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

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Abstract

This paper examines the long-term impacts of growth and development monitoring. For this purpose, we evaluate a pediatric healthcare program, the Systematic Management of Children (SMC), which offers growth and development surveillance through routine health checkups to all young children (0-6 years) in China. Using data on a county-by-county rollout of the program 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.

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JEL Classification: H75, I15, I18, J24, N35, O12, O15

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1 Introduction

Since 1961, the World Health Organization (WHO) has launched growth standards and charts and has enthusiastically advocated the implementation of growth and development monitoring in member countries (WHO, 1962). Subsequently, 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 (UN-Habitat and Total, 2021; McCray et al., 2023; Unicef et al., 2018). Growth and development monitoring is an important diagnostic tool for identifying children with health and nutritional problems, thus enabling action to be taken before the child's health status is seriously jeopardized (WHO, 1962; De Onis et al., 2004; Ashworth et al., 2008). With this persuasive logic behind, UNICEF has been spending more than US$110 million on programs with growth and development monitoring (WHO, 2023). However, the WHO evaluation office airs concerns regarding the efficacy of growth and development surveillance and the justification of investments in this area (Pearson, 1995; Ashworth et al., 2008). There is not yet credible evidence that growth and development monitoring is causally beneficial *per se*, whether in the short run or long run, and therefore little to compare with the short-term costs (De Onis et al., 2004; Ashworth et al., 2008).

Existing evaluation studies could not disentangle the role of growth and development monitoring *per se*, as their analyses rely on health programs where growth and development monitoring was part of a package of health and nutrition services. Evidence from developed economies have been based, in large part, on infant home visiting programs and health center cares (Wüst, 2012; Hjort et al., 2017; Hoehn-Velasco, 2021; Bhalotra et al., 2017). The services of these programs are a combination of nutrition and sanitation promotion, growth and development monitoring, and parental health investments. 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 focus on small- and large-scale randomized controlled trials (RCTs) (Cunningham et al., 1978; Gwatkin et al., 1980; Hossain et al., 2005). While some RCTs in Nigeria, Jamaica, India, Tazania, and Senegal provide tentative evidence that participation in growth and development monitoring confers a significant benefit on health status of children (Cunningham et al., 1978; Gwatkin et al., 1980; Hazarika and Viren, 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. Moreover, these RCTs could not disaggregate the effects of growth and development monitoring from those of other inputs either.

Exploring the county-by-county rollout of a pediatric health program, the Systematic Management of Children (SMC), in China, this 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. With 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 examination, and developmental evaluation. There is substantial variation in the timing of the SMC at the county level, which enables us to use a cohort difference-in-differences (DID) design developed in Duflo (2001) to estimate the long-term impacts of the program.[1] Specifically, as the SMC is mandatory with a nearly 100% participation rate, all children residing in a SMC county while under the age of seven form the treatment group. Within the same county, exposed children are compared against older never-treated cohorts. Besides, we compare children across each birth year for early and later-treated counties. This comparison of early and later-treated children mitigates concern over both selection into treatment and changes in cohort-specific earning patterns.

We hand-collected a county-level dataset of the years in which each county initiated the SMC from over 3,000 book-length local gazetteers. We combined this dataset with individual-level population census to estimate the program's long-term effects. Using the staggered DID strategy, 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.[2] The

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

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

changes are mainly from hourly wage increases rather than hours worked, and do not differ by gender. We find that earnings improvement is greatest for children who receive the SMC services from birth (i.e., full exposure), and it decreases in magnitude as the age at first exposure increases from 0 to 6.

After estimating the overall increase in adult income, the rich information in the data from the 2005 census, the China Family Panel Studies (CFPS), and the China Health and Nutrition Survey (CHNS) allows us to test the respective roles of health and schooling. This analysis is inspired by theoretical work that lays out 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). 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 uses of routine health examinations among adolescents. These findings corroborate related literature on the health-related income gains (Bleakley, 2007; Pitt et al., 2012; Baird et al., 2016).

We provide solid evidence to support the central parallel-trend assumption in our cohort DID strategy. Our main results are also 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.

We also conduct a back-of-the-envelope calculation to quantify the induced benefits we estimate above. The increase in annual income in adulthood (i.e., 198 RMB or 31 USD per person) has far exceeded 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, our results are directly relevant to ongoing policy debates about the merits of growth and development monitoring in developing countries. The concerns center largely around the effectiveness of growth and development surveillance *per se* and whether the 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. As the largest developing country, infant mortality rates and per capita incomes in China during the period of the SMC rollout from the 1950s to 1990s 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-run effectiveness of public health programs. Previous studies have examined the effectiveness of home visits (Wüst, 2012; Moehling and Thomasson, 2014), piped water (Cutler and Miller, 2005; Devoto et al., 2012; Li and Xiao, 2023), hookworm eradication (Miguel and Kremer, 2004; Bleakley, 2007; Baird et al., 2016), Iodine Supplements (Field et al., 2009), and vaccination (Bloom et al., 2012). A primary focus of the effectiveness literature on early childhood has been family visits programs for pregnant women and infants. Services in these programs include immunization, growth and development monitoring, hygiene promotion, and parental health investments. There is not yet credible evidence 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 one with a long enough post period to confirm that growth and development surveillance in and of itself could generate substantial long-term benefits, especially on lifetime earnings, and are highly cost-beneficial.

The results of this paper also add to 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; Rosales-Rueda and Triyana, 2019), smoking (Bhai, 2020), floods (Rosales-Rueda, 2018), extreme weather (Rocha and Soares, 2015), and 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; Hjort et al., 2017), psychological interventions (Gertler et al., 2013), health insurance coverage (Cohodes et al., 2016; Huang and Liu, 2023; Levere et al., 2019; Miller and Wherry, 2019), and nutrition improvements (Almond et al., 2011; Adhvaryu et al., 2020; Lundborg et al., 2022). Exploiting 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 Sections 4, we detail the data used. Next, in Section 5, we introduce the main empirical specification, a difference-in-differences (DID) model. Sections 6 and 7 present the main results of the DID model and a number of robustness checks. Section 8 provides a back-of-the-envelope cost–benefit calculation of the SMC and concludes.

