The Effects of the National School Lunch Program on Education and Health*

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Abstract: This paper estimates the effects of participating in the National School Lunch Program in the middle of the 20th century on health outcomes as an adult and on educational attainment. I utilize an instrumental variables strategy that exploits a change in the formula used by the federal government to allocate funding to the states. Identification is achieved by the fact that different birth cohorts were exposed to different degrees to the original formula and the new formula, along with the fact that the change of the formula affected states differentially by per capita income. Participation in the program as a child appears to have few long-run effects on health, but the effects on educational attainment are sizable. These results may suggest that subsidized lunches induced children to attend school but displaced food consumption from other sources. Alternatively, the program may have had short-run health effects that dissipated over time but that facilitated higher educational attainment.

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I. Introduction

Section 2 of the National School Lunch Act of 1946 reads,

> It is hereby declared to be the policy of Congress, as a measure of national security, to safeguard the health and well-being of the Nation's children and to encourage the domestic consumption of nutritious agricultural commodities and other food, by assisting the States, through grants-in-aid and other means, in providing an adequate supply of foods and other facilities for the establishment, maintenance, and expansion of nonprofit school-lunch programs.

In the hearings for this Act, Major General Lewis B. Hershey testified to Congress that 16% of Selective Service registrants in World War II were rejected from service or placed in the limited service class and that malnutrition or underfeeding played a likely role in somewhere between 40% and 60% of these cases (U.S. Congress 1945). Congress felt the need to remedy this situation and, thus, the National School Lunch Program (NSLP), under which the federal government provides cash and commodity aid to states for localities to use in serving warm lunches to students, was seen as a "measure of national security." It was not clear in this era that children would be nourished adequately if they brought a lunch to school or were released from school to eat lunch at home. Therefore, a government-subsidized lunch program could potentially have had a real impact on health and, if nutrition and learning are complements, may have also increased educational attainment. Moreover, receiving a subsidized lunch may raise incentives to attend school. On the other hand, the program was broadly-targeted at its inception, and it is not clear that the aid from such a program would find its way to the subset of the population that suffered from malnutrition.

This paper studies the historical effects of participating in the NSLP on health outcomes (such as adult height and body mass index) and educational attainment. In addition to least squares estimates, I present instrumental variables estimates that exploit a change in the funding formula determining the allocation of federal cash assistance across states. The change in the formula affected states differentially (and non-linearly) by per capita income, with wealthier states receiving relatively more funding under the later formula. However, new funding amounts are calculated each year. Thus, in order to avoid estimates that are contaminated by changes in the inputs to the funding formula, the instrument is based on funding that would be received given a state's average characteristics over the time period. To preview the results, my analysis of data from the National Health Interview Survey uncovers few lasting effects of the NSLP on health, but I find a sizable effect of the NSLP on educational attainment using data from the Census. A potential explanation for these findings is that students would have had a similar diet in the absence of the program but that they attended school in order to purchase food at a subsidized price. An alternative interpretation is that the potential health effects have faded away by the time individuals reach adulthood but that I detect an effect on education because education is a more contemporaneous measure of the impact of the NSLP.

Estimating the effects of the NSLP is of interest in its own right as an evaluation of a major government-sponsored nutrition program.[1] Uncovering the effects of the NSLP at its inception may also be relevant for developing countries that have recently adopted or are considering adopting a similar large-scale child nutrition program.[2] Moreover, the

[1] To give an indication of the size of the program in the time period under consideration in this paper, the federal government alone spent roughly $500 million (in 2005 dollars) on the NSLP in 1947 and roughly $1 billion (in 2005 dollars) in 1973. Federal spending on the NSLP is now over $8 billion annually.

