Long-term Impacts of Growth and Development Monitoring: Evidence from Routine Health Examinations in Early Childhood

Yinhe Liang[*], Xiaobo Peng[†], Meiping Aggie Sun[‡]

March 9, 2024[§]

Abstract

This paper examines the long-term impacts of growth and development monitoring in early childhood. For this purpose, we evaluate a public health program, the Systematic Management of Children (SMC), which offers growth and development monitoring through routine health checkups for all young children (0-6 years) in China. Using data on the program's county-by-county rollout from 1950 to 2010, we find that full exposure to the SMC from birth increases lifetime income by 5%. We further provide evidence of several underlying mechanisms, including improved physical and mental health, better educational outcomes, increased cognitive skills, and sustained use of routine health checkups among adolescents.

Keywords: Growth and Development Monitoring, Adult Earnings, Human Capital, Health, Public Goods
JEL Classification: H51, H75, I15, I18, J24, N35, O12, O15

[*]Assistant Professor, School of Economics, Central University of Finance and Economics, Beijing, China (email: liangyinhe@cufe.edu.cn).

[†]Associate Professor, School of Economics, Central University of Finance and Economics, Beijing, China (email: xiaobopeng1212@163.com).

[‡]Corresponding author. Assistant Professor, Department of Economics, Fordham University, Lowenstein 808B, 113 West 60th Street, New York City, NY, USA 10023 (email: msun46@fordham.edu).

[§]We thank Janet Currie, Christopher Carpenter, Michael Best, Wojciech Kopczuk, Heather Schofield, Hitoshi Shigeoka, Gabriella Conti, Joachim Winter, Douglas Harris, Augustine Denteh, Wei Long, Kevin Thom, Yingying Dong, Karna Basu, Shariq Mohammed, Jorge Luis García, Lauren Hoehn-velasco, Aleksandra Jakubowski, Shantanu Khanna, Andrew Dustan, Matthew Larson, Andrew Simons, Subha Mani, Stephen Wu, Utteeyo Dasgupta, Alexander Henke, Melanie Khamis, and Moiz Bhai for discussions and comments that shaped the content of this paper. We thank Qiuyan Guo and Yuhan Cao for outstanding research assistance. We also thank seminar participants at the CESifo/CES Workshop on the Economics of Children, the Midwest Econometrics Group Meeting, Tulane University, University of Wisconsin-Milwaukee, Howard University, Fordham University, The College of William & Mary, and Lafayette College for their comments. All three authors are co-first authors. All errors are our own.

1 Introduction

Since 1961, the World Health Organization (WHO) has launched growth standards and charts and enthusiastically advocated the implementation of growth and development monitoring in member countries (WHO, 1962).[1] Growth and development monitoring is an important diagnostic tool for identifying children with health and nutritional problems, thus enabling action to be taken before their health status is seriously jeopardized. Driven by this persuasive logic, UNICEF has spent over 110 million USD on programs with growth and development monitoring (WHO, 2023). However, the WHO Evaluation Office has voiced concerns regarding the efficacy of growth and development monitoring, as well as the justification of investments in this area (Pearson, 1995). To date, no credible evidence has been presented to prove that growth and development monitoring is causally beneficial *per se*, whether in the short or long run; therefore, no effective comparison has been made with the short-term costs (De Onis et al., 2004; Ashworth et al., 2008).

Existing evaluation studies are unable to distinguish the role of growth and development monitoring *per se*, as their analyses rely on health programs in which growth and development monitoring is part of a package of health and nutrition services. Evidence from developed economies has been largely based on infant home visiting programs and health center cares (Currie, 2009; Bhalotra et al., 2017; Hjort et al., 2017; Hoehn-Velasco, 2021; Baker et al., 2023; Conti et al., 2024). The services of these programs, however, are a combination of nutrition education, sanitation promotion, growth and development monitoring, and immunization. Thus, whether the process of growth and development surveillance in and of itself bestows significant benefits remains a question. The bulk of studies from developing country contexts have focused on small- and large-scale randomized controlled trials (RCTs). While some RCTs in Nigeria, Jamaica, India, Tanzania, and Senegal provide tentative evidence that participation in growth and development monitoring confers a significant benefit on children's health status (Cunningham et al., 1978; Gwatkin et al., 1980; Hazarika and Viren,

[1] Subsequently, the United Nations International Children's Emergency Fund (UNICEF) developed the Multiple Indicator Cluster Surveys (MICS) in 1995, a dedicated Sustainable Development Goal indicator (SDG 4.2.1) in 2015, and the Global Scales for Early Development (GSED) in 2023 to assess children attaining developmental milestones (UNICEF, 2021; McCray et al., 2023; UNICEF, 2018).

2013), a number of RCTs in India, Bangladesh, Ghana, Lesotho, and Thailand indicate that growth and development monitoring does not improve average nutrition, health, or school performance outcomes (Avsm et al., 1995; Hossain et al., 2005; Karim et al., 2003). Moreover, these RCTs could not disaggregate the effects of growth and development monitoring from those of other inputs.

By exploring the county-by-county rollout of a public health program implemented in China called the Systematic Management of Children (SMC), the present study constitutes a unique opportunity to inform our understanding of the lifelong benefits of growth and development monitoring through routine health examinations in early childhood. Under the SMC, each child visits local clinics five times during the first year of life, twice each in the second and third years, and then once a year until age six. Services in all clinic visits include basic anthropometric measurements, routine physical examinations, and developmental evaluations.

The substantial variation in the timing of the SMC at the county level enables us to use a cohort difference-in-differences (DID) design to estimate the long-term impacts of the program.[2] Specifically, as the SMC is mandatory with a nearly 100% participation rate, all children residing in SMC counties while under the age of seven comprise the treatment group. Within the same counties, exposed children are compared against older, never-treated cohorts. Furthermore, we compare children across each birth year for early and later-treated counties.

For this study, we hand-collect a county-level dataset of the years in which each county initiated the SMC from over 3,000 book-length local gazetteers. We combine this dataset with China's 2005 One-Percent Population Census, the China Family Panel Studies (CFPS), and the China Health and Nutrition Survey (CHNS) data to estimate the program's long-term effects on on a broad range of outcomes.

Using the staggered DID strategy and individual-level census data, we show that children with full exposure to the SMC (i.e., from birth to age six) earned approximately 5% more in adulthood than never-treated individuals, equivalent to approximately one year of schooling.[3] The changes are mainly due to hourly wage increases

[2]Once a county implements the program, it remains in place.

[3]For this comparison, we use results from Wang (2013), who finds that an additional year of schooling in China raises an individual's income by about 5.3%.

rather than hours worked and do not differ by gender. We also find that earnings improvement is greatest for children who receive SMC services from birth (i.e., full exposure) and decreases in magnitude as the age at first exposure increases from zero to six. It is worth noting that children exposed to the SMC from age three or four years still gained an approximately 2% increase in lifetime earnings, suggesting that growth and development monitoring beyond the first three years of life remains important and could generate considerable long-term benefits.

After estimating the overall increase in adult income, we test the respective roles of health and schooling, using the rich information found in the census data and household surveys. This analysis is inspired by theoretical works that have identified mechanisms through which good health in early childhood can unlock lifetime benefits (see, e.g., Currie and Almond 2011; Heckman et al. 2013; Almond et al. 2018; García et al. 2020). We find that the introduction of the SMC leads to substantial improvements in physical and mental health, increases in years of schooling, higher high school and college graduation rates, better math and verbal test scores, and sustained usage of routine health examinations among adolescents. These findings corroborate the related literature on health-related income gains (Bleakley, 2007; Pitt et al., 2012; Baird et al., 2016).

We also provide solid evidence to support the central parallel-trend assumption in our cohort DID strategy. Our main results are robust to a wide range of alternative specifications, to accounting for multiple hypotheses testing, to using alternative income measures, and to accounting for recent concerns that staggered DID estimates may be biased in the presence of heterogeneity in the treatment effects over time or across groups.

Furthermore, we conduct back-of-the-envelope calculations to quantify the induced benefits we estimate above. The increase in annual income in adulthood (i.e., 198 RMB or 31 USD per person) far exceeds the financing cost of the SMC during early childhood (i.e., 45 RMB or 7.1 USD per child per year).

Given the levels of population, health, medical technology, and wealth involved in the practice of the SMC in China, our results are directly relevant to ongoing policy debates regarding the merits of growth and development monitoring in developing countries. Such concerns center largely on the effectiveness of monitoring *per se* and whether related investments are justified. Using a variety of survey and administrative data, we show that growth and development monitoring through routine health checkups in early childhood could generate substantial long-term benefits and are highly cost-beneficial. The infant mortality rates and per capita incomes in China—the largest developing country—during the period of the SMC rollout are comparable to those of the Third World today. Therefore, our results and methods contribute credible evidence to this important policy issue.

Our findings add to the literature measuring the long-term effectiveness of public health programs. Previous studies have examined the effectiveness of home visits (Moehling and Thomasson, 2014; Butikofer et al., 2015), piped water (Devoto et al., 2012; Li and Xiao, 2023), hookworm eradication (Baird et al., 2016), iodine supplements (Field et al., 2009), and vaccination (Bloom et al., 2012). However, no credible evidence has been presented indicating that growth and development monitoring *per se* is causally beneficial in the long run. To the best of our knowledge, our study is the first with a long enough post-period timeframe to confirm that growth and development surveillance in and of itself are highly cost-beneficial and could generate substantial long-term benefits, especially on lifetime earnings.

The results of this paper also expand the literature on the long-term effects of early-life conditions. A subset of this literature has focused on demonstrating the impact of negative or traumatic experiences, such as stress (Aizer, 2011; Currie and Rossin-Slater, 2013), diseases (Nelson, 2010), famines (Chen and Zhou, 2007), air pollution (Almond et al., 2009; Alexander and Schwandt, 2022), smoke (Rangel and Vogl, 2019), radiation (Black et al., 2019), vitamin D deficiency (Dustmann et al., 2022), floods (Rosales-Rueda, 2018), political instability (Aparicio Fenoll and González, 2021), and *in utero* exposure to maternal stress (Currie, 2009; Persson and Rossin-Slater, 2018) in early life. More recent studies have focused on estimating gains from exposure to early childhood interventions, such as infant care programs (Bhalotra et al., 2017; Butikofer et al., 2015; Daysal et al., 2022), psychological interventions (Gertler et al., 2013), health insurance coverage (Aizer, 2007; Cohodes et al., 2016; Huang and Liu, 2023; Miller and Wherry, 2019), maternity leave (Dustmann and Schönberg, 2012; Fabel, 2021), nutrition improvements (Adhvaryu et al., 2020; Lundborg et al., 2022), and women empowerment (Kose et al., 2021). By exploring the variation in the county-by-county rollout of the

SMC, we show that growth and development monitoring through routine health examinations in early childhood significantly increases children's lifetime earnings, physical and mental health, and educational attainment.

The remainder of this study proceeds as follows. First, we provide a literature review on growth and development monitoring in Section 2 and background information on the SMC in Section 3. Then, in Section 4, we provide details on the data used in this study. Next, in Section 5, we introduce the main empirical specification, which is a cohort DID model. Sections 6 and 7 present the main results of the DID model and several robustness checks. Section 8 provides a back-of-the-envelope cost-benefit calculation of the SMC and concludes this work.

2 Literature Review

Early childhood health is the foundation of lifelong health (Heckman, 2007; Currie and Almond, 2011; Currie and Vogl, 2013; Almond et al., 2011) and has persistent and profound impacts on human capital accumulation and economic outcomes among adults (Heckman and Mosso, 2014; Currie and Almond, 2011; Conti et al., 2016). A number of theoretical works have identified various mechanisms through which good health in early childhood can unlock lifetime benefits (see, e.g., Heckman et al. 2013; Almond et al. 2018; García et al. 2020). Extensive literature has documented the long-term detrimental consequences of poor health early in life (Aizer, 2011; Currie and Rossin-Slater, 2013; Conti et al., 2012; Nelson, 2010; Chen and Zhou, 2007) and the mitigating effects of targeted health programs that improve early life health on human capital formation and lifelong earnings (Cutler and Miller, 2005; Miguel and Kremer, 2004; Bleakley, 2007; Field et al., 2009; Conti et al., 2016). At the same time, a growing number of studies have examined the benefits of public health programs with growth and development monitoring (Moehling and Thomasson, 2014; Hjort et al., 2017; Hoehn-Velasco, 2021; Baker et al., 2023). However, these studies were unable to identify the role of growth and development monitoring *per se*, as their estimates relied on programs in which growth and development monitoring was only part of a package of health and nutrition services.

Existing studies on growth and development monitoring in developed countries have been largely based on infant home visiting programs and the expansion of health center care services (Wüst, 2012; Moehling and Thomasson, 2014; Butikofer et al., 2015; Hjort et al., 2017; Bhalotra et al., 2017; Hoehn-Velasco, 2021; Baker et al., 2023). For instance, in examining the Sheppard-Towner Act from 1924 through 1929, Moehling and Thomasson (2014) showed that one-on-one contact and follow-up care through home visits reduced infant deaths in the United States more than classes and conferences. Bhalotra et al. (2017) found that the introduction of health centers and home visits in Sweden in the early 1930s prolonged treated individuals' lives in the very long run (probability of survival past age 75). Another study reported that people visited by nurses in infancy through the 1937 Danish home visiting program experienced a robustly estimated increase in adult survival rates during middle age (45-64 years) and a lower predisposition to serious adult diseases (Hjort et al., 2017). In a recent study, Hoehn-Velasco (2021) examined a sample of rural counties in the US and found that county-level health departments (CHDs), which provided health services geared toward children, increased men's later-life earnings by 2%-5%. However, the services of these programs include a combination of nutrition education, hygiene promotion, growth and development monitoring, and immunization. Therefore, these studies could not provide credible evidence that growth and development monitoring, in and of itself, is causally beneficial in the short or long run.

The literature on the impacts of growth and development monitoring in developing countries has focused on small- and large-scale RCTs. Several small-scale RCTs in Nigeria, Jamaica, India, and Madagascar, as well as large RCTs in Brazil, Tanzania, India, and Senegal, provide tentative evidence that participation in growth and development monitoring confers a significant benefit on the health and nutritional status of children (Cunningham et al., 1978; Gwatkin et al., 1980; Kielmann et al., 1978; Alderman et al., 1978; Marek et al., 1999; De Souza et al., 1999; Shekar, 1991; Shekar and Latham, 1992). For instance, a nutrition program for young children, which comprised growth monitoring and nutrition education, was delivered by community health aides in July 1973 in Parish Hanover, Jamaica (Alderman et al., 1978; Gwatkin et al., 1980). After the program was introduced, there was a halving in the prevalence of underweight in treated areas. In contrast, a number of RCTs in Ghana, Lesotho, Thailand, India, and Bangladesh indicate that growth and development monitoring does not improve average nutrition, health, or school performance outcomes (Avsm et al., 1995; Hossain et al., 2005; Karim et al., 2003; Kapil and Pradhan, 1999; Pielemeier, 1978; Viravaidhya et al., 1981; Hazarika and Viren, 2013; Nandi et al., 2018, 2020). Weaknesses in program delivery, including incorrect weighing and plotting (Kapil et al., 1996) and failure to identify children with suspicious conditions, have been reported for these programs (Gopaldas et al., 1990; Gopaldas, 1988; Lalitha and Standley, 1988), which might explain the lack of impact from growth and development monitoring. Furthermore, these RCTs were unable to distinguish the effects of growth and development monitoring from those of other inputs.

3 Background

The SMC was designed by the Chinese Ministry of Health (MOH) in response to the prevalence of low health status among children and low average life expectancy in the early years of the People's Republic of China.[4] After measuring public opinions and consulting with medical doctors and other experts, the Chinese government decided to focus on growth and development monitoring with routine health checkups, thereby initiating the SMC as a trial in several provincial capitals, such as Tianjin, and a handful of other cities from the 1950s to 1960s. After observing improvements in child health status in the implemented cities, the MOH rolled out the SMC nationwide. By the end of 2020, more than 95% of counties and 96% of the Chinese population had been covered by this program.