2 Literature Review

Early childhood health is the foundation of lifelong health (Heckman, 2007; Currie and Almond, 2011; 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). A number of theoretical work laid out 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). As an extensive literature has documented long-run detrimental consequences of poor health early in life (Aizer, 2011; Currie and Rossin-Slater, 2013; 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), a growing number of studies examine the benefits of growth and development monitoring (Currie and Vogl, 2013; Moehling and Thomasson, 2014; Hjort et al., 2017; Hoehn-Velasco, 2021; Baker et al., 2023). However, these studies could not identify the role of growth and development monitoring *per se*, as their estimates rely on health programs where growth and development monitoring was part of a package of health and nutrition services.

Existing studies on growth and development surveillance from developed country contexts have been based, in large part, on infant home visiting programs and expansion of health center cares (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, exploiting the Sheppard-Towner Act from 1924 through 1929, Moehling and Thomasson (2014) shows that one-on-one contact and follow-up care through home visits reduced infant deaths in the United States more than did classes and conferences. Bhalotra et al. (2017) finds 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). Hjort et al. (2017) finds that people visited by nurses in infancy through the 1937 Danish home visiting program experience a robustly estimated increase in adult survival rates during middle age (45-64) and lower predisposition to serious adult diseases. In a recent study, Hoehn-Velasco (2021) examines a sample of rural counties in the US and finds that county-level health departments (CHDs) that provided health services geared toward children before age ten increases men's later-life earnings by 2-5%. The services of these programs are a combination of nutrition and sanitation promotion, growth and development monitoring, parental health investments, 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 run or long run.

The literature on the impacts of growth and development monitoring in developing countries focus on small- and large-scale RCTs. Several small-scale RCTs in Nigeria, Jamaica, India, Madagascar, and large RCTs in Brazil, Tazania, India, and Senegal provide tentative evidence that participation in growth and development monitoring confers a significant benefit on 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 young child nutrition program, 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). There was a halving in the prevalence of underweight in regions after the program was introduced. There was no comparable reduction in underweight in other Parishes. 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) and might explain the lacking of impact from growth and development surveillance. Furthermore, these RCTs were unable to disentangle 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.[3] After consulting with medical doctors and other experts as well as measuring public opinions, the Chinese government decided to focus on growth and development monitoring with routine health checkups and initiated 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 percent of Chinese population had been covered by this program.

The SMC provides government-funded free routine health checkups to all young children (0-6 years) through community-based clinics operated by the MOH. Each child visits community-based clinics at 1, 3, 6, 9, 12 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. 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, externalia, and cardiac murmur), and developmental evaluation (e.g., the Denver Developmental Screening Test). Additional visits can be scheduled if clinically needed. When a suspicious physical or developmental finding is discovered at the clinics, the

[3] See "Life expectancy at birth, total (years) - China" from the World Bank for more details on life expectancy in China from 1960 to 2020.

child is referred to a specialist for further diagnosis and treatment at hospitals.[4] Care is given by public health nurses working in collaboration with physicians. Appendix Table C.1. provides the full list of the schedule of the SMC and descriptions for service items.

The SMC has four features that facilitate our empirical analysis. First, although designed and initiated by the central government, the SMC was implemented locally. There is significant variation in the timing of the SMC at the county level, which enables us to use a cohort difference-in-differences (DID) model to capture its long-term impacts.[5] In particular, children in later-treated counties are compared with children in counties that initiated the program in earlier years. These later-treated individuals help account for unobservable characteristics that may affect selection into treatment that are not removed by county fixed effects.

Second, participation in the SMC is mandatory for young children (0-6 years). For a first offense, parents who do not send their children for routine visits to community clinics will receive a warning letter from the local government and are urged to make up the missed visit as soon as possible. For subsequent offenses, parents may face penalties such as restrictions on enrollment of welfare programs. As such, all children residing in a SMC county while under the age of seven form the treatment group. Within the same county, 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 long enough post period to estimate the long-term impacts of the program. In addition, a child's birth date and *hukou* registration county nicely approximate the treatment assignment and the age at treatment for the SMC in our empirical analysis.[6] The *hukou* system acts as a domestic passport system with only nonimmigrant visas.[7] An indi-

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

[5]After a county initiates the SMC, it remains in effect.

[6]The ideal data would include details about the birth county and the history of migration during the first 6 years of life. Since this data does not exist, instead, we gauge the treatment assignment and the age at treatment for the SMC with a child's birth date and *hukou* registration county.

[7]The *hukou* system was first started in cities in 1951 and was promulgated as a permanent system

vidual's *hukou* is ascribed at birth based upon 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.[8] Only a small groups are permitted to receive a permanent change in their *hukou* registration county: 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).[9] This nationwide restriction on migration was still in place by 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, thus attenuating our estimations towards zero (Chen et al., 2020; Sun, 2021; Zhao, 1997).

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

4 Data

In this section, we present the main features of the data sets used in this study. First, we gathered information from over 3,000 local gazetteers (described in more detail in the next subsection) to construct a unique county-level dataset of the years in which each county implemented the SMC. Second, we matched this county-level information to individual-level population censuses and family surveys. The main outcome variable,

nationwide in 1958 (Chan and Zhang, 1999; Sun, 2021).

[8]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 *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).

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

adult earnings, comes from the 2005 population census.

County-level SMC Rollout

Data on county rollout of the SMC come from county gazetteers. Gazetteers are book-length volumes compiled by local historians to record the county's major events and draw upon materials in local archives. They are often considered as the county's "encyclopedia". County gazetteers are not used in evaluating local officials and 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).[10] Local governments usually form task forces to write and periodically update their gazetteers as one important source of local history as well as local pride. Not all the historical information is available in local gazetteers. One piece of information may be recorded 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.[11] Our primary analysis sample includes the 873 counties that record the precise timing of the SMC.[12] We also collected other county-level statistics from local gazetteers to complement our analysis. Appendix Table D.1. displays the summary statistics of these socioeconomic variables from the gazetteers.

There may be some concern about sample selection bias with missing values of

[10] 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 evaluation was based. They document substantial agreement between the two data sources. Besides, Benford's Law in manner suggested by Varian (1972) was applied to detect fake data in gazetteers, where falsified digits tend to be made up uniformly.

[11] 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 instance, a county may write one gazetteer during the 1990s and another one in the 2000s.

[12] Note that if a county changed its code without changing its boundary, we treat it as the same county. We excluded 22 counties that were 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."