[2] India recently began a nationwide lunch program which, according to at least one journalistic account (Lakshmi 2005), has been successful in increasing school attendance among girls. Dreze and Kingdon (2001) show that school lunch programs were associated with higher school participation rates among girls in India before the nationwide program went into effect. Vermeersch and Kremer (2005) report on a randomized evaluation of a preschool breakfast program in Kenya; the program increased attendance and test scores. Jacoby (2002) shows that school feeding programs in the Philippines increased caloric intake among participants. Ahmed (2004) shows that school feeding programs in Bangladesh are associated with increased calorie intake, higher school enrollment and attendance, higher body mass indexes, and higher

research could provide information on trends in health outcomes over time and the effects of health investments as a child on health outcomes as an adult. Thus, this paper is related to other recent papers that have used quasi-experimental methods to study historical health issues, including Almond (2006) on influenza, Bleakley (2007a) on hookworm eradication, Bleakley (2007b) on malaria eradication, and Ludwig and Miller (2007) on Head Start. The paper is also tied to economists' growing interest in investments in young children (e.g., Heckman (1999) and Heckman (2008)).

The remainder of this paper is structured as follows. Section II discusses the NSLP in more detail, Section III reviews related literature, Section IV discusses the data, Section V discusses the identification strategy, Section VI gives the main empirical results, and Section VII concludes. Appendix A is the data appendix, and Appendix B gives further results.

II. The National School Lunch Program[3]

The American school lunch has not always been the institution it is today. There were cities such as Boston and Philadelphia that operated their own school lunch programs, often with the help of volunteers or charitable organizations, as early as the late nineteenth century. But it was not until 1932 that the federal government began providing aid for school lunch programs. This aid began on a small scale and originated from New Deal agencies such as the Federal Emergency Relief Administration, the

test scores. The United Nations' World Food Programme is heavily involved in school feeding programs in developing countries, and the United States also supports such efforts through the McGovern-Dole International Food for Education and Child Nutrition Program

[3] This section, as well as other parts of this paper that discuss historical details, draws on Flanagan (1969), Jones (1994), Martin (1999), and *The National School Lunch Act* (1946). Also see Caton (1990) and Levine (2008).

Reconstruction Finance Corporation, and the Civil Works Administration. Federal involvement expanded in 1935 with the creation of the Works Progress Administration and the National Youth Association, both of which operated programs that provided labor for school lunchrooms. In that same year, the Agricultural Adjustment Act was amended with Section 32, which instituted the donation of surplus farm commodities to school lunch programs. By 1943, the New Deal agencies had been dissolved and farm surpluses were not as large as they had previously been, but there was a desire to keep school lunch programs in place. Thus, federal cash assistance for school lunch programs was appropriated on a year-to-year basis from 1943 to 1946.

The NSLP was made permanent with the passage of the National School Lunch Act in 1946. Under Section 4 of the Act, cash was given from the federal government to the states according to a formula that depended on per capita income and population, and this cash was handed down by states to localities. Schools had the option of participating in the program.[4] If they chose to do so, they would receive cash and commodity aid in exchange for following program requirements, including requirements about the contents of the lunch.[5] A gradual change to a new funding formula began in the 1962-1963 school year and was fully in place for the 1965-1966 school year. This change forms the basis

[4] Not every school participated in the program at its inception. Even today, there is less than full participation among schools.

[5] At the inception of the NSLP, there were three different categories of lunches (Type A, Type B, and Type C), and they had different requirements. The requirements for a Type A lunch were "1) One-half pint of whole milk (which meets the minimum butterfat and sanitation requirements of state and local laws) as a beverage. 2) Two ounces of fresh or processed meat, poultry, cooked or canned fish, or cheese; or one-half cup cooked dry peas, beans, or soybeans; or four tablespoons of peanut butter; or one egg. 3) Six ounces of raw, cooked, or canned vegetables and/or fruit. 4) One portion of bread, muffins, or other hot bread made of whole-grain or enriched flour. 5) Two teaspoons of butter or fortified margarine." The Type B lunch had to meet requirements 1 and 4, as well as half the portions for the other requirements. The Type C lunch had to meet requirement 1. My data unfortunately do not distinguish between Type A, Type B, and Type C lunches; I return to this issue in the robustness checks.

of my identification strategy. The formulas and the identification strategy are discussed in detail in Section V of this paper.