The SMC provides free, government-funded routine health checkups to all young children (0-6 years) through community-based clinics operated by the MOH. Each child visits local clinics at 1, 3, 6, 9, and 12 months during the first year of life, twice in the second year, twice in the third year, and then once a year until six years of age. Services at all visits include basic measurements (e.g., height, weight, and head circumference), routine physical examinations (e.g., oral exams, vision and hearing screening,

[4] See "Life Expectancy at Birth, Total (Years)-China" from the World Bank for more details on life expectancy in China from 1960 to 2020.

externalia, and cardiac murmur), and developmental evaluations (e.g., the Denver Developmental Screening Test). Additional visits can be scheduled if clinically needed. When a suspicious physical or developmental issue is discovered at the clinics, the child is referred to a specialist for further diagnosis and treatment at hospitals.[5] Care is given by public health nurses working in collaboration with physicians. Appendix Table C.1. provides the full list of the SMC schedule and descriptions for the included service items.

The SMC has four features that facilitate our empirical analysis. First, although designed and initiated by the central government, the SMC is implemented locally. Thus, the significant variation in the timing of the SMC at the county level enables us to use a cohort DID model to capture its long-term impacts.[6] In particular, children in later-treated counties are compared with children in counties that initiated the program in earlier years. This comparison of early- and later-treated children addresses concerns over both selection into treatment and changes in cohort-specific earning patterns.

Second, participation in the SMC is mandatory for young children (0-6 years) throughout the country. For a first offense, parents who do not send their children for routine visits to community clinics receive a warning letter from the local government and are urged to make up for the missed visit as soon as possible. For subsequent offenses, parents may face penalties, such as restrictions on enrollment in welfare programs. As such, all children residing in SMC counties under the age of seven comprise the treatment group. Within the same counties, exposed children can be compared against older, never-treated cohorts. This age-cohort comparison follows related literature (Duflo, 2001; Hoynes et al., 2016; Hoehn-Velasco, 2021) and enables the inclusion of county fixed effects that remove time-invariant county characteristics.

Third, most counties in our data introduced the SMC during the 1976-1991 period. As the key dependent variable (income) comes from the 2005 Census, we have a sufficient post-implementation period to estimate the long-term impacts of the program. In addition, a child's birth date and *hukou* registration county approximate the treatment assignment and age at treatment for the SMC in our empirical analysis.[7]

[5]Further diagnosis and treatment by specialist physicians are not part of the SMC services.

[6]Once a county initiates the SMC, it remains in effect.

[7]The ideal data would include details about the birth county and the history of migration during

The unique *hukou* system acts as a domestic passport system with only nonimmigrant visas.[8] An individual's *hukou* is ascribed at birth based on her mother's *hukou* status. People can apply for temporary permits to live and work in other counties but are only entitled to social welfare and various public services in their *hukou* registration county.[9] Only small groups are permitted to permanently change their *hukou* registration counties under the following conditions: recruitment by a state-owned enterprise (*zhaogong*), enrollment in an institution of higher education (*zhaosheng*), and promotion to senior government official jobs (*zhaogan*) (Yang and Zhou, 1999).[10] This nationwide restriction on migration was still in place as of 2005 (Heckman, 2005; Grey, 2008). Our estimation serves as a conservative lower-bound estimate of the SMC's effect on adult earnings: the small percentage of people who have permanently changed their *hukou* registration county by the 2005 Census through the channels mentioned above are likely to be wealthier and better educated than their peers, thus attenuating our estimations toward zero (Chen et al., 2020; Sun, 2021; Zhao, 1997).

Fourth, the SMC is free of charge and delivered according to a standardized model guided by official MOH directives. The services offered in the SMC are identical across different counties. Hence, our analysis of children born in counties that have already initiated the program is informative of the overall effect of the SMC and sheds light on counties that have not yet implemented the program.

4 Data

In this section, we present the main features of the datasets used in this study. First, we gather information from over 3,000 local gazetteers (described in more detail in

the first six years of life. As such data do not exist, we thus gauge the treatment assignment and the age at treatment for the SMC with a child's birth date and *hukou* registration county.

[8] The *hukou* system was first implemented in cities in 1951 and was promulgated as a permanent system nationwide in 1958 (Chan and Zhang, 1999; Sun, 2021).

[9] The *hukou* system has no provision of permanent residency that allows individuals to live, work, and have access to social welfare and public services in another county without a permanent change in their *hukou* registration county. If one chose to migrate without going through legal channels, that person would not be permitted access to resources in the destination area. Denial of food, housing, education, and any other social services rendered illegal migration impossible to maintain (Grey, 2008).

[10] These groups comprised a very small percentage (about 1%-5%) of the whole population by 2005.

the next subsection) to construct a unique, county-level dataset of the years in which each county implemented the SMC. Second, we match this county-level information to individual-level population censuses and family surveys. The main outcome variable (adult earnings) comes from the 2005 Population Census.

County-level SMC Rollout

Data on the county rollout of the SMC were obtained from county gazetteers. Often considered the county's "encyclopedia," gazetteers are book-length volumes compiled by local historians to record each county's major events and draw upon materials in local archives. County gazetteers are not used in evaluating local officials, so they are less susceptible to misreporting. A number of studies have empirically gauged and endorsed the quality of gazetteer data (Almond et al., 2019; Chen et al., 2020; Chen and Lan, 2020).[11] Local governments typically form task forces to write and periodically update their gazetteers as an important source of local history and pride. However, not all historical information is recorded in local gazetteers; for example, one piece of information may be found in the gazetteers of some counties but not in others. We conducted a comprehensive review of all 3,153 gazetteers published in 2,868 counties.[12] Our primary analysis sample included the 873 counties that recorded the precise timing of the SMC.[13] We also collect other county-level statistics from local gazetteers to

[11] Several studies (Almond et al., 2019; Chen et al., 2020; Chen and Lan, 2020) have compared economic statistics in county gazetteers, such as gross production of grain, to the commonly used statistics in yearbooks, on which cadre evaluations are based. They document substantial agreement between the two data sources. Furthermore, Benford's Law, as suggested by Varian (1972), was applied to detect fake data in gazetteers, where falsified digits tended to be made up uniformly.

[12] The number of gazetteers exceeds the number of counties for two reasons. First, a county may have multiple gazetteers on different topics. Second, some counties may produce multiple gazetteers across different years. For example, a county may write one gazetteer during the 1990s and another one in the 2000s.

[13] Notably, if a county changed its code without changing its boundary, we treated it as the same county. We also exclude 22 counties merged before 2005. In those scenarios, we could not uniquely link counties in which the gazetteers were compiled to those in the 2005 Population Census. Appendix Figure A.1. shows the information on the SMC from the local gazetteers of Wuzhong County in Jiangsu Province (Commission of Wuzhong Gazetteer 1997, p. 1033), which documented that, "In 1981, the SMC was implemented in Wuzhong County. Through the SMC, a health management booklet is created right after the birth of a child and used by parents and doctors to record the child's growth, development, and use of health services."

complement our analysis. Appendix Table D.1. displays the summary statistics of these socioeconomic variables from the gazetteers.

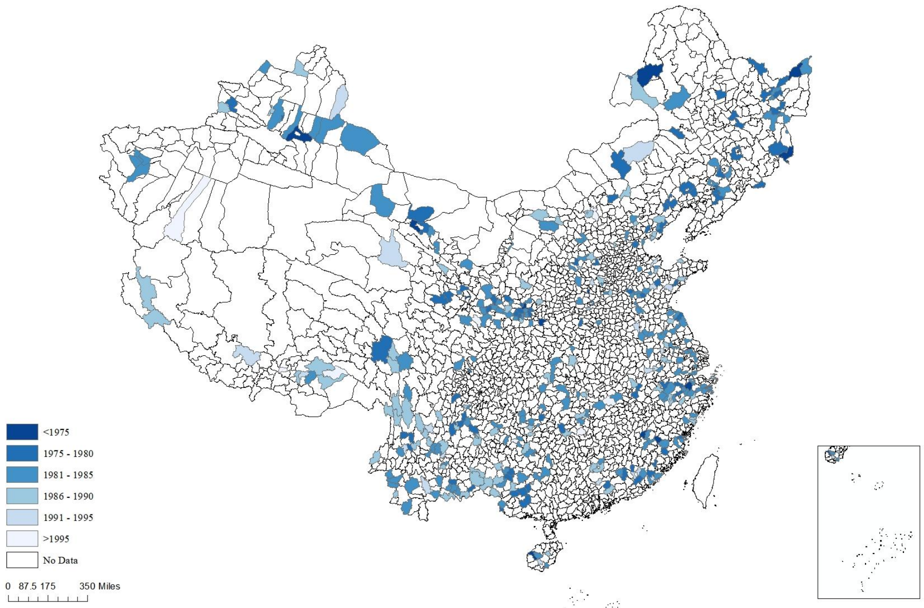

FIGURE 1
Counties and their year of entry into treatment, 1950-2010

Notes: Figure 1 plots county-by-county rollout over time. The county rollout data for the SMC adoption are from county gazetteers.

There may be some concerns about sample selection bias with missing values for the starting year of the SMC in other 1995 counties. We examine the pattern of missing values in Panel A of Appendix Table D.3. After adding province fixed effects, the SMC-reporting counties have similar demographic and socioeconomic characteristics as the non-reporting counties. Thus, missing values in gazetteers are not likely to threaten our empirical results in the baseline specification with province-by-cohort fixed effects.[14] Another concern is the exogeneity of the SMC arrival timing. If the timing of the SMC arrival is not randomly selected, early- and later-treated counties could show systematic differences. We test whether county demographic and economic characteristics predict adoption timing and report the results in Panel B of Table D.3. After

[14] Aside from province-by-cohort fixed effects, the baseline model includes county and birth year fixed effects.

adding province fixed effects, all county-level characteristics are unrelated to the SMC rollout, suggesting that exposure to the SMC is plausibly exogenous, conditional on the baseline fixed effects in our main specifications.

Figure 1 shows the regional variation on the SMC rollout, in which the darker a county, the earlier it implemented the SMC. Considerable variation can be observed in the timing of implementation among both developed and poorer counties. More importantly, as shown in Figure 2, the timing of treatment in the implementing counties varies over the entire period being considered. To identify the long-term effects of the program, our empirical strategy—discussed in the next section—relies on this variation in the timing of treatment initiation.

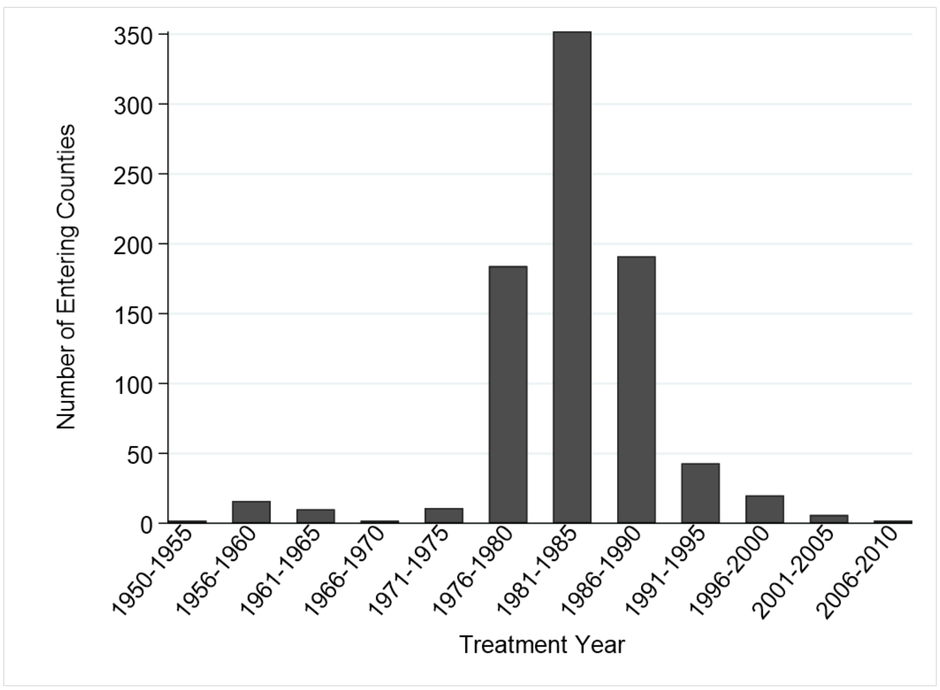

FIGURE 2

Number of counties by their year of entry into treatment, 5-year bins, 1950-2010

Notes: Figure 2 shows the number of counties entering the SMC program in different years. The county rollout data for the SMC adoption are from county gazetteers.

2005 Population Census

We merge the county rollout data with the 1% sample from China's 2005 Population Census to evaluate how young children's exposure to the SMC affected their overall earnings in adulthood. The 2005 Census is suitable for this study for three reasons. First, it records personal monthly income (measured in hundreds of RMB), which we use as the main outcome variable in the DID specification. Earlier or later censuses do not include personal income data. The 2005 Census also reports hours worked in the previous week as an additional measure of income. We compute hourly wages for census respondents by dividing the monthly income by the number of hours worked. To limit the influence of potential outliers in the income data, we winsorize 0.5% from each tail of the income distribution for the baseline sample.[15] In the baseline analysis, we focus on cohorts born between 1976 and 1986, who were at least 18 years old and mostly completed their compulsory education by 2005. Furthermore, these individuals were not exposed to the negative shocks that occurred in the early years of the foundation of the People's Republic of China, such as the Great Famine and the Cultural Revolution.[16]

Second, the 2005 Census collected information on year of birth and *hukou* registration county. As discussed in the background section, a child's birth date and *hukou* registration county nicely approximate the treatment assignment and the age at treatment for the SMC. Specifically, the length of exposure to the SMC is defined as the share of years between birth and age six that the SMC is available in the individual's *hukou* registration county.[17] Appendix Figure B.1. displays exposure to the SMC by

[15]For the 0.5% winsorization, we replace values above the 99.5th percentile by the value at the 99.5th percentile and values below the 0.5th percentile by the value at the 0.5th percentile.

[16]The early years of the People's Republic of China (1949-1976) were marked with a variety of catastrophic events, including the Great Leap Forward (1958-1962), the Great Chinese Famine (1959-1961), and the Cultural Revolution (1966-1976). A large body of literature has discussed the negative, long-term impacts of these historical events (e.g., Chen et al., 2020; Meng et al., 2015; Meng and Qian, 2009; Chen and Zhou, 2007; Deng and Treiman, 1997; Meng and Zhao, 2017). In the baseline analysis, we excluded pre-1976 cohorts that were exposed to these significant negative shocks.

[17]As it is not possible to define a clear-cut starting date of the program, we assume that the program has been initiated since the beginning of the year and count the reform year as one year of exposure for the exposed cohorts. To check the robustness of our analyses, we construct two alternative measures for the SMC exposure, assuming that the program was introduced either in the middle or at the end of the reform year so that the reform year is counted as 0.5 year of exposure or not counted for early-life exposure. The results, reported in Appendix Table E.2., are quite similar to the main results, suggesting

birth cohort, using the baseline sample for the 1976-1986 cohorts. As the timing of the SMC varies across counties, substantial variations in exposure to the program can be observed both within and between cohorts. This finding, combined with the large sample sizes (e.g., over 15,000 census respondents in each birth cohort), allows us to use the discrete nature of the SMC rollout with significant statistical power. Descriptive statistics for the linked sample are reported in Table 1. As shown in Panel B, the average share of years exposed to the SMC from birth to age six is 0.51.

TABLE 1
Summary statistics from the 2005 Census

Variables	(1) Obs.	(2) Mean	(3) Std. Dev.
Panel A. Income variables			
Monthly income	89,104	668.3	637.4
Hourly wage	87,245	3.469	3.485
Hours worked	87,245	47.36	12.93
Panel B. Regressor of interests			
Fractions of years exposed to the SMC (from birth to age 6)	89,104	0.510	0.401
Panel C. Control variables			
Age	89,104	24.30	3.110
Male	89,104	0.511	0.500
Share of ethnic minorities	89,104	0.142	0.349
Rural status	89,104	0.780	0.415

Third, the 2005 Census provides several measures of education outcomes that we can use to test the role of schooling in improving adult incomes. We coded our main education variable, *years of education*, based on the highest level of education an individual received and whether they completed each tier of schooling. We assume that an individual received six years of education if they graduated from primary school and coded higher-level schooling years in a similar fashion. We also use dummy variables indicating whether an individual completed primary (elementary) school, middle (junior high) school, high school, or college education as alternative measures of educational attainment. Aside from the income measures and education outcomes, we

that measurement error is unlikely to affect our results.

use several individual-level demographic and socioeconomic characteristics from the 2005 Census, including gender, age, ethnicity, and rural status, as control variables in our main DID specifications.