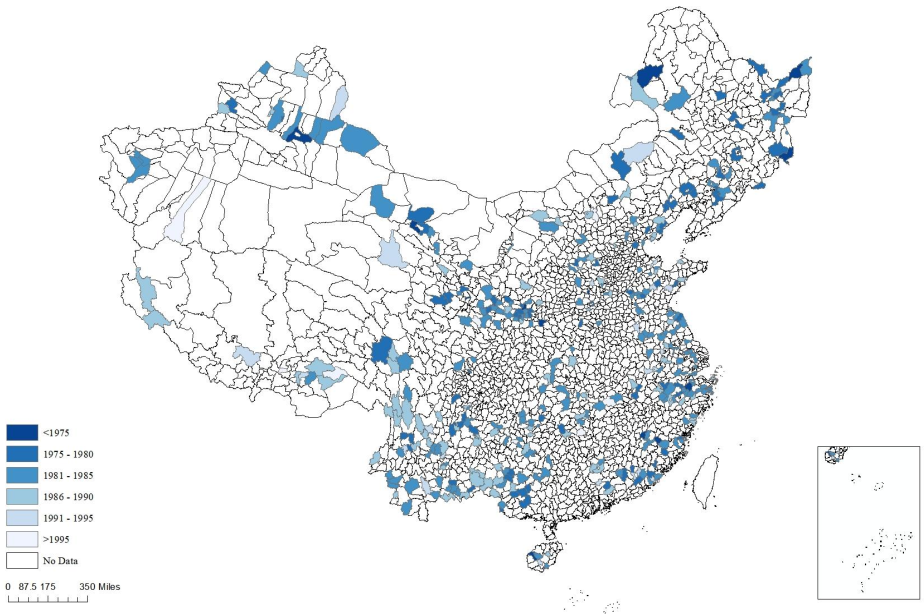

FIGURE 1

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.

the start year of the SMC in other 1995 counties. We examine the pattern of missing values in Panel A of Appendix Table D.3. . We show that the SMC reporting counties have similar demographic and socioeconomic characteristics as non-reporting counties after adding province fixed effects. Thus, missing values in gazetteers are not likely to threaten our empirical results in the baseline specification with province-by-cohort fixed effects.[13] Another concern is the exogeneity of the SMC arrival timing. If the timing of the SMC arrival was not randomly selected, early and later-treated counties could have been systematically different. We test whether county demographic and economic characteristics predict the adoption timing and report the results in Panel B of Table D.3.. All county-level characteristics are unrelated to the SMC rollout after adding province fixed effects, which suggests that exposure to the SMC was plausibly exogenous, conditional on the baseline fixed effects in our main specifications.

[13] Besides province-by-cohort fixed effects, the baseline model includes county and birth year fixed effects.

Figure 1 shows the regional variation on the rollout of the SMC. The darker a county, the earlier it implemented the SMC. There is considerable variation in the timing of implementation among both developed and poorer counties. More importantly, as Figure 2 illustrates, the timing of treatment in the implementing counties varies over the entire period that we consider. Our empirical strategy, discussed in the next section, relies on this variation in the timing of treatment initiation to identify the long-run effects of the program.

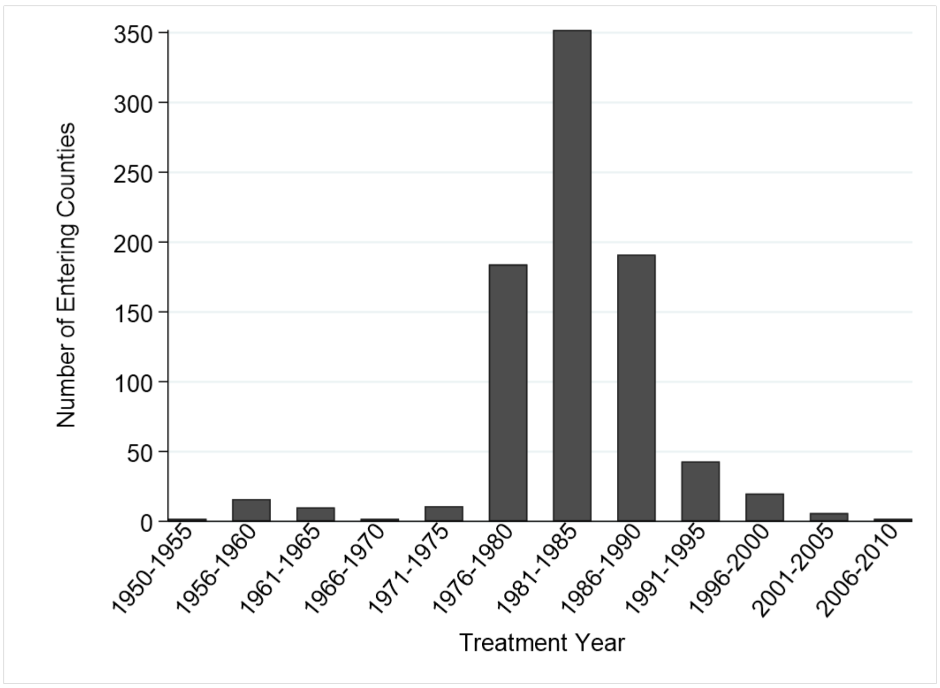

FIGURE 2
Number of counties by their year of entry into treatment, 5-year bins, 1950–2010

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 percent 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. It also reports hours worked last week as an additional measure of income. We compute hourly wage 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 percent from each tail of the income distribution for the baseline sample.[14] In the baseline analysis, we focus on cohorts born between 1976 and 1986. These cohorts were at least 18 years old and mostly have completed their compulsory education by 2005. Meanwhile, these individuals were not exposed to the negative shocks occurred in the early years of the People's Republic of China, such as the Great Famine and the Cultural Revolution.[15]

Second, the 2005 census collects 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 6 that the SMC is available in the individual's *hukou* registration county.[16] Appendix Figure B.1. displays exposure to the SMC by birth cohort, using the baseline sample for the 1976–1986 cohorts. As the timing of the SMC varies across counties, there is substantial variation in exposure to the program both within and between cohorts. This, combined with the large sample sizes

[14] 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.

[15] 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 literature discusses the negative long-term impacts of these historical events (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.

[16] 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 in the middle of the reform year 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 that measurement error is unlikely to affect our results.