III. School Nutrition Programs and Health: Prior Literature

Although this is the first paper of which I am aware to estimate the long-run effects of the NSLP and to estimate the effects of the NSLP in the early years of the program, there is some work on the more recent effects of the NSLP and the related School Breakfast Program (SBP). Schanzenbach (2009) studies the effect of the NSLP on obesity. She shows that participants and non-participants enter school with similar rates of obesity but that the obesity rate is higher among participants than non-participants by the spring of first grade. In addition, a regression discontinuity design exploiting a discontinuity in eligibility for a reduced price lunch at an income of 185% of the poverty level gives similar results.[6] Bhattacharya, Currie, and Haider (2006) study the effects of the SBP, which was introduced as a small-scale pilot program in 1966 and made permanent in 1975, with a difference-in-differences strategy that compares outcomes between the school year and the summer for students in schools where the SBP is available and where it is not available. They find beneficial effects of the program on several outcomes, including the Healthy Eating Index score, the probability of having low serum levels of vitamin C, and the probability of having low fiber intake. Millimet, Tchernis, and Hussain (2008) find suggestive evidence of positive selection on unobservables into the

[6] In Hofferth and Curtin (2005), logistic models suggest a positive relationship between eating a school lunch and being overweight, but instrumental variables estimates are insignificant. Also see Anderson and Butcher (2006) for an indirect case that the nutrition policies of schools have an effect on the body mass index of students. Another recent paper on school nutrition policy is Figlio and Winicki (2005), which shows that schools in Virginia were altering the nutritional content of school lunches around the time of high stakes tests and that this was apparently successful in raising test scores.

SBP and find that, under this assumption of positive selection on unobservables, the NSLP contributes to obesity and the SBP reduces it.[7]

A potential problem with studies of child nutrition programs using recent data is the risk of confounding the effects of different programs with one another. For example, the NSLP and the SBP have similar funding structures and the same income cutoffs for free lunch eligibility (130% of the poverty level) and reduced-price lunch eligibility (185% of the poverty level). In addition, the 130% figure is important for food stamp eligibility, and the 185% figure is important for WIC eligibility.[8] There are also a number of newer child nutrition programs, such as the Summer Food Service Program, whose effects may be confounded with those of the NSLP or the SBP. Studying a time period before these other programs existed should help isolate the effects of the NSLP. Another distinction is that I focus here on long-run effects.

IV. Data

I use three data sets in this paper. The first was assembled from various sources and contains annual information on NSLP funding, NSLP participation, per capita income, and population aged 5-17 by state for the years 1947-1973.[9] The second pools the five National Health Interview Surveys conducted between 1976 and 1980 (United States Department of Health and Human Services 1976-1980). This data set contains

[7] For work regarding other aspects of the NSLP, see St. Pierre and Puma (1992) on the issues of fraud and misclassification in eligibility for free or reduced-price lunches, Gleason and Suitor (2003) on nutrient intake, Long (1991) on the effect on household food expenditures, Dunifon and Kowaleski-Jones (2003) on factors determining participation in the NSLP, Gleason (2008) on the issue of directly certifying for free lunches those who are eligible for other means-tested programs, and Wagner, Senauer, and Runge (2007) on cost issues and on the relationship between lunch sales and nutritional content.

[8] See p. 80 of Currie (2006).

[9] Much of the information in this data set comes from tables showing the exact inputs and output of the NSLP funding formula. When data are unavailable in the funding tables, I use data from other sources or impute the data. Details and source citations are provided in the data appendix.

individual-level data on health outcomes and demographic control variables. The third data set is the 5% sample of the 1980 Census (Ruggles et al. 2004). I merge the first data set with the second to estimate the effects of participation in the NSLP on health and the first with the third to estimate the effects of participation on educational attainment. In the remainder of this section, I discuss the three data sources in more detail. Additional information about the funding and participation data can be found in the data appendix.