China Family Panel Studies (CFPS)

We merge the county rollout data with the CFPS data to evaluate how young children's exposure to the program affected their overall earnings in adulthood. The CFPS is a large-scale, nationally representative, longitudinal survey conducted by the Social Science Survey Institute at Peking University. The survey covers 25 out of 31 provinces and autonomous regions throughout China. Each wave of the survey collects comprehensive information on the demographic attribution, health measures, and economic activities of adults and children. Following the literature (Chen et al., 2020; Xu, 2021; Huang and Liu, 2023), we use the baseline 2010 wave (hereafter referred to as "CFPS-2010") in our main empirical analysis.

The CFPS-2010 provides numerous measures of physical and mental health, as well as cognitive outcomes that we can use to explore additional mechanisms through which exposure to the SMC can lead to improved adult earnings. The first measure of physical health is the self-assessed general health status, which is rated on a 5-point scale (poor, fair, good, very good, or excellent).[18] We also construct a binary health indicator that takes the value of 1 if the adult reports being in excellent or very good health and 0 otherwise. Our second measure of health is an indicator of whether a person has had a doctor's visit due to physical discomfort within the past two weeks. In addition, we aggregate these measures of physical health and construct a physical health index to resolve problems associated with multiple hypothesis testing. Following the literature (Hoynes et al., 2016; Boudreaux et al., 2016), the physical health index is constructed as the average value across the standardized z-scores of each measure of physical health.

For mental health, the first two measures are indicators of whether an individual has experienced feelings of upset or hopelessness in the past four weeks. Likewise, the third and fourth measures report whether a person has experienced feelings of restlessness or worthlessness over the last four weeks. We also aggregate these four measures of

[18]The scale is arranged in ascending order, with poor equals to 1 and excellent equals to 5.

mental health and construct a mental health index as the average value across the standardized z-scores of each measure of mental health to account for multiple hypotheses.

To assess cognitive abilities, we use scores on the math and verbal exams designed and administered in the CFPS-2010. The math exam assesses knowledge of primary and secondary mathematics and consists of 24 questions.[19] The verbal test is based on 34 questions and measures an individual's ability to spell Chinese characters correctly. The total number of possible points for the verbal test is 34.[20] In addition, we construct standardized z-scores for these two cognitive measures (calculated by subtracting the average test scores and dividing by the standard deviation). Consistent with the 2005 Census, we also collect individual-level demographic and socioeconomic characteristics from the CFPS-2010 as control variables in our main DID specifications, including gender, age, ethnicity, and rural status (Panel A of Appendix Table D.2.).

China Health and Nutrition Survey

Apart from the CFPS-2010, we use data from the CHNS 1989-2010 to further explore the potential mechanisms behind income improvements. The CHNS is an ongoing longitudinal survey conducted by the Carolina Population Center at the University of North Carolina Chapel Hill and the Chinese Centers for Disease Control and Prevention. It covers 9 out of 31 provinces and autonomous regions in China.[21]

The CHNS has detailed records of childcare, constituting important supplements to our mechanism analysis. We construct three measures of parental investments from the CHNS and assess how SMC exposure predicts changes in parental investments. The first two measures are maternal childcare time for adolescents aged 7-17 (measured in hours) and monthly household expenditure on childcare (measured in RMB). The third measure is whether adolescents aged 7-17 receive routine health examinations.

[19] These questions are ranked in ascending order of difficulty. Each correct answer is worth one point. The total possible score for the math exam is 24 points.

[20] Similar to the math test, questions in the verbal test are arranged in increasing order of difficulty. One point is awarded for each correct answer and zero points are given for questions that are skipped or answered incorrectly.

[21] These nine sample provinces cover approximately 45% of China's total population and vary widely in terms of geography, economic development, public resources, and health indicators.

5 Empirical Methodology

Difference-in-Differences Specification

Equation 1 below presents our baseline staggered DID model, which compares individuals exposed to the SMC to those born earlier and contrasts children across each birth year for early- and later-treated counties.

$$Y_{icb} = \alpha + \beta SMC_{cb} + \tau X_{icb} + \gamma_c + \mu_b + \delta_{pb} + \epsilon_{icb}, \qquad (1)$$

In the equation, Y_{icb} is the natural logarithm of monthly income for individual i in *hukou* registration county c and birth year b, and SMC_{cb} is the proportion of years an individual is exposed to the SMC from birth to age six (it is a function only of a child's birth year b and county c). For example, if a county adopted the SMC in 1982, cohorts born in and after 1982 in the county are considered fully exposed and are assigned the value 1, while those born before 1976 are defined as nonexposed and are assigned the value 0.

The estimates of the coefficient β reflect the effect of the SMC. With the mandatory participation of all children from birth to six years old, the estimated effects come close to the population average treatment effects of the SMC. In addition, X_{icb} includes a set of individual characteristics, such as gender, age, ethnicity, and rural status. County fixed effects, γ_c, absorb time-invariant location-specific factors that could affect lifelong earnings. The birth year fixed effects, μ_b, control for secular changes that are common to all counties in a given year. Local, time-varying shocks to adult earnings that affect all individuals are absorbed by province-by-birth-year fixed effects, δ_{pb}.[22] ϵ_{icb} represents the regression error, with all standard errors clustered at the county level throughout the analysis.[23]

[22]It should be noted that the fixed effect for the timing of implementation, θ_t, is absorbed by the county fixed effect. This is because the timing of the SMC adoption does not vary within county.

[23]In our robustness checks in Appendix Table E.3., we cluster standard errors at the county-year level, allowing arbitrary correlation in error terms for a given county-year pair. The results show that the SMC effect remains highly similar when clustering standard errors at the county-year level.

The advantage of the specification in Equation 1 lies in the two control groups created for SMC_{cb}. The first control group includes cohorts seven years and older upon the implementation of the SMC in their *hukou* registration county. The second control group exists because of the staggered adoption of the SMC; children under seven in early-treated counties are compared with older, nonexposed children in later-treated counties. As the timing of treatment is unrelated with county demographic characteristics after controlling for province-by-birth-year fixed effects, as shown in Panel B of Appendix Table D.3., these later-treated individuals help account for unobservable characteristics that may affect selection into treatment that are not removed by county fixed effects.

Internal Validity

The central requirement for identification in our DID strategy is the parallel-trend assumption, wherein in the absence of the SMC, the average income for people exposed to the SMC would have followed the same trend as that for nonexposed people. While the counterfactual is certainly unobservable, we perform a series of robustness tests to support the parallel-trend assumption. As shown in Figure 3, we conduct an event study to examine the relationship between age at first exposure and adult outcomes. Specifically, we employ a set of dummy variables indicating the timing of the SMC exposure. We find that the estimates of "placebo" exposure (i.e., cohorts aged seven and older when the SMC was first implemented in their *hukou* registration county) are very small and statistically insignificant. This little or no impact of the SMC on nontreated cohorts supports the parallel trend of our DID strategy. To better address concerns about differential cohort trends, we assumed that the SMC had been implemented 5, 6, 7, 8, and 9 years earlier than the actual arrival year in each county and then replicated the main regressions in Appendix Table E.10. We consistently find no effect of the SMC on adult income in these "placebo" settings, lending further credence to the staggered DID approach.

We also estimate models that control for county-specific linear or quadratic cohort trends. It is particularly important in our context that the trends reflect pre-treatment trends, as it would be easy to confuse a gradually increasing post-SMC effect for cohorts increasingly exposed to the SMC with post-treatment county-specific trends. Recall that, among the cohorts who participated in the program, the oldest cohort exposed in a given county was exposed for only one year, the next-to-oldest for two years, and so on. Therefore, we estimate the pretreatment trends on a sample of individuals born between 1950 and 1960, where we run regressions on monthly income as a function of county, birth year, and province-by-birth-year fixed effects and linear or quadratic county-specific trends. We then used the coefficients from these regressions to predict the trends in monthly income for our main sample and included these predicted trends as control variables in our baseline DID regressions.[24]

We expect that access to the SMC will improve adult income. However, the same forces could also lead to a change in birth cohorts through endogenous sample selection. For instance, if the introduction of the SMC leads to increases in the fertility of disadvantaged women, this could bias the estimates downward. We evaluate this channel in Appendix Table E.4. and find no effect of the SMC on the size of birth cohorts.

In addition, there may be some concerns that our estimates are biased by other concurrent policies and factors. These must coincide with the SMC rollout by county and only affect children below the age of seven when the SMC was first introduced in the county. From our systematic review of contemporaneous historical policies, no candidate confounders adhere to these precisely described patterns. Nonetheless, to further alleviate concerns regarding concurrent policies, we control for the possible influences of the compulsory education system and the One-Child Policy, which could raise the overall lifetime earnings in China, and report the results in Table E.5. in the Appendix.

The estimated coefficients on the SMC remain highly similar to those in the baseline specifications and statistically significant, thus confirming the robustness of our SMC estimates (see Appendix, Section E for more details). Furthermore, in Appendix Table E.8., we show that the estimates for the long-term effects of the SMC are robust to accounting for heterogeneity in the treatment effects over time or across groups.[25]

[24] See Wolfers (2006), Holmlund (2008), Lee and Solon (2011), and Lundborg et al. (2022) for examples of this approach.

[25] For this robustness check, we used the methods proposed by De Chaisemartin and d'Haultfoeuille (2020) and Callaway and Sant'Anna (2021).

In Table E.3., our estimates are also robust to various empirical specifications that relax the classical DID assumption and allow differential growth trajectories for different provinces.

Finally, we conduct the randomization inference procedure, as suggested by Bertrand et al. (2004), and presented the results in Appendix Figure E.1. Here, we randomly assign a year of the SMC implementation to each county and estimate the DID specification as a placebo treatment effect. This procedure is repeated 1000 times to form a distribution of placebo treatment effects. The point estimates obtained in the main regressions are significant compared with the distribution of placebo effects, thus corroborating the validity of the DID approach. [26]

6 Long-Run Income Effects of the SMC

This section assesses the long-term impacts of the SMC on adult earnings. Table 2 presents estimates of the increases in adult incomes driven by the SMC, using different control variables in each DID specification. The specification in Column 1 controls for county, birth year, and province-by-birth-year fixed effects, indicating that full exposure to the SMC leads to a 5.3% increase in adult earnings. As individual characteristics may affect adult outcomes, our preferred specification in Column 2 includes gender, age, ethnicity, and rural status as additional control variables.[27] The addition of these individual characteristics increases the estimates to a 5.8% income gain, and the effect remains statistically significant.

We make several adjustments to the base specifications to ensure the robustness of these results to county-time effects, which may relate to the timing of the SMC. In particular, our specifications in Columns 3-7 build on the model in Column 2 by adding linear cohort trends interacted with county characteristics in Table D.3., including population size, urbanization rate, per capita grain production, share of ethnic minorities, and average years of schooling. The estimates obtained are highly similar to those shown in Columns 1-2, thus bolstering confidence in our baseline model.

[26] Please see Section E in the Appendix for more detail.

[27] Given that the age variable is calculated by subtracting the birth year from the 2005 Census year, it is collinear and absorbed by the birth year fixed effects.

TABLE 2

Effects of the SMC on adult income

	log(Monthly income)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SMC Share IU–6	0.053**	0.058**	0.055**	0.057**	0.050**	0.047**	0.047**
	(0.025)	(0.023)	(0.023)	(0.023)	(0.024)	(0.024)	(0.024)
Observations	89,112	89,104	83,663	83,663	75,483	75,483	75,483
R-squared	0.357	0.427	0.415	0.415	0.413	0.413	0.413
Baseline FE	YES	YES	YES	YES	YES	YES	YES
Controls		YES	YES	YES	YES	YES	YES
Log(County population in 1964) * Trend			YES	YES	YES	YES	YES
Share of urban population in 1964 * Trend				YES	YES	YES	YES
Log(Grain output in 1965) * Trend					YES	YES	YES
Share of ethnic minorities in 1964 * Trend						YES	YES
Average years of schooling * Trend							YES

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. The dependent variable in each column is the natural logarithm of monthly income for individual i. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The baseline specification in Column 1 includes birth year, county, and province-by-birth-year fixed effects. Column 2 adds individual characteristics on the basis of Column 1, including age, gender, ethnicity, and rural status. Columns 3, 4, 5, 6, and 7 build on the specification in Column 2 by adding the natural logarithm of the county population in 1964, share of urban population in 1964, the natural logarithm of grain output in 1965, share of ethnic minorities in 1964, and average years of schooling interacted with linear time trend. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Appendix Table D.4. also reports the heterogeneous effects of the SMC on adult earnings by gender and by level of development (more-developed eastern provinces versus less-developed non-eastern provinces).[28] Columns 1-2 indicate that the effects did not differ by gender.[29] In Columns 3-4, we find that children from eastern provinces gained more from the SMC than their peers from non-eastern provinces. The larger estimates for the SMC exposure in more developed provinces are reasonable, as these provinces offer enhanced job opportunities for individuals to realize their earning po-

[28] Eastern provinces were the original focus of Chinese economic liberalization in the 1980s. Thus, these provinces have higher levels of economic growth, foreign direct investments, and personal incomes.

[29] Our estimates of the earnings improvement for males are not statistically different from those estimated for females (*p-value=0.926*).

tential.

To the best of our knowledge, no previous studies have estimated the long-term benefits of growth and development monitoring *per se*. To put the longer-term effects of the SMC into perspective, our estimates of the earnings improvement from full exposure to the SMC are of similar magnitude to those estimated in a recent study for early childhood exposure to county-level health departments (CHD) in rural America (Hoehn-Velasco, 2021). In particular, Hoehn-Velasco (2021) concluded that CHD operations before the age of five increase men's later-life earnings by 2%-5%. Besides, the estimated income gains are qualitatively similar to the corresponding estimates for school lunch reform (Lundborg et al., 2022). Lundborg et al. (2022) reported that Swedish pupils exposed to the free school lunch program during their entire primary school period had 3% higher lifetime incomes than their peers who were not exposed. The benefit of the SMC exposure, however, is lower than the estimated positive long-term (adulthood) effects of early childhood intervention programs, such as deworming treatments, malaria eradication, and use of food stamps (Baird et al., 2016; Bleakley, 2007, 2010; Hoynes et al., 2016). For instance, malaria eradication has been associated with a 50% increase in later-life income (Bleakley, 2010). In the current study, smaller estimates for the SMC exposure are expected, as these intervention programs have targeted highly selected and disadvantaged groups, where the scope for long-term income improvements is likely greater at the start.

Event Study: Differential Effects by Age at First Exposure

Motivated by the findings in the previous subsection, we conducted an event study to examine how the effects of the SMC vary across different exposure windows in childhood, especially when the services offered can be most effective. Empirically, we replace the main measure of the SMC (SMC_{cb}) in Equation 1 with a set of dummy variables for categorical age at the SMC introduction in their *hukou* registration county, measured in 1-year bins from prebirth to adulthood (e.g., -1-, 0, 1, 2, and so on). Relative to the baseline model, this flexible specification allows us to capture the differential effects across all windows of exposure, including the "placebo" exposure beyond age six. Meanwhile, through this event study, we could assess the validity of the parallel-trend

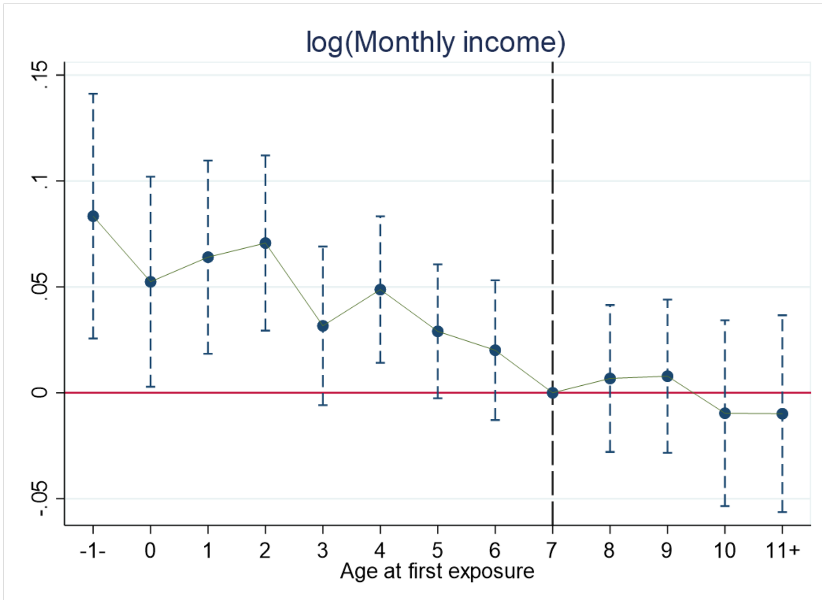

FIGURE 3

Effect of the SMC on the long-term income with different ages at first exposure

Notes: Figure 3 plots the coefficients and the 95% confidence intervals for the main specification, where the key independent variables are a set of categorical measures of age when the SMC was introduced in the county. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and includes adults who were born between 1976 and 1986. On the x-axis, the event time "-1-" is when the SMC was introduced in the county prior to birth, indicating the fully exposed cohorts. The other event times such as "1" and "8" indicate ages at first exposure. The model estimated uses the same set of preferred county, birth year, province-by-birth-year fixed effects and individual characteristics as in Table 2. Standard errors are clustered at the county level.

assumption of the DID approach, which states that trends in adult outcomes across different counties would have been similar in the absence of the SMC exposure.