(for example, more than 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 respective role of schooling in improving adult incomes. We coded our main education variable, *years of education*, according to the highest level of education an individual received and whether they completed each tier of schooling. We assume that people received 6 years of education if they graduated from primary school. We 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.

Besides the income measures and education outcomes, we also use a number of individual-level demographic and socioeconomic characteristics from the census as control variables in our main DID specifications, including gender, age, ethnicity, and rural status.

China Family Panel Studies (CFPS)

We also merge the county rollout data with the CFPS data to evaluate how young children's exposure to the SMC 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. It covers 25 out of 31 provinces and autonomous regions in China. Each wave of the survey collects comprehensive information on 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 CFPS-2010) in our main empirical analysis.

The CFPS-2010 provides many measures of physical and mental health as well as cognitive outcomes that we can use to explore additional mechanisms through which early childhood exposure to the SMC can lead to an improvement in adult earnings. The first measure of physical health is the self-assessed general health status, rated on a 5-point scale (excellent, very good, good, fair, or poor). 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 visit due to physical discomfort within the past six months. In addition, we aggregate these measures of physical health and construct a physical health index to alleviate 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 across standardized z-score 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 mental health and construct a mental health index as the average across standardized z-score 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 twenty-four questions.[17] The verbal test is based on thirty-four questions and measures the ability to correctly spell Chinese characters. The total points possible for the verbal test are 34.[18] 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 a set of 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

Besides the CFPS-2010, we use data from the China Health and Nutrition Survey (CHNS) 1989-2010 to further explore potential mechanisms behind the 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.[19]

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

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

[18] 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.

[19] These 9 sample provinces cover approximately 45% of China's total population and vary widely in 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.

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

Y_{icb} is the natural logarithm of monthly income for individual i in *hukou* registration county c and birth year b. SMC_{cb} 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 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 take the value 1, while those born before 1976 are defined as nonexposed and take 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 6 years old, the estimated effects come close to the population average treatment effects of the SMC. 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 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}.[20] We cluster standard errors at the county level, allowing for arbitrary correlation in error terms for a given county.[21]

[20] 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.

[21] 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. The results show that the SMC effect remains highly similar when clustering standard errors at the county-year level.

Internal Validity

The central requirement for identification in our DID strategy is the parallel-trend assumption: 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. 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 7 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 cohorts that were not treated supports the parallel-trend of our DID strategy. To better address concerns about differential cohort trends, we assume that the SMC had been implemented 5, 6, 7, 8, and 9 years earlier than the actual arrival year in each county and then replicate 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, since it would be easy to confuse a gradually increasing post-SMC effect for cohorts that were increasingly exposed to the SMC with post-treatment county-specific trends. Recall that among the cohorts exposed to the SMC, the oldest cohort exposed in a given county was exposed for only one year, the next-to-oldest for two years, etc. We therefore estimate the pre-treatment trends on a sample of individuals born between 1950 to 1960, where we run regressions on monthly income as a function of county fixed effects, birth year fixed effects, province-by-birth-year fixed effects, and linear or quadratic county-specific trends. We then use the coefficients from these regressions to predict the trends in monthly income for our main sample and include these predicted trends as control variables in our baseline DID regressions (see Wolfers (2006), Holmlund (2008), Lee and Solon (2011), and Lundborg et al. (2022) for examples of this approach).

We expect that access to the SMC should improve adult income. The same forces, however, could also lead to a change in birth cohorts through endogenous sample selection. For instance, if the SMC introduction leads to increases in 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 concern that our estimates are biased by other concurrent policies and factors. These must coincident with the rollout of the SMC by county and only affect children below age 7 when the SMC was introduced in the county. From our systematic review of contemporaneous historical policies, no candidate confounders adhere to both precisely-described patterns. Nonetheless, to further alleviate concern over concurrent policies, in Appendix Table E.5., we report the results after controlling for the possible influences of the compulsory education system and the one-child policy that could raise overall lifetime earnings of children in China. The estimated coefficients on the SMC remain highly similar to those in baseline specifications and statistically significant, confirming the robustness of our SMC estimates. See Section E in Appendix for more detail.

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

Finally, in Appendix Figure E.1., we conduct the randomization inference procedure as suggested by Bertrand et al. (2004). We randomly assign a year of the SMC implementation to each county and estimate the DID specification as 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 when compared to the distribution of placebo effects, corroborating the validity of the DID approach.[23]

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

[23] See Section E in Appendix for more detail.

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 and shows that full exposure to the SMC is associated with an increase of 5.3% 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.[24] The addition of these individual characteristics increases the estimates to a 5.8% income gain and the effect remains statistically significant.

To ensure the robustness of these results to county demographic and socioeconomic characteristics, we make several adjustments to the base specification. In particular, our specifications in Columns 3-7 build on the model in Column 2 by adding linear cohort trends interacted with the population size, urbanization rate, per capita grain production, share of ethnic minorities, and average years of schooling in the *hukou* registration county. The estimates obtained are highly similar to those shown in Columns 1-2, bolstering confidence in our baseline model.

Appendix Table D.4. reports the heterogeneous effect of the SMC on adult earnings by gender and by level of development (more-developed eastern provinces versus less-developed non-eastern provinces).[25] Columns 1-2 show that the effects did not differ by gender.[26]. In Columns 3-4, we found children from eastern provinces gained more from the SMC than those 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 potential.

No previous studies have estimated the long-run benefits of growth and development monitoring *per se*. To place the longer-term effects of the SMC into perspective, our estimates of the earnings improvement from full exposure to the SMC is of sim-

[24] 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.

[25] Eastern provinces were the original focus of Chinese economic liberalization in the 1980s. These provinces have higher levels of economic growth, foreign direct investment, and personal incomes.

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

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 includes adults who were born between 1976 and 1986. The dependent variable 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.

ilar magnitude to those estimated in one recent study for early childhood exposure to county-level health departments (CHD) in rural America (Hoehn-Velasco, 2021). Hoehn-Velasco (2021) finds that CHD operation before the age of five increases 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) shows that Swedish pupils exposed to the school lunch program free of charge during their entire primary school period have 3% higher lifetime income. 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 food stamps (Baird et al., 2016; Bleakley, 2007, 2010; Hoynes et al., 2016). For instance, in Bleakley (2010), malaria eradication is associated with a 50% increase in later-life income. The 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 start.

