** (0.013)	-0.001 (0.002)	0.018* (0.010)	0.216*** (0.021)
Treat	-0.088*** (0.011)	0.001 (0.002)	-0.026*** (0.008)	-0.167*** (0.017)
Gender (Male=1)	-0.013*** (0.004)	0.000 (0.001)	-0.000 (0.003)	-0.014** (0.006)
Ethnicity (Han=1)	-0.017 (0.012)	0.000 (0.002)	0.004 (0.009)	0.003 (0.021)
Residence (Urban=1))	0.073*** (0.007)	0.001 (0.001)	0.012*** (0.004)	0.143*** (0.010)
Number of siblings	-0.029*** (0.004)	0.001 (0.001)	-0.006** (0.003)	-0.032*** (0.006)
Father's age	-0.000 (0.001)	-0.000 (0.000)	0.001* (0.000)	-0.002 (0.001)
Father's years of schooling	0.015*** (0.001)	0.000 (0.000)	0.003*** (0.001)	0.023*** (0.001)
Mother's age	0.002*** (0.001)	-0.000 (0.000)	-0.001 (0.001)	0.004*** (0.001)
Mother's years of schooling	0.002** (0.001)	0.000 (0.000)	0.001** (0.001)	0.011*** (0.002)
Per student education expenditure	0.052*** (0.018)	0.001 (0.001)	0.012 (0.015)	0.201*** (0.046)
Observations	30,006	30,006	24,810	17,862
R ²	0.506	0.091	0.223	0.274

Note. Estimates are obtained using matched samples. The dependent variable in column 1 is grade-for-age status. The dependent variables in columns 2-4 are dummies indicating whether individuals enter or have entered primary, junior high, and senior high school at the expected age, respectively. Birth month and province-birth cohort-birth month fixed effects are included in all regressions. Standard errors (in parentheses) are clustered at the province-year level.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

TABLE A6
Demographic characteristics

	Younger cohort			Older cohort	
	Census	CFPS		Census	CGSS
	(1)	(2)		(3)	(4)
Age group			Age group		
Aged 6-8	0.217	0.233	Aged 30-32	0.227	0.193
Aged 9-11	0.220	0.241	Aged 33-35	0.229	0.217
Aged 12-14	0.237	0.238	Aged 36-38	0.266	0.282
Aged 15-17	0.327	0.288	Aged 39-41	0.279	0.308
Level of education			Level of education		
Primary school and below	0.440	0.407	Primary school and below	0.145	0.248
Junior high school	0.313	0.302	Junior high school	0.524	0.384
Senior high school	0.207	0.282	Senior high school	0.173	0.183
College degree and above	0.040	0.009	College degree and above	0.158	0.185
Hukou (Urban = 1)	0.169	0.143	Hukou (Urban = 1)	0.202	0.222
Gender (Male = 1)	0.300	0.330	Gender (Male = 1)	0.279	0.277
Ethnicity (Han = 1)	0.531	0.527	Ethnicity (Han = 1)	0.520	0.501

Note. Data for the older cohort (individuals born between September 1967 and August 1980) are from the Chinese General Social Survey (CGSS) 2010, and data for the younger cohort (individuals born between September 1991 and August 2004) are from the China Family Panel Studies (CFPS) 2010. Values are weighted descriptive statistics. Source: Authors' calculations based on the 0.095% sample of the 2010 Chinese Population Census, CFPS 2010, and CGSS 2010.