Figure 3 plots the estimates of the timing dummies with 95% confidence intervals for log value of monthly income using the same set of preferred county, birth year, province-by-birth-year fixed effects, and controls as in Column 2 of Table 2. The reported coefficients capture the effects of the SMC on children with different exposures to the program. On the x-axis, the event time "-1-" occurred when the SMC was introduced in the county prior to the birth year, indicating the fully exposed cohorts. The other event times, such as "1" and "8", indicate ages at first exposure. Consistent with our results in Table 2, Figure 3 highlights a systematic and persistent increase in adult earnings for those exposed to the SMC. Earnings improvement is greatest for children who received the SMC services from birth and shows an overall declining trend as age at first exposure increases. The finding that children exposed to the SMC from age three or four years still gained an approximately 2% increase in lifetime earnings calls further attention, as this suggests growth and development monitoring beyond the first three years of life remains important and could generate considerable long-term benefits. The estimates of "placebo" exposure above age 6 (i.e., 7, 8, 9, and so on) are small and statistically insignificant. Such a zero or negligible impact on children not exposed to the SMC because the program arrived too late supports the validity of our DID specification.

Decomposition of the increase in adult income

TABLE 3

Decomposition of the SMC effect on long-term income

Variables	log(Monthly income)	log(Hourly wage)	log(Hours worked)
	(1)	(2)	(3)
SMC Share IU–6	0.058**	0.049***	-0.013
	(0.023)	(0.015)	(0.009)
Baseline FE	YES	YES	YES
Controls	YES	YES	YES
Observations	89,104	87,245	87,245
R-squared	0.427	0.434	0.126

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 Census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. The dependent variable of Column 1 is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. The dependent variable of Column 2 is the natural logarithm of hourly wage and the dependent variable of Column 3 is the natural logarithm of hours worked last week. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. All models include birth year, county, and province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

After estimating the overall impact of the SMC on adult earnings, we decompose the effect by estimating Equation 1 on the natural logarithm of hourly wage and, separately, on the natural logarithm of hours worked last week, using the preferred specification in Column 2 of Table 2. The estimates are reported in Table 3. As can be seen, Column 1 replicates the regression in Column 2 of Table 2 as benchmark estimates. Column 2 examines the effects of the SMC on hourly wages and finds similar results. Comparing the estimates of β in Columns 1 and 2, we see that the increase in adult earnings mainly comes from the increase in marginal productivity. Meanwhile, Column 3 examines the effect of the SMC on hours worked last week. As shown in the table, the coefficient of β is only 0.015 and not statistically significant. These findings suggest that income improvements primarily result from the higher marginal productivity of individuals, rather than a trade-off between leisure and time spent in the labor force.

Robustness Tests

In Appendix Section 6, we discuss the robustness of the main results and address several confounding factors that may also generate the positive link between the arrival of the SMC and an increase in adult income. We also performed additional robustness tests to bolster a causal interpretation of our results. Our main results are robust to different sample choices (Appendix Table E.1.), to the use of alternative measures for the SMC exposure (Appendix Table E.2.), and to various specifications that allow differential growth trajectories for different provinces and cluster standard errors at the county-year level (Appendix Table E.3.). Besides, the effect on income is not driven by changes in birth cohorts (Appendix Table E.4.), contemporaneous historical events (Appendix Table E.5.), or income outliers, such as top- and low-earners (Appendix Table E.6.). Furthermore, the effect of the SMC on lifetime income is robust after controlling for linear and quadratic county-specific trends (Appendix TableE.7.), upon accounting for recent concerns that staggered DID estimates may be biased in the presence of heterogeneity in the treatment effects over time or across groups (Appendix Table E.8.), and accounting for multiple hypotheses testing (Appendix Table E.9.). Finally, the point estimates obtained in the main regressions are significant compared with the distribution of placebo effects obtained in the randomization inference procedure (Appendix Figure E.1.).

7 Health and Education Outcomes

After estimating the income improvements driven by the SMC, we turn to health and education outcomes. Specifically, we consider the effects of the SMC on the exposed children's physical and mental health, educational attainment, and cognitive development. While these are interesting outcomes in their own right, we also evaluate them as potential mediators through which the SMC may affect adult income.

Physical Health

TABLE 4
The effect of the SMC on physical health

	Self-reported health status			
	5-point scale	Dummy	Doctor visit	Physical health index
	(1)	(2)	(3)	(4)
SMC Share IU–6	0.390**	0.123**	-0.142***	0.580***
	(0.155)	(0.053)	(0.039)	(0.125)
$\bar{Y}$ of control group	4.566	0.939	0.101	0.042
Baseline FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	2,142	2,142	2,142	2,142
R-squared	0.229	0.204	0.200	0.192

Notes: This table shows the regression results for Equation (1). Data are a linked sample of the CFPS 2010 with the SMC county-by-county rollout and include adults who were born between 1976 and 1992. The dependent variable in Column 1 is a 5-point scale of self-reported health status. The dependent variable in Column 2 is a binary health indicator that takes the value of 1 if the adult reports being in excellent or very good health and 0 otherwise. The dependent variable in Column 3 is a binary health indicator that takes the value of 1 if the adult has had a doctor's visit due to physical discomfort within the past two weeks and 0 otherwise. The dependent variable in Column 4 is a summary index calculated as the average of standardized z-scores for the three measures of physical health in Columns 1-3. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The specification in each column includes birth year, county, province-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Access to growth and development monitoring during early childhood may improve children's longer-term physical health and development through the early diagnosis and timely treatment of health issues. In the current study, we access this potential channel using the sample of cohorts born between 1976 and 1992 from the CFPS-2010. These cohorts were at least 18 years old by 2010. Specifically, we modify Equation 1 to use the self-assessed general health status—rated on a 5-point scale—as the dependent variable. Column 1 of Table 4 displays the effect of the SMC on general health status in adulthood, using the same set of preferred control variables as in Column 2 of Table 2. In line with our expectations, the introduction of the SMC improves self-assessed health status.

Next, we repeat the analysis using a dummy variable in Column 2 of Table 4, indicating whether an individual is in excellent or very good health. The results indicate that the SMC increases the chances of being in good health by 12.4 percentage points. In Column 3 of Table 4, we replicate the analysis using an indicator of whether a person has had a doctor's visit due to physical discomfort within the past two weeks. Consistent with the estimates in Columns 1 and 2, the SMC exposure in early childhood reduces the probability of doctor's visits due to physical discomfort by 14.2 percentage points.[30] These findings offer evidence that there is an improvement in overall health for people exposed to the SMC. These estimates remain highly similar when we account for multiple hypotheses testing with FDR-corrected p-values (Panel A in Appendix Table G.1.).

To further ensure the robustness of the results, we conduct the event study for the physical health index in Panel A of Figure 4. Consistent with initial expectations, the health improvement shows an overall declining trend as age at first exposure increases from 0 to 6. The estimates of "placebo" exposure above age six are small and statistically insignificant, corroborating the validity of our DID specification. Our estimate of

[30] We also examine the effect of the SMC on chronic diseases. The estimates are small and statistically insignificant for the 1976-1992 cohorts in the CFPS-2010 and the CHNS (Table H.1. in the Appendix). This is not surprising because the oldest cohort in our baseline sample is 34, at which age chronic health conditions have not yet emerged for most people. To further explore the effects of the program on chronic illnesses, we continue the analysis with cohorts in the middle age (45-64). Table H.2. presents the results for hypertension, tumor, fracture, migraine, and gastritis. We find that treated individuals have a lower probability of having chronic diseases. In particular, those exposed to the SMC are less likely to be diagnosed with high blood pressure, tumor, and migraine. Furthermore, exposure to the SMC decreases the probability of developing bone fractures and gastritis. These findings suggest that individuals exposed to the program enjoy healthier lives at older ages and are consequently more likely to impose a significantly lower financial burden on the country's medical system.

the long-term health improvement of the SMC exposure is qualitatively similar to the corresponding estimates for Medicaid (Boudreaux et al., 2016) and the Food Stamp Program (Hoynes et al., 2016). In addition, these findings align with prior work (Pitt et al., 2012; Baird et al., 2016; Bhalotra et al., 2017; Hoehn-Velasco, 2021), suggesting that enhancements in health during early childhood lead to improved physical well-being in adulthood.

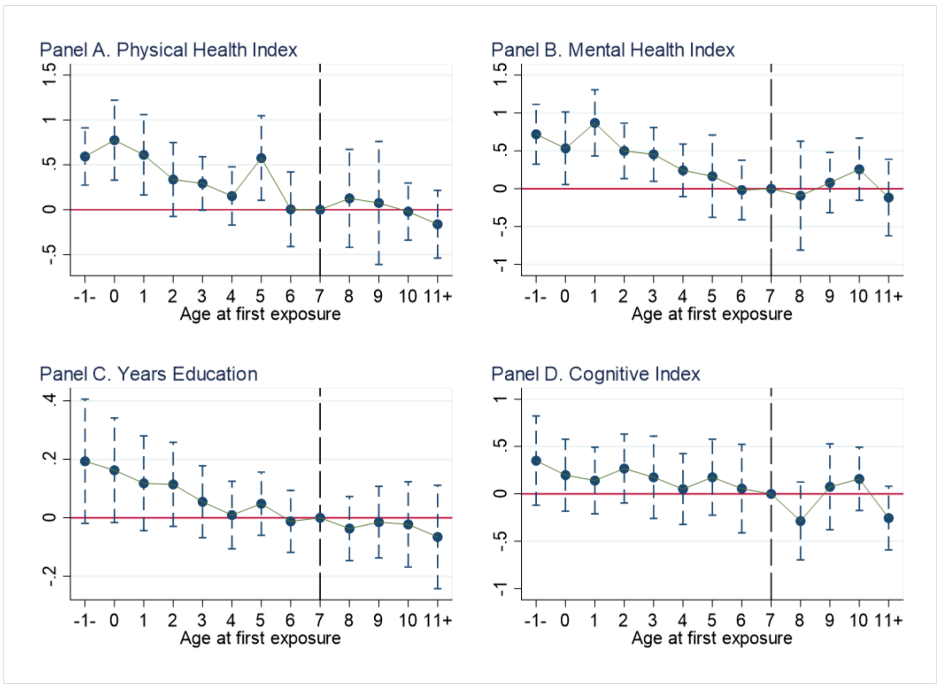

FIGURE 4

Event Study Plots (Health and Education Outcomes)

Notes: Figure 4 plots the coefficients and the 95% confidence intervals for the main specification, where the key independent variables are a set of categorical measures of age when the SMC was introduced in the county. Data in Panel A, B and D are a linked sample of the CFPS-2010 with the SMC county-by-county rollout and include adults who were born between 1976 and 1992. Data in Panel C are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. On the x-axis, the event time "-1" is when the SMC was introduced in the county prior to birth, indicating the fully exposed cohorts. The other event times such as "1" and "8" indicate ages at first exposure. The model estimated uses the same set of preferred county, birth year, province-by-birth-year fixed effects and individual characteristics as in Table 2. Standard errors are clustered at the county level.

Mental Health

TABLE 5
The effect of the SMC on mental health

Variables	(1) Upset	(2) Hopeless	(3) Restless	(4) Worthless	(5) Mental health index
SMC share IU–6	-0.159***	-0.137**	-0.091**	-0.104***	-0.760***
	(0.049)	(0.051)	(0.037)	(0.033)	(0.154)
$\bar{Y}$ of control group	0.048	0.026	0.031	0.039	-0.107
Baseline FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	2,142	2,142	2,142	2,142	2,142
R-squared	0.151	0.160	0.139	0.150	0.156

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the CFPS-2010 with the SMC county-by-county rollout and include adults who were born between 1976 and 1992. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in Column 1 is an indicator that takes the value of 1 if a person has had upset feelings in the past four weeks and 0 otherwise. The dependent variables in Columns 2-4 are indicators that take the value of 1 if a person has experienced feelings of hopelessness, restlessness, or worthlessness in the past four weeks, respectively. The dependent variable in Column 5 is a summary index calculated as the average of standardized z-scores for the four measures of mental health in Column 1-4. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Apart from the benefits mentioned above, routine health checkups offered by the SMC may improve the mental well-being by promptly diagnosing and treating mental health issues. Meanwhile, SMC exposure could reduce mental distress by endowing children with a better quality of life and improved productivity. To analyze this channel, we estimated the long-term effects of the SMC on four measures of mental health based on Equation 1 and reported the results in Table 5. The estimates indicate significant improvement in psychological well-being in adulthood with exposure to the SMC. Specifically, as shown in Columns 1-2, access to the SMC from birth, compared to its absence, is associated with a decrease of 15.9 percentage points in the likelihood of experiencing upset feelings and a 13.7 percentage point reduction in the probability of experiencing feelings of hopelessness. Consistently, in Columns 3-4, the estimates suggest that full exposure to the SMC reduces the probability of feeling restless by 8.6 percentage points and decreases feelings of worthlessness by 5.4 percentage points.

In addition, in Column 5, we show that exposure to the SMC reduces the mental health index by 0.767 standard deviation. The effect of the SMC on mental health remains significant after accounting for multiple hypotheses using FDR-corrected p-values (Panel B in Table G.1.). In Panel B of Figure 4, the event study for the mental health index confirms that the SMC exposure improves psychological well-being in adulthood. As expected, the effect declines through age six and shows no evidence of pretrends from nonexposed cohorts. These findings confirm the results of related works (Adhvaryu et al., 2019; Persson and Rossin-Slater, 2018) stating that better early-life health decreases the probability of mental distress and enhances mental well-being in adulthood.

Parental Investments

Several economic studies have shown that parents' investment strategies are related to childhood endowments; that is, parents invest more in children with higher endowments (Deng and Lindeboom, 2022). Therefore, if the SMC boosts early childhood endowment, children with higher program exposure are likely to receive more investments from their parents (i.e., reinforcing parental investments). Following the literature, we use a sample of children aged 0-17 years from the CHNS and assess how SMC exposure predicts changes in three measures of parental investments, based on Equation 1. The first measure is monthly household expenditure on childcare. The second measure is maternal childcare time for adolescents aged 7-17. The third measure is whether adolescents at ages 7-17 continue to receive growth and development monitoring through routine health examinations. Table 6 presents the estimates for the variables of the parental investment channel. As can be seen, while SMC has no significant effect on monthly expenditure and the amount of time dedicated to childcare, the introduction of the SMC increases the use of routine health examinations by 3.7 percentage points among children aged 7-17. This finding suggests that parents make reinforcing investments in growth and development monitoring for their children who received the SMC services in early childhood. The observed sustainability

TABLE 6

The effect of the SMC on parental investments

	(1) Monthly expenditure on childcare	(2) Maternal childcare time	(3) Routine health examination
SMC Share IU–6	0.707	1.206	0.079*
	(0.661)	(0.842)	(0.043)
$\bar{Y}$ of control group	3.404	1.651	0.021
Baseline FE	YES	YES	YES
Province-birth FE	YES	YES	YES
Province-wave FE	YES	YES	YES
Controls	YES	YES	YES
Observations	1,015	2,521	2,370
R-squared	0.489	0.137	0.190

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the CHNS 1997-2011 with the SMC county-by-county rollout and include households with children aged 7-17. The dependent variable in Column 1 is the monthly household expenditure on childcare (measured in RMB). The dependent variable in Column 2 is the maternal childcare time. The dependent variable in Column 3 is whether adolescents at ages 7-17 continue to receive routine health examinations. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

of the increase in routine health checkup usage among adolescents aligns with continued behavioral changes after completing hygiene promotion programs (Wilson and Chandler, 1993; Cairncross et al., 2005).[31]

Education Outcomes

Children who become healthier from SMC exposure are more likely to attend school regularly and attain more years of schooling. This increase in the quantity of education attained would, in turn, then contribute to their higher earnings in adulthood, as measured in Table 2. To explore the potential connection between the SMC and schooling, we examine the sample of children born between 1976 and 1986 from the 2005 Census

[31]Over half the adults in intervention areas still maintained good handwashing practice up to nine years since the conclusion of a multifaceted hygiene promotion intervention, while only less than 10% of adults in control areas sustained their handwashing practices (Cairncross et al., 2005).

and estimate the effects of the SMC on years of education based on Equation 1. In addition, we used dummy variables indicating whether an individual completed elementary (primary) school, middle (junior high) school, high school, or college as alternative measures of educational attainment. The first column in Table 7 reports the results for years of schooling, showing that SMC exposure increased children's education by about 0.18 years. Given previous estimates of returns to schooling, the 0.18-year increase in schooling translates into an approximately 0.95% increase in adult incomes.[32] We arrive at a similar conclusion after controlling for schooling in a regression on the effect of the SMC on income, where the SMC coefficient decreases by 20% (Table F.1.). To ensure the robustness of the results, we provide event-study estimates of the effect of the SMC on years of education in Panel C of Figure 4. Consistent with the initial expectation, SMC exposure improves years of schooling, with the effect declining through age six. The pattern in the figure shows no evidence of pretrends; the point estimates of the "placebo" exposure are close to zero and insignificant.