Event Study: Differential Effects by Age at First Exposure

Motivated by the findings in the previous subsection, we conduct an event study to examine how the effects of the SMC vary across different exposure windows in childhood, especially when the services of the SMC 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 pre-birth to adulthood (e.g., -1-, 0, 1, 2, and so on). Relative to the baseline model, this flexible specification enables us to capture the differential effects across all windows of exposure, including "placebo" exposure beyond age six. Meanwhile, through this event study, we could assess the validity of the parallel-trend assumption of the DID approach 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 effect of the SMC on children with different exposures to the program. On the x-axis, the event time "-1-" is when the SMC was introduced in the county prior to 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. We find that the 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 still gain around 2% increase in lifetime earnings calls for attention. This suggests that growth and development monitoring beyond the first three years of life remains important and could generate considerable long-term benefits. The estimates

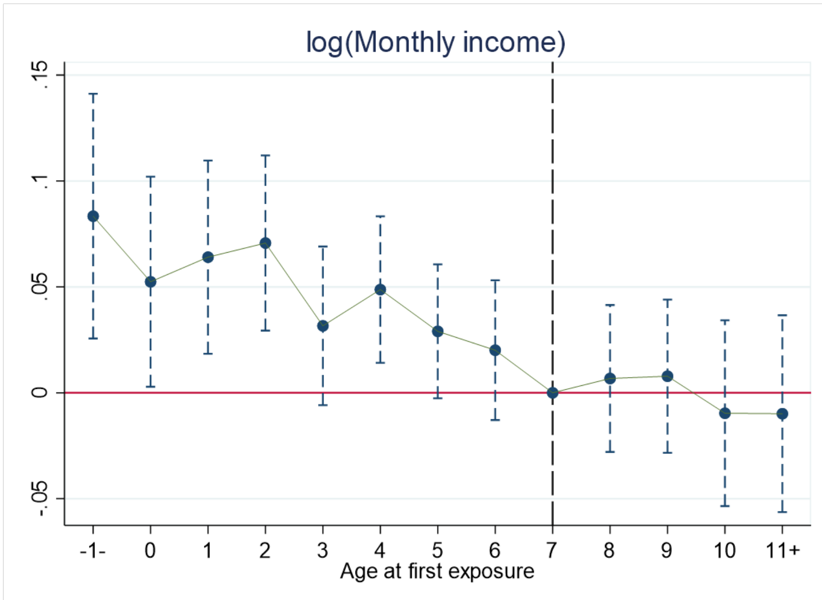

FIGURE 3

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.

of "placebo" exposure above age 6 (i.e., 7, 8, 9, and so on) are small and statistically insignificant. This zero or negligible impact on children who were 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

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

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 includes 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, 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.

in Column 2 of Table 2. The estimates are reported in Table 3. Column 1 replicates the regression in Column 2 of Table 2 as benchmark estimates. Column 2 examines the effects of the SMC on hourly wage 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 the marginal productivity. Column 3 examines the effect of the SMC on hours worked last week. The coefficient of β is only 0.015 and not statistically significant. These findings suggest that income improvements primarily result from higher marginal productivity of individuals rather than a trade-off between leisure and time spent in the labour force.

Robustness Tests

In Appendix Section E, we discuss robustness of the main results and address a number of confounding factors that may also generate the positive link between the arrival of the SMC and increase in adult income. We also perform additional robustness tests to bolster a causal interpretation for our results. Our main results are robust to different choices of sample (Appendix Table E.1.), to using 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.), by contemporaneous historical events (Appendix Table E.5.), or by income outliers such as top- and low-earners (Appendix Table E.6.). Furthermore, the effect of the SMC on lifetime income is robust to controlling for linear and quadratic county-specific trends (Appendix Table E.7.), to accounting for recent concerns that staggered difference-indifference estimates may be biased in the presence of heterogeneity in the treatment effects over time or across groups (Appendix Table E.8.), and to accounting for multiple hypotheses testing (Appendix Table E.9.). Finally, the point estimates obtained in the main regressions are significant when compared to 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 then turn to health and education outcomes. Specifically, we consider the effect of the SMC on physical and mental health of exposed children, educational attainment, and cognitive development. While these are interesting outcomes on their own right, we also evaluate them as potential mediators through which the SMC may affect adult income.

Physical Health

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. 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 dependent variable. Column 1 of Table

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 includes 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 visited a doctor due to physical discomfort in the past six months and 0 otherwise. The dependent variables 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.

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 the self-assessed health status. We then repeat the analysis using a dummy variable indicating whether an individual being in excellent or very good health in Column 2 of Table 4 and show 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 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 visits due to physical discomfort by 14.2 percentage points.[27] These findings

[27] 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 Appendix). This is not surprising since the oldest cohort in our baseline sample is 34, at which age chronic health

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 results are robust, we conduct the event study for the physical health index in Panel A of Figure 4. Consistent with initial expectation, 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 6 are small and statistically insignificant, corroborating the validity of our DID specification. Our estimate of 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). Besides, these findings align with prior work (Pitt et al., 2012; Baird et al., 2016; Bhalotra et al., 2017; Hoehn-Velasco, 2021) and suggest that health is producing adult productivity gains.

Mental Health

Besides, routine health checkups offered by the SMC may improve the mental health of children with better quality of life and productivity. To analyze this channel, we estimate the long-term effects of the SMC on four measures of mental health based on Equation 1 and report 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 15.9-percentage-point decrease 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

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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 middle age (45 to 64). Table H.2. presents results for hypertension, tumor, arthritis, 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 arthritis. Meanwhile, exposure to the SMC decreases the probability of developing migraine and gastritis. These findings suggest that individuals exposed to the SMC enjoy more healthy life at older ages and consequently are likely to cost the medical system significantly less.