TABLE 7

The effect of the SMC on educational attainment

Variables	Years education	Primary	Junior high	Senior high	College
	(1)	(2)	(3)	(4)	(5)
SMC Share IU–6	0.180**	0.002	0.004	0.020*	0.025***
	(0.088)	(0.005)	(0.010)	(0.011)	(0.010)
$\bar{Y}$ of control group	9.010	0.936	0.768	0.250	0.030
Baseline FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	115,069	115,069	115,069	1115,069	115,069
R-squared	0.444	0.227	0.273	0.376	0.167

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in Column 1 is the years of education. The dependent variables in Columns 2-5 are dummy variables indicating whether an individual completed primary (elementary) school, middle (junior high) school, high school, or college education. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

[32] For this calculation, we used results from Wang (2013), who concluded that an additional year of schooling in China raises income by about 5.3%. For the current study's sample of children born between 1976 and 1986 from the 2005 Census, the income increase is 0.18 x 5.3 which is about 0.95%.

Columns 2 and 3 respectively present the results using the completion of primary and middle school instead. Neither shows any sign of significance, and the coefficients are much smaller, indicating that the SMC has no impact on the likelihood of finishing elementary or middle school for the 1976-1986 cohorts. These findings are reasonable because these cohorts are all covered by the compulsory education law and are mandated to finish middle school. Meanwhile, Columns 4 and 5 in Table 7 display the results using the completion of high school and college as alternative educational outcomes. As can be seen, exposure to the SMC increases the likelihood of high school and college graduation by 2.4 and 2.2 percentage points, respectively. The effect on schooling remains significant when we adjust for multiple hypothesis testing using FDR-corrected p-values (Panel C in Appendix Table G.1.). The SMC education benefit treatment is sizable and comparable to those estimated in previous studies for early childhood exposure to health insurance (Huang and Liu, 2023; Miller and Wherry, 2019) and iodine supplement (Deng and Lindeboom, 2022; Field et al., 2009). In addition, the magnitude of the improvements in schooling is similar to those estimated for school lunches in Sweden (Lundborg et al., 2022) and access to safe drinking water in China (Zhang and Xu, 2016).

Cognitive Outcomes

Furthermore, as schoolwork is an energy-intensive activity, healthier children are more likely to do better in their coursework. This improvement in the quality of education would also increase their later-life earnings in adulthood. To test this potential channel, we look at the sample of 1976-1992 cohorts from the CFPS-2010 and estimate the effects of the SMC on two cognitive measures, math and verbal test scores, based on Equation 1. The first two columns of Table 8 display the results for verbal scores. No statistically significant change in verbal test scores are observed after the introduction of the SMC. In contrast, Column 3 shows a significant improvement in math scores from the SMC exposure. The introduction of the SMC is associated with a 1.82-percentage point increase in math test scores, which is significant at the 5% level. Consistently, Column 4 reports a 0.29 increase in the standard deviation in math

TABLE 8

The effect of the SMC on cognitive outcomes

Variables	Verbal test score		Math test score	
	Score	z-score	Score	z-score
	(1)	(2)	(3)	(4)
SMC Share IU–6	1.274	0.218	1.816**	0.290**
	(0.140)	(0.148)	(0.842)	(0.141)
$\bar{Y}$ of control group	21.943	0.102	12.192	-0.018
Baseline FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	2,142	2,142	2,142	2,142
R-squared	0.632	0.572	0.739	0.704

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the CFPS-2010 with the SMC county-by-county rollout and include adults who were born between 1976 and 1992. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variables in Columns 1 and 3 are math and verbal test scores, respectively. The dependent variables in Columns 2 and 4 is a summary index calculated as the average of standardized z-scores for math and verbal test scores. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

scores after the implementation of the SMC.[33] This pattern is in line with existing studies on cognitive outcomes, which find stronger and more significant effects on math test scores (Chen et al., 2022; Harris and Sass, 2009). Our event-study estimates in Panel D of Figure 4 show the effects of the SMC on cognitive skills for exposed, but not unexposed, cohorts, thereby confirming the robustness of these findings. In particular, the increases in verbal and math test scores are of similar magnitude to those estimated in recent studies for early childhood exposure to health insurance (Huang and Liu, 2023) and tap water (Chen et al., 2022). Furthermore, these cognitive gains are qualitatively similar to the corresponding estimates for the Deferred Action for Childhood Arrivals (DACA) program (Kuka et al., 2020), the Matlab Maternal and Child Health and Family Planning (MCH-FP) program implemented in Bangladesh (Barham, 2012), and the Nutrition of Central America and Panama (INCAP) early-life intervention program conducted in Guatemala (Maluccio et al., 2009). The effects of

[33] Here, a one standard deviation increase in math score is equivalent to answering 4.5 more questions correctly on the math test. As such, a child with full exposure to the SMC would answer around 1.3 more questions correctly compared to another child with no exposure.

the SMC on the identified cognitive measures are robust after accounting for multiple hypotheses testing using FDR-corrected p-values, as shown in Panel A of Appendix Table G.2..

8 Discussions and Conclusions

The SMC is a government-funded public health program offering growth and development monitoring through routine health examinations to all young children (0-6 years) in China. This program provides a unique opportunity to examine how growth and development monitoring per se improves individuals' lifelong earnings. To conduct this analysis, we digitize a novel county-level dataset on the precise timing of the SMC from over 3,000 book-length local gazetteers and matched it with the 2005 Census and individual-level household surveys.

We then employ a cohort DID specification, wherein our identifying assumption is that exposure to the SMC is plausibly exogenous, conditional on the baseline fixed effects in our main specifications. A number of specification checks support this assumption. We find that full exposure to the SMC from birth to age six increases adult earnings by about 5%. In particular, income improvements come from higher marginal productivity rather than from a trade-off between leisure and time spent in the labor force. Our main results are also robust to a wide range of alternative specifications. Apart from estimating the overall increase in adult earnings, we investigated the potential mechanisms underlying the documented long-term benefits of the SMC. By exploring rich information in the data from the 2005 Census, the CFPS-2010, and the CHNS (1989-2010), we find that the main productivity effect of the SMC operates through improved adult physical and mental health, better educational attainment and cognitive skills, and sustained use of routine health examinations, thereby corroborating related literature on health-related income gains (Pitt et al., 2012; Baird et al., 2016).

Overall, the SMC has a high internal rate of return. The median annual income was 4128 RMB for the 1976-1986 cohorts in the 2005 census. Our DID estimates imply that exposure to the SMC improves adult earnings by around 5% or 198 RMB. As the average annual cost of the SMC reached about 45 RMB per child in 2005, such an income gain would more than cover the expected cost. Meanwhile, given that the total financing cost of the program per child is 270 RMB,[34] a conservative estimate of the long-run annual return to this investment would approximately be 73 percent (=198/270). Thus, these back-of-the-envelope calculations imply that the introduction of the SMC is highly cost-beneficial. If we consider the cost savings related to improved physical and mental health, as well as the long-term benefits of better educational attainment and cognitive skills, the true returns of the SMC would be much larger.

Our results are directly relevant to ongoing policy debates regarding the merits of growth and development monitoring in developing countries. Since 1961, the WHO has launched growth standard and charts and has enthusiastically promoted the implementation of growth and development monitoring in member countries (WHO, 1962). Although the logic behind the advocacy of growth and development monitoring is persuasive, the appropriateness of these programs has been questioned. The concerns centered largely on the effectiveness of growth and development monitoring and whether the investments are justified. Thus far, no unequivocal evidence has been presented to prove that growth and development monitoring is beneficial *per se* in the short or long run (De Onis et al., 2004; Ashworth et al., 2008). Using a variety of survey and administrative data, we demonstrate in this study that growth and development monitoring through routine health checkups in early childhood could generate substantial long-term benefits and is highly cost-beneficial. During the period of the SMC rollout, infant mortality rates and per capita incomes in China—currently the largest developing country in the world—are comparable to those of the Third World today. Therefore, our results and methods contribute credible evidence to this important policy issue.

References

Adhvaryu, A., S. Bednar, T. Molina, Q. Nguyen, and A. Nyshadham (2020). When it rains it pours: The long-run economic impacts of salt iodization in the united states. *Review of Economics and Statistics 102*(2), 395–407.

[34] The estimated total cost per child is calculated as 45 RMB x 6 years = 270 RMB.

Adhvaryu, A., J. Fenske, and A. Nyshadham (2019). Early life circumstance and adult mental health. *Journal of Political Economy 127*(4), 1516–1549.

Aizer, A. (2007). Public health insurance, program take-up, and child health. *The Review of Economics and Statistics 89*(3), 400–415.

Aizer, A. (2011). Poverty, violence, and health the impact of domestic violence during pregnancy on newborn health. *Journal of Human Resources 46*(3), 518–538.

Alderman, M. H., P. H. Wise, R. P. Ferguson, H. La Verde, A. J. D'souza, et al. (1978). Reduction of young child malnutrition and mortality in rural jamaica. *Journal of Tropical Pediatrics and Environmental Child Health 24*(1), 7–11.

Alexander, D. and H. Schwandt (2022). The Impact of Car Pollution on Infant and Child Health: Evidence from Emissions Cheating. *The Review of Economic Studies 89*(6), 2872–2910.

Almond, D., J. Currie, and V. Duque (2018). Childhood circumstances and adult outcomes: Act ii. *Journal of Economic Literature 56*(4), 1360–1446.

Almond, D., L. Edlund, and M. Palme (2009). Chernobyl's subclinical legacy: Prenatal exposure to radioactive fallout and school outcomes in sweden. *The Quarterly Journal of Economics 124*(4), 1729–1772.

Almond, D., H. W. Hoynes, and D. W. Schanzenbach (2011). Inside the war on poverty: The impact of food stamps on birth outcomes. *Review of Economics and Statistics 93*(2), 387–403.

Almond, D., H. Li, and S. Zhang (2019). Land reform and sex selection in china. *Journal of Political Economy 127*(2), 560–585.

Aparicio Fenoll, A. and L. González (2021). Political instability and birth outcomes: Evidence from the 1981 military coup in spain. *Health Economics 30*(2), 328–341.

Ashworth, A., R. Shrimpton, and K. Jamil (2008). Growth monitoring and promotion: Review of evidence of impact. *Maternal & Child Nutrition 4*, 86–117.

Avsm, Y. S., N. Gandhi, B. Tandon, and K. Krishnamurthy (1995). Integrated child development services scheme and nutritional status of indian children. *Journal of Tropical Pediatrics 41*(2), 123–128.

Baird, S., J. H. Hicks, M. Kremer, and E. Miguel (2016). Worms at work: Long-run impacts of a child health investment. *The Quarterly Journal of Economics 131*(4), 1637–1680.

Baker, J., L. Bjerregaard, C. M. Dahl, T. Johansen, E. Sørensen, and M. Wüst (2023). Universal investments in toddler health. learning from a large government trial.

Barham, T. (2012). Enhancing cognitive functioning: Medium-term effects of a health and family planning program in matlab. *American Economic Journal: Applied Economics 4*(1), 245–273.

Benjamini, Y. and D. Yekutieli (2001). The control of the false discovery rate in multiple testing under dependency. *Annals of Statistics*, 1165–1188.

Bertrand, M., E. Duflo, and S. Mullainathan (2004). How much should we trust differences-in-differences estimates? *The Quarterly Journal of Economics 119*(1), 249–275.

Bhalotra, S., M. Karlsson, and T. Nilsson (2017). Infant health and longevity: Evidence from a historical intervention in sweden. *Journal of the European Economic Association 15*(5), 1101–1157.

Black, S. E., A. Bütikofer, P. J. Devereux, and K. G. Salvanes (2019). This Is Only a Test? Long-Run and Intergenerational Impacts of Prenatal Exposure to Radioactive Fallout. *The Review of Economics and Statistics 101*(3), 531–546.

Bleakley, H. (2007). Disease and development: Evidence from hookworm eradication in the american south. *The Quarterly Journal of Economics 122*(1), 73–117.

Bleakley, H. (2010). Malaria eradication in the americas: A retrospective analysis of childhood exposure. *American Economic Journal: Applied Economics 2*(2), 1–45.

Bloom, D. E., D. Canning, and E. S. Shenoy (2012). The effect of vaccination on children's physical and cognitive development in the philippines. *Applied Economics 44*(21), 2777–2783.

Boudreaux, M. H., E. Golberstein, and D. D. McAlpine (2016). The long-term impacts of medicaid exposure in early childhood: Evidence from the program's origin. *Journal of Health Economics 45*, 161–175.

Butikofer, A., K. V. Løken, and K. G. Salvanes (2015). Long-term consequences of access to well-child visits. *NHH Dept. of Economics Discussion Paper* (29).

Cairncross, S., K. Shordt, S. Zacharia, and B. K. Govindan (2005). What causes sustainable changes in hygiene behaviour? a cross-sectional study from kerala, india. *Social Science & Medicine 61*(10), 2212–2220.

Callaway, B. and P. H. Sant'Anna (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics 225*(2), 200–230.

Chan, K. W. and L. Zhang (1999). The hukou system and rural-urban migration in china: Processes and changes. *The China Quarterly 160*, 818–855.

Chen, S. and X. Lan (2020). Tractor vs. animal: Rural reforms and technology adoption in china. *Journal of Development Economics 147*, 102536.

Chen, Y., Z. Fan, X. Gu, and L.-A. Zhou (2020). Arrival of young talent: The send-down movement and rural education in china. *American Economic Review 110*(11), 3393–3430.

Chen, Y. and L.-A. Zhou (2007). The long-term health and economic consequences of the 1959-1961 famine in china. *Journal of Health Economics 26*(4), 659–681.

Chen, Y. J., L. Li, and Y. Xiao (2022). Early-life exposure to tap water and the development of cognitive skills. *Journal of Human Resources 57*(6), 2113–2149.

Cohodes, S. R., D. S. Grossman, S. A. Kleiner, and M. F. Lovenheim (2016). The effect of child health insurance access on schooling: Evidence from public insurance expansions. *Journal of Human Resources 51*(3), 727–759.

Conti, G., C. Hansman, J. J. Heckman, M. F. X. Novak, A. Ruggiero, and S. J. Suomi

(2012). Primate evidence on the late health effects of early-life adversity. *Proceedings of the National Academy of Sciences 109*(23), 8866–8871.

Conti, G., J. J. Heckman, and R. Pinto (2016). The Effects of Two Influential Early Childhood Interventions on Health and Healthy Behaviour. *The Economic Journal 126*(596), F28–F65.

Conti, G., J. Smith, E. Anson, S. Groth, M. Knudtson, A. Salvati, and D. Olds (2024). Early home visits and health outcomes in low-income mothers and offspring: 18-year follow-up of a randomized clinical trial. *JAMA network open 7*(1), e2351752–e2351752.

Cunningham, N. et al. (1978). The under fives clinic-what difference does it make? *Journal of Tropical Pediatrics and Environmental Child Health 24*(6), 237–334.

Currie, J. (2009). Healthy, wealthy, and wise: Socioeconomic status, poor health in childhood, and human capital development. *Journal of Economic Literature 47*(1), 87–122.

Currie, J. and D. Almond (2011). Human capital development before age five. In *Handbook of Labor Economics*, Volume 4, pp. 1315–1486. Elsevier.

Currie, J. and M. Rossin-Slater (2013). Weathering the storm: Hurricanes and birth outcomes. *Journal of Health Economics 32*(3), 487–503.

Currie, J. and T. Vogl (2013). Early-life health and adult circumstance in developing countries. *Annual Review of Economics 5*(1), 1–36.

Cutler, D. and G. Miller (2005). The role of public health improvements in health advances: The twentieth-century united states. *Demography 42*(1), 1–22.

Daysal, N. M., M. Simonsen, M. Trandafir, and S. Breining (2022). Spillover Effects of Early-Life Medical Interventions. *The Review of Economics and Statistics 104*(1), 1–16.

De Chaisemartin, C. and X. d'Haultfoeuille (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review 110*(9), 2964–2996.

De Onis, M., T. M. Wijnhoven, and A. W. Onyango (2004). Worldwide practices in child growth monitoring. *The Journal of Pediatrics 144*(4), 461–465.

De Souza, A., K. Peterson, E. Cufino, J. Gardner, M. Craveiro, and A. Ascherio (1999). Relationship between health services, socioeconomic variables and inadequate weight gain among brazilian children. *Bulletin of the World Health Organization 77*(11), 895.

Deng, Z. and M. Lindeboom (2022). A bit of salt, a trace of life: Gender norms and the impact of a salt iodization program on human capital formation of school aged children. *Journal of Health Economics 83*, 102614.

Deng, Z. and D. J. Treiman (1997). The impact of the cultural revolution on trends in educational attainment in the people's republic of china. *American Journal of Sociology 103*(2), 391–428.

Devoto, F., E. Duflo, P. Dupas, W. Parienté, and V. Pons (2012). Happiness on tap: Piped water adoption in urban morocco. *American Economic Journal: Economic Policy 4*(4), 68–99.

Du, H., Y. Xiao, and L. Zhao (2021). Education and gender role attitudes. *Journal of Population Economics 34*, 475–513.

Duflo, E. (2001). Schooling and labor market consequences of school construction in indonesia: Evidence from an unusual policy experiment. *American Economic Review 91*(4), 795–813.

Dustmann, C., M. Sandner, and U. Schönberg (2022). The effects of sun intensity during pregnancy and in the first 12 months of life on childhood obesity. *Journal of Human Resources*.

Dustmann, C. and U. Schönberg (2012). Expansions in maternity leave coverage and children's long-term outcomes. *American Economic Journal: Applied Economics 4*(3), 190–224.

Ebenstein, A. (2010). The "missing girls" of china and the unintended consequences of the one child policy. *Journal of Human Resources 45*(1), 87–115.

Fabel, M. (2021). Maternity leave and children's health outcomes in the long-term. *Journal of Health Economics 76*, 102431.

Fang, H., K. N. Eggleston, J. A. Rizzo, S. Rozelle, and R. J. Zeckhauser (2012). The returns to education in china: Evidence from the 1986 compulsory education law. Technical report, National Bureau of Economic Research.

Field, E., O. Robles, and M. Torero (2009). Iodine deficiency and schooling attainment in tanzania. *American Economic Journal: Applied Economics 1*(4), 140–169.

García, J. L., J. J. Heckman, D. E. Leaf, and M. J. Prados (2020). Quantifying the life-cycle benefits of an influential early-childhood program. *Journal of Political Economy 128*(7), 2502–2541.

Gertler, P., J. Heckman, R. Pinto, A. Zanolini, C. Vermeersch, S. Walker, S. M. Chang, and S. Grantham-McGregor (2013). Labor market returns to early childhood stimulation: A 20-year followup to an experimental intervention in jamaica. Technical report, National Bureau of Economic Research.

Gopaldas, T. (1988). Field level health worker's skill in detection of growth retardation and faltering in young children. *Indian Journal of Pediatrics 55*(1 Suppl), S55–S58.

Gopaldas, T., P. S. Christian, R. D. Abbi, and S. Gujral (1990). Does growth monitoring work as it ought to in countries of low literacy? *Journal of Tropical Pediatrics 36*(6), 322–327.

Grey, W. (2008). Migrant education in beijing: Hukou and the future of human capital development.

Gwatkin, D. R., J. R. Wilcox, and J. D. Wray (1980). Can health and nutrition interventions make a difference. *ODC Monograph (USA)* (13).

Harris, D. N. and T. R. Sass (2009). The effects of nbpts-certified teachers on student achievement. *Journal of Policy Analysis and Management 28*(1), 55–80.

Hazarika, G. and V. Viren (2013). The effect of early childhood developmental program attendance on future school enrollment in rural north india. *Economics of Education*

Review 34, 146–161.
Heckman, J., R. Pinto, and P. Savelyev (2013). Understanding the mechanisms through which an influential early childhood program boosted adult outcomes. *American Economic Review 103*(6), 2052–2086.
Heckman, J. J. (2005). China's human capital investment. *China Economic Review 16*(1), 50–70.
Heckman, J. J. (2007). The economics, technology, and neuroscience of human capability formation. *Proceedings of the National Academy of Sciences 104*(33), 13250–13255.
Heckman, J. J. and S. Mosso (2014). The economics of human development and social mobility. *Annual Review of Economics 6*(1), 689–733.
Hjort, J., M. Sølvsten, and M. Wüst (2017). Universal investment in infants and long-run health: Evidence from denmark's 1937 home visiting program. *American Economic Journal: Applied Economics 9*(4), 78–104.
Hoehn-Velasco, L. (2021). The long-term impact of preventative public health programs. *The Economic Journal 131*(634), 797–826.
Holmlund, H. (2008). *A researcher's guide to the Swedish compulsory school reform*. Number 87. Centre for the Economics of Education, London School of Economics and Political Science.
Hossain, S. M., A. Duffield, and A. Taylor (2005). An evaluation of the impact of a us $60 million nutrition programme in bangladesh. *Health Policy and Planning 20*(1), 35–40.
Hoynes, H., D. W. Schanzenbach, and D. Almond (2016). Long-run impacts of childhood access to the safety net. *American Economic Review 106*(4), 903–934.
Huang, W. and H. Liu (2023). Early childhood exposure to health insurance and adolescent outcomes: Evidence from rural china. *Journal of Development Economics 160*, 102925.
Kapil, U. and R. Pradhan (1999). Integrated child development services scheme (icds) and its impact on nutritional status of children in india and recent initiatives. *Indian Journal of Public Health 43*(1), 21–25.
Kapil, U., N. Saxena, D. Nayar, and N. Gnanasekaran (1996). Status of growth monitoring activities in selected icds projects of rajasthan. *Indian Pediatrics 33*, 949–951.
Karim, R., S. Lamstein, M. Akhtaruzzaman, K. Rahman, and N. Alam (2003). The bangladesh integrated nutrition project: Endline evaluation of the community based nutrition component. *Dhaka: Institute of Nutrition and Food Science, University of Dhaka*.
Kielmann, A. A., C. E. Taylor, and R. L. Parker (1978). The narangwal nutrition study: A summary review. *The American Journal of Clinical Nutrition 31*(11), 2040–2052.
Kose, E., E. Kuka, and N. Shenhav (2021). Women's suffrage and children's education. *American Economic Journal: Economic Policy 13*(3), 374–405.
Kuka, E., N. Shenhav, and K. Shih (2020). Do human capital decisions respond to

the returns to education? evidence from daca. *American Economic Journal: Economic Policy 12*(1), 293–324.

Lalitha, N. and J. Standley (1988). Training workers and supervisors in growth monitoring: Looking at icds. *The Indian Journal of Pediatrics 55*, S44–S54.

Lee, J. Y. and G. Solon (2011). The fragility of estimated effects of unilateral divorce laws on divorce rates. *The BE Journal of Economic Analysis & Policy 11*(1).

Li, L. and Y. Xiao (2023). Beyond boiling: The effect of in utero exposure to treated tap water on childhood health. *Journal of Environmental Economics and Management 119*, 102814.

Lundborg, P., D.-O. Rooth, and J. Alex-Petersen (2022). Long-term effects of childhood nutrition: Evidence from a school lunch reform. *The Review of Economic Studies 89*(2), 876–908.

Ma, M. (2019). Does children's education matter for parents' health and cognition? evidence from china. *Journal of Health Economics 66*, 222–240.

Maluccio, J. A., J. Hoddinott, J. R. Behrman, R. Martorell, A. R. Quisumbing, and A. D. Stein (2009). The impact of improving nutrition during early childhood on education among guatemalan adults. *The Economic Journal 119*(537), 734–763.

Marek, T., I. Diallo, B. Ndiaye, and J. Rakotosalama (1999). Successful contracting of prevention services: Fighting malnutrition in senegal and madagascar. *Health Policy and Planning 14*(4), 382–389.

McCray, G., D. McCoy, P. Kariger, M. Janus, M. M. Black, S. M. Chang, F. Tofail, I. Eekhout, M. Waldman, S. Van Buuren, et al. (2023). The creation of the global scales for early development (gsed) for children aged 0–3 years: Combining subject matter expert judgements with big data. *BMJ Global Health 8*(1), e009827.

Meng, X. and N. Qian (2009). The long term consequences of famine on survivors: Evidence from a unique natural experiment using china's great famine. Technical report, National Bureau of Economic Research.

Meng, X., N. Qian, and P. Yared (2015). The institutional causes of china's great famine, 1959-1961. *The Review of Economic Studies 82*(4), 1568–1611.

Meng, X. and G. Zhao (2017). The long shadow of the chinese cultural revolution: The intergenerational transmission of education. *IZA Discussion Paper*.

Miguel, E. and M. Kremer (2004). Worms: Identifying impacts on education and health in the presence of treatment externalities. *Econometrica 72*(1), 159–217.

Miller, S. and L. R. Wherry (2019). The long-term effects of early life medicaid coverage. *Journal of Human Resources 54*(3), 785–824.

Moehling, C. M. and M. A. Thomasson (2014). Saving babies: The impact of public education programs on infant mortality. *Demography 51*(2), 367–386.

Nandi, A., J. R. Behrman, S. Kinra, and R. Laxminarayan (2018). Early-life nutrition is associated positively with schooling and labor market outcomes and negatively with marriage rates at age 20-25 years: Evidence from the andhra pradesh children and

parents study (apcaps) in india. *The Journal of Nutrition 148*(1), 140–146.
Nandi, A., J. R. Behrman, and R. Laxminarayan (2020). The impact of a national early childhood development program on future schooling attainment: Evidence from integrated child development services in india. *Economic Development and Cultural Change 69*(1), 291–316.
Nelson, R. E. (2010). Testing the fetal origins hypothesis in a developing country: Evidence from the 1918 influenza pandemic. *Health Economics 19*(10), 1181–1192.
Pearson, R. (1995). *Thematic evaluation of UNICEF support to growth monitoring*. Evaluation and Research Working Paper Series No. 2. UNICEF: New York.
Persson, P. and M. Rossin-Slater (2018). Family ruptures, stress, and the mental health of the next generation. *American Economic Review 108*(4-5), 1214–52.
Pielemeier, N. R. (1978). *Use of the child's growth chart as an educational tool*. Office of Nutrition, Agency for International Development.
Pitt, M. M., M. R. Rosenzweig, and M. N. Hassan (2012). Human capital investment and the gender division of labor in a brawn-based economy. *American Economic Review 102*(7), 3531–3560.
Rangel, M. A. and T. S. Vogl (2019). Agricultural Fires and Health at Birth. *The Review of Economics and Statistics 101*(4), 616–630.
Rosales-Rueda, M. (2018). The impact of early life shocks on human capital formation: Evidence from el niño floods in ecuador. *Journal of Health Economics 62*, 13–44.
Shekar, M. (1991). *The Tamil Nadu Integrated Nutrition Project: A review of the project with special emphasis on the monitoring and information system.*
Shekar, M. and M. Latham (1992). Growth monitoring can and does work! an example from the tamil nadu integrated nutrition project in rural south india. *The Indian Journal of Pediatrics 59*, 5–15.
Sun, M. (2021). The potential causal effect of hukou on health among rural-to-urban migrants in china. *Journal of Family and Economic Issues 42*, 1–10.
UNICEF (2018). Multiple indicator cluster survey 2016. Technical report, NBS, UNICEF.
UNICEF (2021). Sdg indicator metadata.
Varian, H. R. (1972). Benford's law (letters to the editor). *The American Statistician 26*(3), 65–66.
Viravaidhya, K. V., K. Tima, and H. Merrill (1981). Impact of age/weight charts maintained in the home and nutrition education on nutritional status of infants and preschool children. *Nutrition Division, Ministry of Public Health, Royal Thai Government: Bangkok*.
Wang, L. (2013). Estimating returns to education when the iv sample is selective. *Labour Economics 21*, 74–85.
Wei, S.-J. and X. Zhang (2011). The competitive saving motive: Evidence from rising sex ratios and savings rates in china. *Journal of Political Economy 119*(3), 511–564.

WHO (1962). *Joint FAO/WHO Expert Committee on Nutrition: Sixth Report*. WHO.

WHO (2023). Nurturing care framework progress report 2018-2023: Reflections and looking forward.

Wilson, J. M. and G. N. Chandler (1993). Sustained improvements in hygiene behaviour amongst village women in lombok, indonesia. *Transactions of the Royal Society of Tropical Medicine and Hygiene 87*(6), 615–616.

Wolfers, J. (2006). Did unilateral divorce laws raise divorce rates? a reconciliation and new results. *American Economic Review 96*(5), 1802–1820.

Wüst, M. (2012). Early interventions and infant health: Evidence from the danish home visiting program. *Labour Economics 19*(4), 484–495.

Xu, H. (2021). The long-term health and economic consequences of improved property rights. *Journal of Public Economics 201*, 104492.

Yang, D. T. and H. Zhou (1999). Rural-urban disparity and sectoral labour allocation in china. *The Journal of Development Studies 35*(3), 105–133.

Zhang, J. and L. C. Xu (2016). The long-run effects of treated water on education: The rural drinking water program in china. *Journal of Development Economics 122*, 1–15.

Zhao, Y. (1997). Labor migration and returns to rural education in china. *American Journal of Agricultural Economics 79*(4), 1278–1287.

Appendix A: Examples of the SMC records from local gazetteers

第二十七卷 卫 生·1033

年起，建立妇女病普查制度。1978 年起工矿女职工属晚婚计划生育的，享受 72 天产假，工资照发，哺乳期规定每天 2 次，每次 30 分钟的工间送奶时间。女工集中的厂矿建立了卫生室、淋浴室。1987 年，查治妇女病者 10607 例，患病率 35.52 %，比 1971 年下降 14.68 个百分点，全县有 23 个单位建立女工冲洗室，2 个单位使用上了冲洗器。

儿童保健 1970 年，全县有 222921 名 12 岁以下的儿童口服驱虫净，占该年龄组总人数的 96.5 %，排虫率 66.5 %。1981 年起，各级医院开设儿保门诊，实行儿童系统管理，每个婴儿出生后 42 天左右到医院建立保健卡，1 岁以内每隔 2～3 个月体检 1 次；1～3 岁，每半年体检 1 次；4～7 岁，每年体检 1 次；

FIGURE A.1.

Examples of the SMC records from local gazetteers

Notes: Figure A.1. shows the information on the SMC from the local gazetteers of Wuzhong County in Jiangsu province, which documented that "In 1981, the SMC was implemented in Wuzhong county. Through the SMC program, a health management booklet is created right after the birth of a child and used by parents and doctors to record the child's growth, development, and use of health services. Each child visits community-based clinics every 2-3 months during the first year of life, twice in the second year, twice in the third year, and then once a year until age 6."