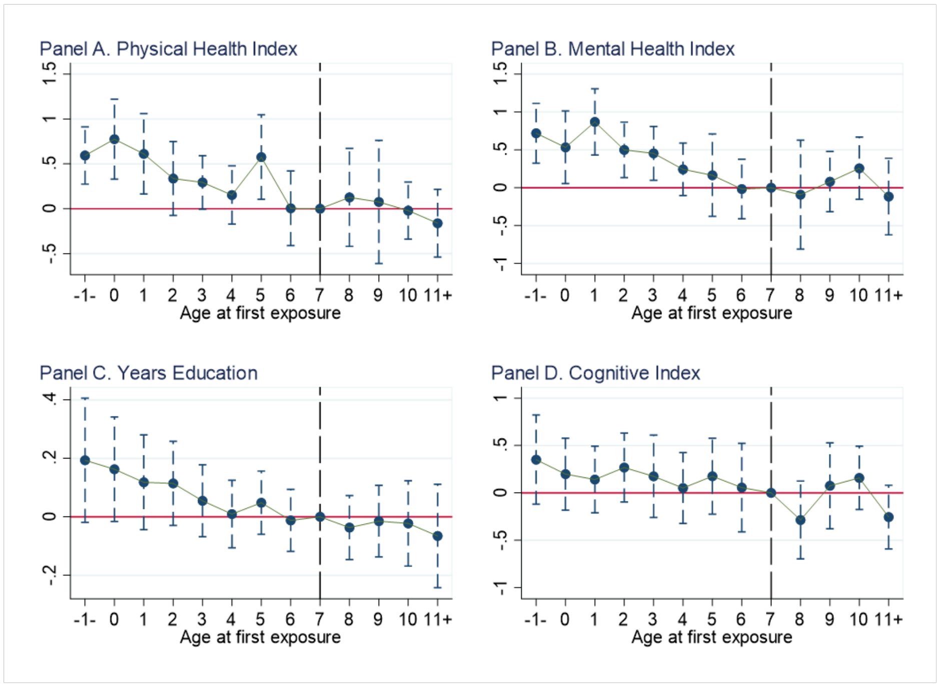

FIGURE 4

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 are a linked sample of the CFPS 2010 with the SMC county-by-county rollout and includes adults who were born between 1976 and 1992. 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.

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 in early childhood reduces the mental health index by 0.767 standard deviation. The effect of the SMC on mental health remains significant when we account for multiple hypotheses using FDR-corrected p-values (Panel B in Table G.1). In addition, 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 6 and shows no evidence of pre-trends from nonexposed cohorts. These findings confirm results in related work (Adhvaryu et al., 2019; Persson and Rossin-Slater, 2018)

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 variable in Column 2-4 are indicators that take the value of 1 if a person has experienced feelings of hopeless, restless and worthless, respectively in the past four weeks. The dependent variables 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.

that suggest better early-life health decreases the probability of mental distress and enhances mental well-being in adulthood.

Parental Investments

A number of economic studies show that parents' investment strategies are related to childhood endowments: parents invest more in children with higher endowments (Deng and Lindeboom, 2022). In this view, if the SMC boosts early childhood endowment, children with higher program exposure were likely to receive more investments from their parents (i.e., reinforcing parental investments). Following the literature, we use the sample of children aged 0–17 from the CHNS and assess how the exposure to the SMC predicts the changes in three measures of parental investments, based on Equation 1. The first measure is the monthly household expenditure on childcare. The

TABLE 6

The effect of the SMC on parental investments

	(1) Expenses for child care	(2) Mother's time input children	(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 includes 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.

second measure is the 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. While no significant effect of the SMC on monthly expenditure and the amount of time dedicated to childcare, we find that the introduction of the SMC increases the uses of routine health examinations by 3.7 percentage points among children aged 7–17, suggesting that parents make reinforcing investments on pediatric health services for their children that received the SMC services in early childhood. The observed sustainability of the increase in routine health checkup usage among adolescents aligns with continued behaviour changes after hygiene promotion programs (Wilson and Chandler, 1993; Cairncross et al., 2005).[28]

[28] Cairncross et al. (2005) finds that more than half the adults in intervention areas still keep good handwashing practice up to nine years since conclusion of a multifaceted hygiene promotion intervention, while less than 10 percent of adults in control areas sustained the handwashing practices.

Education Outcomes

Children who become healthier from exposure to the SMC in early childhood are more likely to attend school regularly and attain more years of schooling. This increase in the quantity of education attained would then contribute to the higher earnings in adulthood measured in Table 2. To explore the potential connection between the SMC and schooling, we look at the sample of children born between 1976 and 1986 from the 2005 census and estimate the effects of the SMC on years of education based on Equation 1. In addition, we use dummy variables indicating whether an individual completes 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 and shows that exposure to the SMC increased children's education by about 0.2 years. Given previous estimates of the returns to schooling, the 0.2 year increase in schooling translates into approximately 0.9% increase in adult incomes.[29] We arrive at a similar conclusion when 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 results are robust, we provide event-study estimates of the effect of the SMC on years of education in Panel C of Figure 4. Consistent with initial expectation, exposure to the SMC improves years of schooling with the effect declining through age 6. The pattern in the figure shows no evidence of pre-trends; the point estimates of the "placebo" exposure are close to zero and insignificant.

Columns 2 and 3 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 only affects the probability of completing high school and college. It is reasonable that the SMC has no impact on the likelihood of finishing elementary or middle school for the 1976-1986 cohorts in our baseline analysis because these cohorts are all covered by the compulsory education law and are mandated to finish middle school. Columns 4 and 5 in Table 7 display the results using the completion of high school and college as alternative educational outcomes. Exposure to the SMC increases the likelihood of high school graduation by 2.4 percentage points and that

[29] For this calculation, we use results from Wang (2013), which finds that an additional year of schooling in China raises income by about 5.3%. For the sample of children born between 1976 and 1986 from the 2005 census, the income increase is 0.2 X 5.3 which is about 1.06%.

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 CFPS-2010 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.

of college graduation by 2.2 percentage points. 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 programs (Deng and Lindeboom, 2022; Field et al., 2009). In addition, the magnitude of the improvements in schooling is similar to the ones estimated for school lunches in Sweden (Lundborg et al., 2022) and access to safe drinking water (Zhang and Xu, 2016).

Cognitive Outcomes

Furthermore, as schoolwork is an energy-intensive activity, healthier children are more likely to do better in coursework. This improvement in the quality of education would also increase the 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

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 variable of Column 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.