Appendix B: Fraction of years exposed to the SMC from birth to age 6

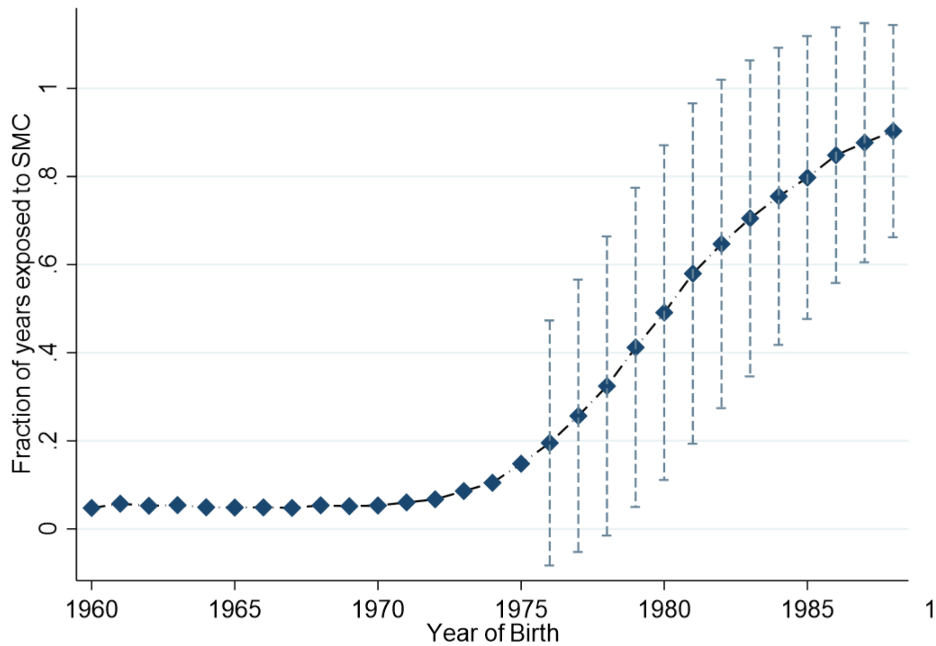

FIGURE B.1.
Fraction of years exposed to the SMC from birth to age 6, by birth cohort.

Notes: Figure B.1. plots the 1976-1986 birth cohorts from the 2005 census (individual-level observations). Error bars represent ±1 standard deviation from the mean

Appendix C: Schedule and service items for the SMC

TABLE C.1.
Schedule and Service Items for the SMC

Schedule		The Recommended Age	Service Items
Within 2 Months After Birth	1st	1 Month	**Physical examination:** Height, weight, head circumference, nutritional status, general examination, pupils, responses to sounds, cleft lip and palate, cardiac murmur, colic, cryptorchidism, externalia, hip screening. **Feeding status:** Feeding methods. **Developmental diagnosis and observation:** Startle reaction, object gazing.
2 to 4 Months	2nd	3 Months	**Physical examination:** Height, weight, head circumference, nutritional status, general examination, pupils and fixation vision, hepatosplenomegaly, hip screening, cardiac murmur. **Feeding status:** Feeding methods. **Developmental diagnosis and observation:** Head raising, palms opening, smiling.
5 to 7 Months	3rd	6 Months	**Physical examination:** Height, weight, head circumference, nutritional status, general examination, eye position, pupils and fixation vision, hip screening, colic, cryptorchidism, externalia, responses to sounds, cardiac murmur, oral examination. **Feeding status:** Feeding methods, introduction of supplementary food. **Developmental diagnosis and observation:** Turning over, grabbing things, alert to sounds, removing handkerchief on face with hands (4 to 8 months), crawling, standing with support, expressing "goodbye"
8 to 10 Months	4th	9 Months	**Physical examination:** Height, weight, head circumference, nutritional status, general examination, eye position, pupils and fixation vision, hip screening, colic, cryptorchidism, externalia, responses to sounds, cardiac murmur, oral examination. **Feeding status:** Feeding methods, introduction of supplementary food. **Developmental diagnosis and observation:** Turning over, grabbing things, alert to sounds, removing handkerchief on face with hands (4 to 8 months), crawling, standing with support, expressing "goodbye" pronouncing ba and ma (8 to 9 months).

(Table continued on next page)

TABLE C.1.

Schedule and Service Items for the SMC (Continued)

Schedule		The Recommended Age	Service Items
11 to 13 Months	5th	12 Months	**Physical examination:** Height, weight, head circumference, nutritional status, general examination, eye position, pupils and fixation vision, colic, cryptorchidism, externalia, responses to sounds, cardiac murmur, oral examination. **Feeding status:** Solid food. **Developmental diagnosis and observation:** Standing firmly, walking with support, holding things, understanding simple sentences.
17 to 19 Months	6th	18 Months	**Physical examination:** Height, weight, head circumference, nutritional status, general examination, eye position (cover test to exam strabismus and amblyopia), cornea, pupils, responses to sounds, oral examination. **Feeding status:** Solid food. **Developmental diagnosis and observation:** Standing firmly, walking with support, holding things, understanding simple sentences.
23 to 25 Months	7th	24 Months	**Physical examination:** Height, weight, head circumference, nutritional status, general examination, eye position (cover test to exam strabismus and amblyopia), cornea, pupils, responses to sounds, oral examination. **Feeding status:** Solid food. **Developmental diagnosis and observation:** Walking, holding a glass, imitating, speaking single words, understanding oral instructions, body expression, sharing interesting things, substituting toys with objects.
2 to 3 Years	8th	2.5 Year	**Physical examination:** Height, weight, nutritional status, general examination, eye examination, cardiac murmur, oral examination. **Developmental diagnosis and observation:** Running, taking off shoes, scribbling with pens, saying names of body parts.
2 to 3 Years	9th	3 Year	**Physical examination:** Height, weight, nutritional status, general examination, eye examination, cardiac murmur, oral examination. **Developmental diagnosis and observation:** Running, taking off shoes, scribbling with pens, saying names of body parts.

(Table continued on next page)

TABLE C.1.
Schedule and Service Items for the SMC (Continued)

Schedule		The Recommended Age	Service Items
3 to under 4 Years	10th	3 to under 4 Years	**Physical examination:** Height, weight, nutritional status, general examination, eye examination (random dot stereogram test), cardiac murmur, externalia, oral examination. **Developmental diagnosis and observation:** Jumping, squatting, drawing circles, turning pages, telling their own names, understanding oral instructions, body expression, speaking clearly, identifying shapes and colors.
4 to under 5 Years	11th	4 to under 5 Years	**Physical examination:** Height, weight, nutritional status, general examination, eye examination (random dot stereogram test), cardiac murmur, externalia, oral examination. **Developmental diagnosis and observation:** Jumping, squatting, drawing circles, turning pages, telling their own names, understanding oral instructions, body expression, speaking clearly, identifying shapes and colors.
5 to under 6 Years	12th	5 to under 6 Years	**Physical examination:** Height, weight, nutritional status, general examination, eye examination (random dot stereogram test), cardiac murmur, externalia, oral examination. **Developmental diagnosis and observation:** Jumping, squatting, drawing circles, turning pages, telling their own names, understanding oral instructions, body expression, speaking clearly, identifying shapes and colors.
6 to under 7 Years	13th	6 to under 7 Years	**Physical examination:** Height, weight, nutritional status, general examination, eye examination (random dot stereogram test), cardiac murmur, externalia, oral examination. **Developmental diagnosis and observation:** Jumping, squatting, drawing circles, turning pages, telling their own names, understanding oral instructions, body expression, speaking clearly, identifying shapes and colors.

Appendix D: Summary statistics

TABLE D.1.
Summary statistics of county characteristics from local gazetteers

	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample			Baseline sample		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
County population in 1964(Log)	2,785	12.360	0.856	798	12.380	0.783
Share of urban population in 1964	2,769	10.030	11.710	798	9.356	10.430
Grain output in 1965(Log)	2,491	11.170	0.870	729	11.200	0.857
Share of ethnic minorities	2,872	0.158	0.295	839	0.138	0.276
Average years of education	2,872	8.460	2.038	839	8.433	1.789

TABLE D.2.
Summary statistics of health and education outcomes

	Obs.	Mean	Std.Dev.
Panel A. Census			
Years education	115,069	9.369	3.216
Primary school graduation	115,069	0.958	0.204
Junior high graduation	115,069	0.812	0.391
Senior high graduation	115,069	0.269	0.443
College graduation	115,069	0.033	0.178
Panel B. CFPS			
Gender	2,142	0.493	0.500
Age	2,142	24.735	5.538
Share of ethnic minorities	2,142	0.099	0.299
Rural status	2,142	0.805	0.396
Self-reported health status	2,142	4.641	0.644
Health status dummy	2,142	0.962	0.191
Doctor visit	2,142	0.086	0.281
Physical health index	2,142	-0.007	1.005
Upset	2,142	0.089	0.285
Hopeless	2,142	0.044	0.205
Restless	2,142	0.055	0.227
Worthless	2,142	0.035	0.184
Mental health index	2,142	-0.000	0.993
Verbal test score	2,142	23.071	8.307
Verbal test z score	2,142	-0.001	0.993
Math test score	2,142	13.680	5.898
Math test score z score	2,142	-0.001	0.991
Panel C. CHNS			
Monthly expenditure on childcare	1,015	3.601	1.597
Maternal childcare time	2,521	1.739	8.051
Routine health examination	2,370	0.053	0.224
Gender	3,385	0.510	0.500
Age	3,385	12.399	3.160
Share of ethnic minorities	3,385	0.241	0.428

TABLE D.3.
Determinants of the SMC rollout from local gazetteers

Variables	(1) Pop 1964 (Log)	(2) Share of Urban Pop 1964	(3) Grain Output 1965 (Log)	(4) Share of Ethnic Minorities	(5) Average Years Education
Panel A. Whether the missing values are random					
Whether policy time is missing (without province FE)					
	0.009	-0.001**	0.009	0.000	-0.070**
	(0.009)	(0.001)	(0.010)	(0.004)	(0.028)
Observations	2,785	2,769	2,491	2,800	2,800
R-squared	0.000	0.001	0.000	0.000	0.002
Whether policy time is missing (with province FE)					
	-0.002	-0.001	0.008	0.006	0.037
	(0.012)	(0.001)	(0.012)	(0.005)	(0.040)
Observations	2,782	2,766	2,488	2,795	2,795
R-squared	0.088	0.087	0.095	0.099	0.099
Panel B. The timing of policy implementation is random					
Policy time (without province FE)					
	-0.114	-0.050**	-0.301	0.442***	2.010**
	(0.290)	(0.024)	(0.256)	(0.162)	(0.811)
Observations	798	798	729	839	839
R-squared	0.000	0.006	0.002	0.014	0.007
Policy time (with province FE)					
	-0.236	-0.024	-0.348	0.144	-0.928
	(0.339)	(0.023)	(0.267)	(0.221)	(1.221)
Observations	797	797	728	836	836
R-squared	0.084	0.084	0.097	0.093	0.093

Notes: *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE D.4.
Heterogeneous effect of the SMC (2005 Census)

	log(Monthly income)			
	(1)	(2)	(3)	(4)
VARIABLES	Eastern	Non-Eastern	Female	Male
SMC share IU–6	0.109***	0.043**	0.058**	0.061**
	(0.055)	(0.047)	(0.030)	(0.029)
Baseline FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Observations	16,121	16,308	43,583	45,519
R-squared	0.351	0.404	0.435	0.433

Notes: Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. Each estimate is from a separate regression of the outcome on share of years between birth and age six that the SMC is in the county. All models include birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Appendix E: Robustness analyses

Sample Adjustments

In Appendix Table E.1., we show that our main results are robust to different sample choices. In Panels A and B, the estimated effects of the SMC are almost identical to our baseline specification when we use the sample of children born between 1975 and 1986 and those born between 1976 and 1988 instead. We excluded pre-1976 cohorts in the baseline estimation as these cohorts were exposed to catastrophic events in the early years of the People's Republic of China, such as the Great Chinese Famine (1959-1961) and the Cultural Revolution (1966-1976). Numerous studies have discussed the negative long-term impacts of these events on various socioeconomic outcomes (Chen et al., 2020; Meng et al., 2015; Meng and Qian, 2009; Chen and Zhou, 2007; Deng and Treiman, 1997; Meng and Zhao, 2017). As a robustness check, we reran the baseline model with the 1970-1986, 1965-1986, 1960-1986, and 1955-1986 cohorts. Panels C-F in Table E.1. present the results, respectively. In line with existing studies, these historic events have negative consequences on the earnings of affected cohorts: our estimates become somewhat smaller in magnitude. Despite the significant negative shocks, the estimated effects of the SMC remain significant, suggesting that our results are robust to the inclusion of the pre-1976 cohorts.

There may be a concern that top- and low-earners could lead to biased estimates. Thus, we winsorize the tails of income distribution from the baseline sample in Table E.6. to control for the influence of potential outliers. In Panel A, the one percent tails are winsorized from the sample.[35] The effects of the SMC are quite similar to the baseline. Panels B-E additionally winsorize the two, three, four, and five percent tails. The effects of the SMC on earnings remain highly similar. These processes serve as additional checks of the earnings results, thus ensuring that our findings are not driven by outliers.

[35] For the 1% winsorization, we replaced values above the 99th percentile by the value at the 99th percentile and values below the 1st percentile by the value at the 1st percentile.

Alternative Measures for the SMC Exposure

In Appendix Table E.2., we construct two alternative measures for the SMC exposure, assuming that the program has been introduced in the middle (Column 2) or at the end of the year (Column 3). In Column 2,the SMC arrival year is counted as 1/2 year of exposure. In Column 3, the SMC arrival year is not counted for exposure. The results are quite similar to the main results, thus confirming that measurement errors are not likely to affect our results.

Sensitivity Checks with Alternative Specifications

In Appendix Table E.3., we perform several sensitivity checks of our main results. In Column 1, we replace province-by-cohort fixed effects in our baseline specification with province-specific time trends to allow differential growth trajectories for different provinces. This modification to the baseline DID specification does not appreciably change our main results. In Column 2, we clustered standard errors at the county-year level instead, allowing arbitrary correlations in error terms for a given county-year pair. The results indicate that the SMC effect remains highly similar. Column 3 includes both modifications from Columns 1-2, and as can be seen, the SMC effect remains highly robust.

Endogenous Sample Selection

Overall, we expect that exposure to the SMC can improve one's earnings as an adult. The same forces, however, could also lead to a change in birth cohorts. For example, if the SMC introduction leads to increased fertility among low-income families, this could lead to a negative compositional effect on birth cohorts and a subsequent downward bias on our estimates. We consider this possibility by evaluating whether the SMC introduction is associated with changes in the size of birth cohorts. Specifically, we modify Equation 1 to use birth cohort sizes at the county level as the dependent variable. Appendix Table E.4. presents the results. As can be seen, the estimated coefficients on the SMC are small and insignificant, indicating no effect of the SMC on the size of birth cohorts.

Contemporaneous Historical Events

Another concern would be about other policies that closely follow the county-level rollout of the SMC and have had impacts only on the later-life earnings of children below seven years of age when the SMC was introduced in the county. From our systematic review of contemporaneous historical events, no candidate policies adhered to these precisely prescribed patterns. Nevertheless, to further alleviate concerns over concurrent policies, we reported the results after controlling for the possible influences of the compulsory education system and the One-Child Policy (OCP), which could raise the overall lifetime earnings of children in China.

The Compulsory Education System

China's Compulsory Education Law (CEL) was passed and implemented in 1986. Under the CEL, all Chinese children are mandated to receive nine years of free education, generally starting at six years of age. Prior studies have shown that education plays an important role in determining labor market performance, with better-educated individuals generally receiving higher earnings. Following this line of logic, the implementation of the compulsory education system could have raised overall educational attainment and lifetime earnings in China, thus upwardly biasing our estimates. As the timing of the CEL adoption does not vary within provinces (Du et al., 2021; Fang et al., 2012; Ma, 2019), the effect of compulsory education is absorbed by province-by-birth-year fixed effects in our baseline specification. To further control for the influence of the CEL, we substituted province-by-birth-year fixed effects with province-specific time trends. Then, we follow Du et al. (2021), who studied the impact of education on gender role attitudes, to exploit exogenous temporal and geographical variation in the enforcement of the CEL. As the central government recognized that not all provinces would have sufficient resources to enforce the law immediately, the provinces were initially allowed to have different effective dates to implement the law. Most provinces implemented the law in 1986 and 1987, while some provinces, such as Gansu, Guangxi, Hainan, and Tibet, only implemented the law in the early 1990s (Du et al., 2021). For the current study, we collected province-level information on the timing of the CEL. Panel A of Table E.5. presents the results after considering the impact of the CEL. As can be seen, the estimated coefficient of the CEL is positive and statistically significant, indicating that the CEL helped raise adult incomes. Meanwhile, the estimated coefficients on the SMC are somewhat larger than those in Table 2 and remain statistically significant, thus confirming the robustness of our SMC estimates.

The One-Child Policy (OCP)

The Chinese government imposed the OCP in 1979 to curb the growth of the population, which, at that time, was reaching 972 million people.[36] This nationwide fertility policy was firmly enforced for around 32 years until 2011. With tight fertility control, parents were likely to devote more time and financial resources to childcare and educational investment for their only child, consequently raising their later-life earnings. For the current study, our empirical strategy to control for the influence of the OCP follows that of Ebenstein (2010), who studied the impact of the OCP on higher ratios of males to females.[37] Specifically, we approximate the variation in enforcement of the policy with the average policy fine for excess fertility.[38] Panel B of Table E.5. reports the results after controlling for the effects of the OCP. The estimated coefficient of the SMC is almost identical to the main specification in Table 2. The last panel of Table E.5. shows the results of simultaneously controlling for all the confounding factors considered above, and as can be seen, the SMC effect remains highly robust. The last Panel of Table E.5. simultaneously controlled for all the confounding factors considered above, and the SMC effect remains highly robust.

[36]The policy most strictly applied to Han Chinese but not to ethnic minorities around China, although there were exceptions for rural farmers and certain situations. Rural parents are allowed to have a second child if the first is a daughter. Likewise, families with a handicapped child are entitled to another birth.

[37]We collected province-year-level information on the average monetary penalty (i.e., OCP policy fine) rate for unauthorized births from 1979 to 2000 to formally differentiate the effects of the SMC and the OCP. The policy fine is formulated in multiples of annual income (Ebenstein, 2010; Wei and Zhang, 2011).

[38]Given that there is no within-province variation in fines levied by unauthorized births, we substituted province-by-birth-year fixed effects with province-specific time trends for this robustness check.

Heterogeneous Treatment Effects

There are some concerns that the two-way fixed-effect estimates in staggered DID designs may be biased in the presence of heterogeneous treatment effects over time or across groups. We check the robustness of our results by using the methods proposed by De Chaisemartin and d'Haultfoeuille (2020) and Callaway and Sant'Anna (2021). Table E.8. presents the results of these additional robustness checks, confirming that the estimates of the long-term effects are robust to accounting for treatment heterogeneity.

Multiple Hypotheses Testing

SMC estimates that falsely appear significant in multiple hypotheses testing are another potential issue with our income analysis. Thus, to address this concern regarding multiple inferences, we applied the false discovery rate (FDR) correction proposed by Benjamini and Yekutieli (2001) and reported FDR-adjusted p-values in Table E.9. in the Appendix. The results are robust to accounting for multiple hypotheses testing.

Randomization Inference Procedure

As an additional robustness check, we conduct the randomization inference procedure, as suggested by Bertrand et al. (2004). First, we randomly assign a year of the SMC implementation to each county, while maintaining the distribution of the SMC events over time. Next, we estimate the DID specification to derive the corresponding placebo treatment effect. We repeat this process 1000 times to generate a distribution of placebo treatment effects, against which we compare the treatment effect observed in the actual treatment assignment. This allowed us to obtain p-values and tests of statistical significance. In Appendix Figure E.1., we present the probability density function of placebo treatment effects for adult earnings. In particular, we show that the point estimates obtained in the main regressions are clearly significant compared with the distribution of placebo effects, thus confirming the validity of the DID approach.

TABLE E.1.
Robustness checks with sample adjustments

Variables	(1) [1976,1988]	(2) [1976, 1987]	(3) [1976, 1985]	(4) [1970, 1986]	(5) [1960, 1986]	(6) [1955, 1986]
SMC share IU–6	0.048**	0.047**	0.048**	0.030**	0.027**	0.031**
	(0.021)	(0.022)	(0.023)	(0.014)	(0.013)	(0.013)
Baseline FE	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Observations	98,749	94,841	83,075	162,635	284,985	330,066
R-squared	0.426	0.425	0.433	0.437	0.441	0.447

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of children's birth year b and *hukou* registration county c. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.2.

Robustness checks of the SMC across different introduction times in a year

	(1) The beginning of the year	(2) The middle of the year	(3) The end of the year
SMC share IU–6	0.058**	0.059**	0.056**
	(0.023)	(0.023)	(0.023)
Baseline FE	YES	YES	YES
Controls	YES	YES	YES
Observations	89,104	89,104	89,104
R-squared	0.427	0.427	0.427

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county-year level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.3.

Robustness checks with different specifications (2005 Census)

	log(Monthly income)		
	(1)	(2)	(3)
SMC share IU–6	0.058**	0.058***	0.058***
	(0.022)	(0.018)	(0.018)
Observations	89,104	89,104	89,104
R-squared	0.426	0.427	0.426
Province-specific linear cohort	YES	NO	YES
Cluster at county-year level	NO	YES	YES

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level in Column 1 and county-year level in Columns 2 and 3. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.4.
Endogenous sample selection

	(1)	(2)
	Birth cohort sizes	ln(Birth cohort sizes)
SMC Share IU–6	-0.229	-0.023
	(0.661)	(0.049)
Baseline FE	YES	YES
Controls	YES	YES
Observations	7,099	7,099
R-squared	0.811	0.751

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable is the birth cohort sizes at the county level. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.5.

Robustness checks addressing contemporaneous historical events

	log(Monthly income)		
	(1)	(2)	(3)
SMC share IU–6	0.055**	0.054**	0.057**
	(0.027)	(0.027)	(0.026)
One Child Policy	0.049***		0.055***
	(0.021)		(0.021)
Compulsory Education		0.199***	0.222***
		(0.074)	(0.075)
County FE and birth year FE	YES	YES	YES
Controls	YES	YES	YES
Observations	89,104	89,104	89,104
R-squared	0.423	0.423	0.423

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. The main specification in each column includes birth year, county, and province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.6.

Robustness checks with additional winsorization of adult income

Variables	(1) 1% Tail	(2) 2% Tail	(3) 3% Tail	(4) 4% Tail	(5) 5% Tail
SMC share IU–6	0.054**	0.051**	0.048**	0.048**	0.046**
	(0.022)	(0.021)	(0.021)	(0.021)	(0.020)
Baseline FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	89,104	89,104	89,104	89,104	89,104
R-squared	0.437	0.442	0.444	0.445	0.443

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.7.

Effects of the SMC on adult income: Specifications with county-specific trends

	log(Monthly income)		
	(1)	(2)	(3)
SMC share IU–6	0.058**	0.047**	0.047**
	(0.023)	(0.022)	(0.022)
Baseline FE	YES	YES	YES
Controls	YES	YES	YES
Linear trends	NO	YES	NO
Quadratic trends	NO	NO	YES
Observations	89,104	89,104	89,104
R-squared	0.427	0.431	0.431

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.8.
Heterogeneity in the treatment effect

	(1) Baseline	(2) 1% Tail	(3) 3% Tail
Panel A. DiD estimator proposed by de Chaisemartin and D'Haultfoeuille (2021)			
SMC share IU-6	0.160***	0.157***	0.145***
	(0.048)	(0.047)	(0.045)
Observations	89,112	89,112	89,112
Panel B. DiD estimator proposed by Callaway and Sant'Anna (2021)			
SMC share IU-6	0.050***	0.048***	0.041***
	(0.018)	(0.017)	(0.016)
Observations	46,155	46,155	46,155

Notes: Panels A and B implement recent estimators that address problems with two-way fixed effects difference-in-differences regressions in setting with staggered delivery of the treatment. Specifically, Panel A follows De Chaisemartin and d'Haultfoeuille (2020), while Panel B follows Callaway and Sant'Anna (2021). Standard errors are clustered at the county level in parentheses. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE E.9.
Adjusting p-values for multiple hypotheses testing on adult income

	(1) log(Monthly income)	(2) log(Hourly wage)	(3) log(Hours worked)
SMC Share IU–6	0.058**	0.049***	-0.013
	(0.023)	(0.015)	(0.009)
Baseline FE	YES	YES	YES
Controls	YES	YES	YES
Unadjusted p-values	0.011	0.001	0.171
FDR-adjusted p-values	0.011	0.001	0.171

Notes: The table shows original and FDR corrected p-values. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in Column 1 is the natural logarithm of monthly income. The dependent variable in Column 2 is the natural logarithm of hourly wage and the dependent variable in Column 3 is the natural logarithm of hours worked last week. All models include birth year, county, and province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

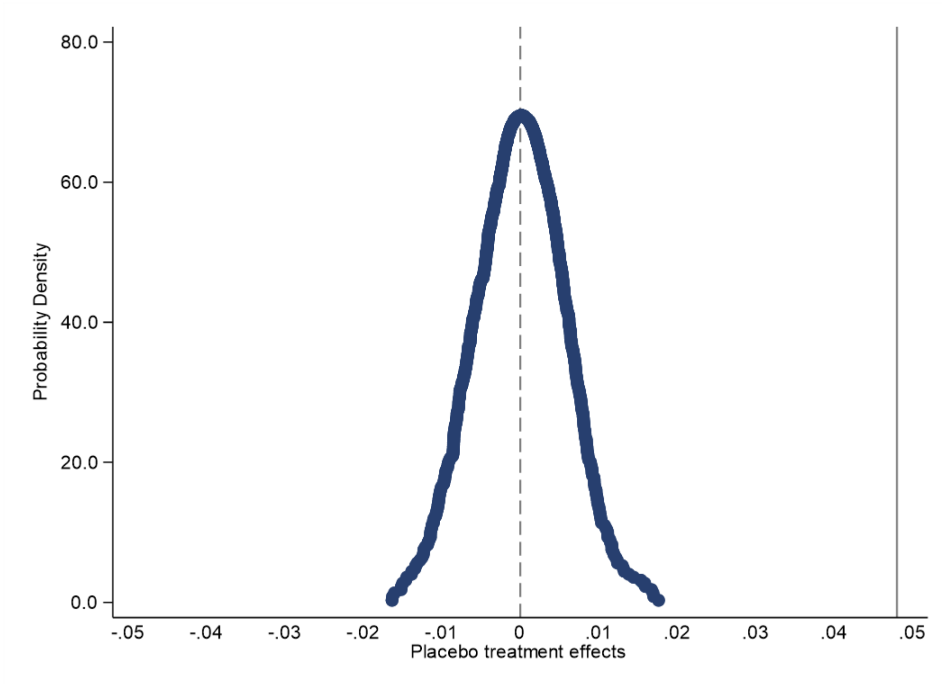

FIGURE E.1.
Random inference distribution

TABLE E.10.

Placebo Exposure Tests: Assume earlier introduction of the SMC

	(1) 5 years earlier	(2) 6 years earlier	(3) 7 years earlier	(4) 8 years earlier	(5) 9 years earlier
SMC share IU–6	0.027	0.015	-0.001	-0.021	-0.034
	(0.022)	(0.023)	(0.024)	(0.025)	(0.026)
Baseline FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	89,104	89,104	89,104	89,104	89,104
R-squared	0.427	0.427	0.427	0.427	0.427

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The dependent variable in each column is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Appendix F: Mediation analyses

TABLE F.1.
Mediation analysis: The effect of the SMC on long-term income

	log(Monthly income)	
	(1)	(2)
SMC Share IU–6	0.058**	0.050**
	(0.023)	(0.021)
Years education		0.076***
		(0.002)
Baseline FE	YES	YES
Controls	YES	YES
Observations	89,104	89,104
R-squared	0.427	0.463

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the 2005 census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. The dependent variable is the natural logarithm of monthly income for individual i in *hukou* registration county c and born in year b. It is a function only of a child's birth year b and *hukou* registration county c. All models include birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Appendix G: Multiple Hypotheses Testing

TABLE G.1.
Adjusting p-values for multiple hypothesis testing of mechanism analysis

	(1)	(2)	(3)	(4)	(5)
Panel A. Physical health					
	Self-reported health status				
	5-point scale	Dummy	Doctor visit	Physical health index	
SMC Share IU–6	0.390**	0.123**	-0.142***	0.580***	
	(0.155)	(0.053)	(0.039)	(0.125)	
Unadjusted p-values	0.016	0.026	0.001	0.000	
FDR-adjusted p-values	0.021	0.026	0.001	0.000	
Panel B. Mental health					
	Upset	Hopeless	Restless	Worthless	Mental health index
SMC Share IU–6	-0.159***	-0.137**	-0.091**	-0.104***	0.760***
	(0.049)	(0.051)	(0.037)	(0.033)	(0.154)
Unadjusted p-values	0.002	0.010	0.019	0.003	0.000
FDR-adjusted p-values	0.005	0.013	0.019	0.005	0.000
	Monthly expenditure on childcare	Maternal childcare time	Routine health examination		
SMC Share IU–6	0.707	1.206	0.079*		
	(0.661)	(0.842)	(0.043)		
Unadjusted p-values	0.303	0.173	0.090		
FDR-adjusted p-values	0.303	0.259	0.259		

Notes: The table shows original and FDR corrected p-values. Data in Panel A and B are a linked sample of the CFPS-2010 with the SMC county-by-county rollout and include adults who were born between 1976 and 1992. Data in Panel C are a linked sample of the CHNS 1997-2011 with the SMC county-by-county rollout and include households with children aged 7-17. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE G.2.

Adjusting p-values for multiple hypothesis testing of mechanism analysis

	(1)	(2)	(3)	(4)	(5)
Panel A. Educational attainment					
	Years education	Primary	Junior high	Senior high	College
SMC Share IU–6	0.200**	0.002	0.003	0.024*	0.022**
	(0.091)	(0.004)	(0.009)	(0.013)	(0.009)
Unadjusted p-values	0.029	0.602	0.728	0.066	0.014
FDR-adjusted p-values	0.072	0.728	0.728	0.110	0.072
Panel B. Cognition					
	Verbal test score			Math test score	
	Score	z-score		Score	z-score
SMC Share IU–6	1.274	0.218		1.816**	0.290**
	(1.140)	(0.148)		(0.842)	(0.141)
Unadjusted p-values	0.270	0.147		0.037	0.045
FDR-adjusted p-values	0.270	0.196		0.091	0.091

Notes: The table shows original and FDR corrected p-values. Data in Panel A are a linked sample of the 2005 Census with the SMC county-by-county rollout and include adults who were born between 1976 and 1986. Data in Panel B are a linked sample of the CFPS-2010 with the SMC county-by-county rollout and include adults who were born between 1976 and 1992. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

Appendix H: Effect of the SMC on chronic diseases

TABLE H.1.
The effect of the SMC on chronic diseases (1976-1994 cohorts)

	(1)	(2)	(3)	(4)	(5)
	Gastritis	Migraine	Fracture	Hypertension	Tumor
SMC Share IU–6	-0.023	-0.091*	-0.001	0.001	-0.003
	(0.018)	(0.046)	(0.015)	(0.007)	(0.012)
Baseline FE	YES	YES	YES	YES	YES
Province-birth FE	YES	YES	YES	YES	YES
Province-wave FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	720	1,525	1,525	2,107	517
R-squared	0.325	0.310	0.149	0.114	0.296

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the CHNS with the SMC county-by-county rollout and include adults who were born between 1976 and 1992. SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The main specification in each column includes birth year, county, province-by-birth-year fixed effects as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.

TABLE H.2.

The effect of the SMC on chronic diseases (age 45-64)

	(1) Gastritis	(2) Migraine	(3) Fracture	(4) Hypertension	(5) Tumor
SMC Share IU–6	-0.126***	-0.091***	-0.060***	-0.162***	-0.060***
	(0.014)	(0.016)	(0.015)	(0.010)	(0.011)
Baseline FE	YES	YES	YES	YES	YES
Province-birth FE	YES	YES	YES	YES	YES
Province-wave FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES
Observations	2,116	3,709	3,706	5,469	1,418
R-squared	0.085	0.157	0.154	0.154	0.118

Notes: This table shows the regression results for Equation 1. Data are a linked sample of the CHNS with the SMC county-by-county rollout and include adults in middle age (45 to 64). SMC is the proportion of years that an individual is exposed to the SMC from birth to age 6. It is a function only of a child's birth year b and *hukou* registration county c. The main specification in each column includes birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and rural status. Standard errors are clustered at the county level. *** Significant at the 1 percent level; ** significant at the 5 percent level; * significant at the 10 percent level.