Equation 1. The first two Columns of Table 8 display the results for verbal scores. There is not a statistically significant change in verbal test scores 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-point increase in math test scores, which is significant at the 5 percent level. Consistently, Column 4 reports a 0.29 standard deviation increase in math scores after the arrival of the SMC.[30] This pattern is in line with existing studies on cognitive outcomes that 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 that the effects of the SMC on cognitive skills arise for exposed, but not for unexposed, cohorts, confirming the robustness of these findings. 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). Besides, these

[30]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 than a similar child with no exposure.

cognitive gains is qualitatively similar to the corresponding estimates for the Matlab Maternal and Child Health and Family Planning (MCH-FP) program in Bangladesh (Barham, 2012) and the Nutrition of Central America and Panama (INCAP) early-life intervention program in Guatemala (Maluccio et al., 2009). The effect of the SMC on cognitive measures are robust when we account for multiple hypotheses testing using FDR-corrected p-value in Panel A of Appendix Table G.2..

8 Discussions and Conclusions

The SMC is a government-funded healthcare 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 surveillance *per se* improves lifelong earnings. To conduct this analysis, we digitized 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 difference-in-differences specification, where 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%. Income improvements primarily come from higher marginal productivity rather than a trade-off between leisure and time spent in the labor force. Our main results are robust to a wide range of alternative specifications. Besides estimating the overall increase in adult earnings, we investigate the potential mechanisms underlying the documented long-term benefits of the SMC. 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, corroborating related literature on the health-related income gains (Pitt et al., 2012; Baird et al., 2016).

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 was about 45 RMB per child in 2005 census, this income gain would more than cover the expected cost. Meanwhile, given the total financing cost of the program per child is 270 RMB,[31] a conservative estimate of the long-run annual return to this investment would be approximately 73 percent (=198/270). These back-of-the-envelope calculations imply that the introduction of the SMC is highly cost-beneficial. If we take into account 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 about the merits of growth and development monitoring in developing countries. Since 1961, the World Health Organization (WHO) has launched growth standard and charts and has enthusiastically promote 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 center largely around the effectiveness of growth and development surveillance and whether the investments are justified. There is not yet unequivocal evidence that growth and development monitoring is beneficial *per se* in the short run or long run (De Onis et al., 2004; Ashworth et al., 2008). Using a variety of survey and administrative data, we show that growth and development surveillance through routine health-checkups in early childhood could generate substantial long-term benefits and are highly cost-beneficial. As the largest developing country, infant mortality rates and per capita incomes in China during the period of the SMC rollout from the 1950s to 1990s are comparable to those of the Third World today. Therefore, our results and methods contribute credible evidence to this important policy issue.

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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

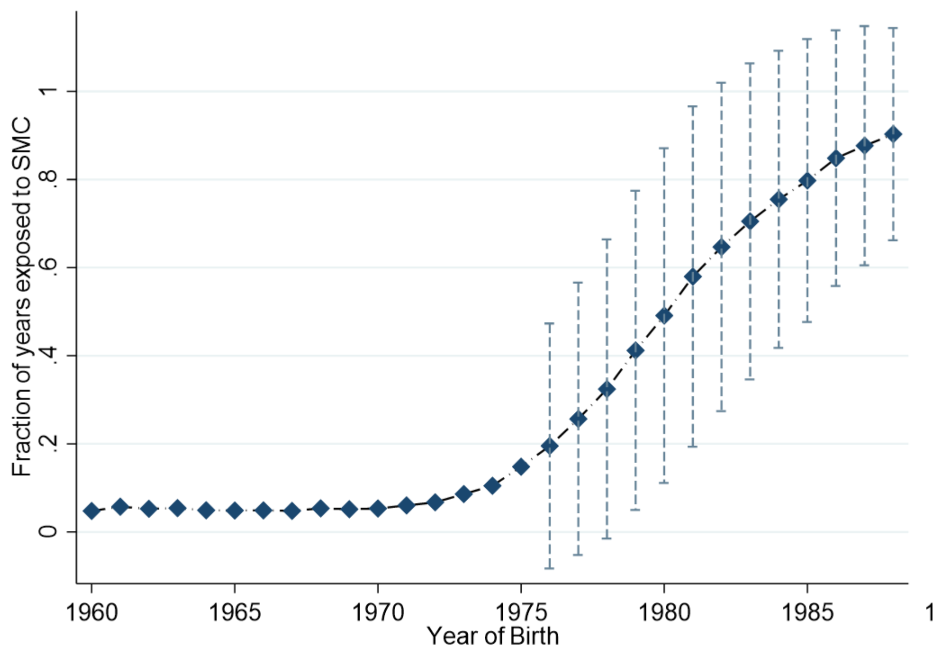

FIGURE B.1.
Fraction of years exposed to the SMC from birth to age 6, by birth cohort.

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
Hukou 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			
Expenses for child care	1,015	3.601	1.597
Mother's time input Children	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) Urban 1964	(3) Grain 1965 (Log)	(4) Share of Ethnic Minorities	(5) Education Year
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 includes 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 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. 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, individual characteristics including gender, age, ethnicity, and hukou 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 choices of sample. 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 exclude pre-1976 cohorts in the baseline estimation as these cohorts were exposed to catastrophic events in the early years of the P.R. China such as the Great Chinese Famine (1959-1961) and the Cultural Revolution (1966-1976). A large number of studies discuss 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 re-run the baseline model with the 1970-1986, 1965-1986, 1960-1986, and 1955-1986 cohorts, respectively. Panels C-F in Table E.1. present the results. In line with the 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 concern that top- and low- earners could bias our estimates. To control for the influence of potential outliers, we winsorize the tails of income distribution from the baseline sample in Table E.6.. In Panel A, the one percent tails are winsorized from the sample.[32] 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 winsorizings serve as additional checks on the earnings results and ensure our findings are not driven by outliers.

[32]For the 1% winsorization, we replace 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 was introduced in the middle of the year (Column 2) or at the end of the year (Column 3) so that the SMC arrival year is counted as 1/2 year of exposure or not counted for exposure. The results are quite similar to the main results, confirming that measurement error is 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 by 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 cluster standard errors at the county-year level instead, allowing arbitrary correlation in error terms for a given county-year pair. The results show that the SMC effect remains highly similar. Column 3 includes both modifications from Columns 1-2, and the SMC effect remains highly robust.

Endogenous Sample Selection

Overall, we expect that exposure to the SMC improves adult earnings. 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 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 dependent variable. Table E.4. in Appendix presents the results. 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 later-life earnings of children below 7 years of age when the SMC was introduced in the county. From our systematic review of contemporaneous historical events, no candidate policies adhere to both precisely-prescribed patterns. Nevertheless, to further alleviate concern over concurrent policies, we report the results after controlling for the possible influences of the compulsory education system and the one-child policy that could raise overall lifetime earnings of children in China.

The Compulsory Education System

China's Compulsory Education Law (CEL) was passed and went into effect in 1986. All 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, therefore upwardly biasing our estimates. Because the timing of 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 substitute province-by-birth-year fixed effects with province-specific time trends, and then follow Du et al. (2021), which studied the impact of education on gender role attitudes, to exploit exogenous temporal and geographical variation in the enforcement of CEL. As the central government recognized that not all provinces would have sufficient resources to enforce the law immediately, provinces were 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 by the early 1990s (Du et al., 2021). We collected province-level information on the timing of the CEL. Panel A of Table E.5. presents the results after considering the impacts of the compulsory education law. The estimated coefficient of CEL is positive and statistically significant, indicating that the compulsory education law did raise the adult incomes. Meanwhile, the estimated coefficient on the SMC are somewhat larger than those in Table 2 and statistically significant, confirming the robustness of our SMC estimates.

The One-Child Policy (OCP)

The Chinese government imposed its one-child policy in 1979 to curb the growth of the population that, at that time, was reaching 972 million people.[33] This nationwide fertility policy was firmly enforced for around 32 years until 2011. With tight fertility control, parents are likely to devote more time and financial resources on childcare and educational investment for their only child, consequently raising their later-life earnings. Our empirical strategy to control for the influence of the OCP follows that of Ebenstein (2010), which studied the impact of the OCP on higher ratios of males to females.[34] Specifically, we approximate the variation in enforcement of the policy with the average policy fine for excess fertility.[35] Panel B of Table E.5. reports the results after controlling for the OCP. The estimated coefficient of the SMC is almost identical to our main specification in Table 2.

The last Panel of Table E.5. simultaneously controlled for all the confounding factors considered above, and the SMC effect remains highly robust.

Heterogeneous Treatment Effects

There may be concern that the two-way fixed effect estimates may not be valid in staggered DID designs. 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. The estimates of the long-term effects are robust to accounting for treatment heterogeneity across groups and time.

[33]The policy most strictly applied to Han Chinese, but not to ethnic minorities around China. There are 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.

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

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

Multiple Hypotheses Testing

Another potential issue with our income analysis is estimates of the SMC that falsely appear significant in multiple hypotheses testing. To address this concern regarding multiple inference, we apply the false discovery rate (FDR) correction proposed by Benjamini and Yekutieli (2001) and report FDR-adjusted p-values in Table E.9. in 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 keeping fixed the distribution of the SMC events over time. We then estimate the difference-in-difference 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 allows us to obtain p-values and tests of statistical significance. In Figure E.1. in Appendix, we show the probability density function of placebo treatment effects for adult earnings. We show that the point estimates obtained in the main regressions are clearly significant when compared to the distribution of placebo effects, 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 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 *hukou* 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 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 *hukou* 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 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 *hukou* status. Standard errors are clustered at the county level in Panel A and county-year level in Panel B. *** 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 *hukou* 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 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 *hukou* 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 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 *hukou* 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 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 *hukou* status. Standard errors are clustered at the county level in Panel A and county-year level in Panel B. *** 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)	(2)	(3)
	log(Monthly income)	log(Hourly wage)	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 of 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 *hukou* 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.

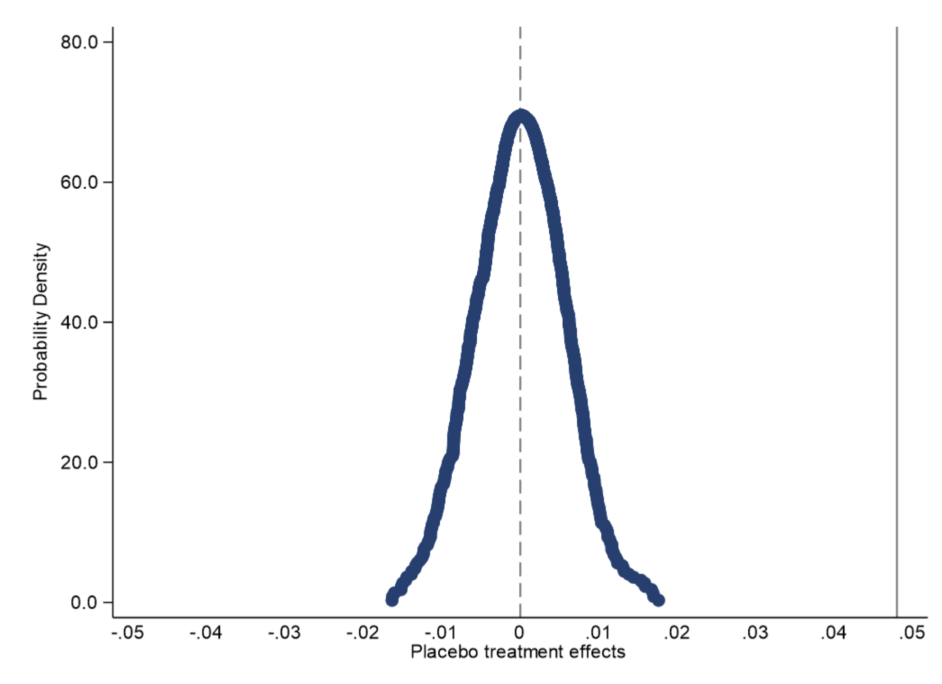

FIGURE E.1.
Random inference distribution

TABLE E.10.

Placebo Exposure Tests: Assume earlier introduction of the SMC

	(1)	(2)	(3)	(4)	(5)
	5 years earlier	6 years earlier	7 years earlier	8 years earlier	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 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 *hukou* 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. All models include birth year, county, province-by-birth-year fixed effects, as well as individual characteristics including gender, age, ethnicity, and *hukou* 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
Panel C. Parental investment					
	Expenses for child care	Mother's time input children	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 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 *hukou* 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 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 *hukou* 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) Gastritis	(2) Migraine	(3) Fracture	(4) Hypertension	(5) 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 *hukou* 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)	(2)	(3)	(4)	(5)
	Gastritis	Migraine	Fracture	Hypertension	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 *hukou* 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.