A. Funding and Participation

Figure 1 shows the national participation rate in the NSLP for each year between 1947 and 1973.[10] The participation rate divides the average number of lunches served in the national "peak month" (generally November or December) by the size of the population aged 5-17.[11] The trend over time is one of increasing participation. Figure 2 shows the amount of Section 4 "general assistance" NSLP funding per child at the national level between 1947 and 1973. Funding per child tends to fall at first but then rises later. Figure 3 is a scatterplot of state participation rates in 1947 and 1973. States with higher participation rates in 1947 also tend to have higher participation rates in 1973, and states with high participation rates tend to be poorer and in the South. Figure 4 is a scatterplot for the cohort born in 1944 of the averages over the 12 years the children are in school of the state participation rate and funding per child; I use the term "exposure" to refer to this average participation rate. This figure reveals that Louisiana

[10] I use the name of a calendar year to refer to the school year or fiscal year ending in that year. In the time period under consideration, the federal government's fiscal year began on July 1 of the previous calendar year and ended on June 30.

[11] Any student at a participating school is eligible to participate. Thus, the data capture full-price as well as free or reduced-price lunches. Uniform national standards for free or reduced-price lunch eligibility were not imposed until 1972 , although Section 11 of the original text of the National School Lunch Act states, "Meals shall be served without cost or at a reduced cost to children who are determined by local school authorities to be unable to pay the full cost of the lunch."

has especially high participation rates. I include state effects in my regressions, but I also drop observations from Louisiana from the sample as a robustness check.

B. National Health Interview Survey

The health outcome variables and the individual-level control variables used in estimating the effects of the NSLP on health outcomes come from the National Health Interview Survey (NHIS). My NHIS dataset is formed by pooling the five NHIS surveys between 1976 and 1980. I use individuals residing in the continental 48 states and born between 1941 and 1956, and I drop outliers in height or weight.[12] The individual-level data is matched to the participation and funding data using state of residence, as state of birth is unavailable in the NHIS. For an individual who is *a* years old in year *y*, I consider the individual to have been born in year *y-a*, the first year of school to be *y-a+6*, and the last year of school to be *y-a+17*. The top panel of Table 1 reports weighted means and standard deviations by gender and race of variables used to estimate the health models. A substantial percentage of individuals in the sample are underweight (1.4% of men and 8.0% of women), suffer from health limitations (9.3% of men and 7.8% of women), or describe their health as fair or poor (6.8% of men and 9.7% of women).

C. 1980 Census

The main data on educational attainment and the individual-level control variables in the education regressions come from the 5% sample of the 1980 Census. I restrict the sample to individuals born in the continental 48 states between 1941 and 1956, excluding

[12] The dropped observations are men who weighed less than 90 pounds or were less than 58 inches tall and women who weighed less than 80 pounds or were less than 53 inches tall. There are 25 male observations and 50 female observations dropped.

those living in group quarters. I match the Census data to the participation data using state of birth and age. The bottom panel of Table 1 reports summary statistics for the Census data.

V. Identification Strategy

A. Estimating Equations and Motivation for IV

I estimate equations of the form

$$y_{isct} = \beta * exposure_{sc} + x'_{isct}\gamma + \alpha_s + \alpha_c + \alpha_t + \varepsilon_{isct} \ . \quad (1)$$

Here y_{isct} is a health or educational outcome variable measured in year t for individual i from state s born in year c. The main righthand side variable is $exposure_{sc}$, the average participation rate over the time the individual was in school measured on a scale of 0-100. The participation rate is calculated for each state in each year by dividing the number of students participating by the size of the population aged 5-17 and multiplying by 100.[13] The remaining variables in the models are a vector of control variables x_{isct} that contains individual-level data on race and state-level data on per capita income,[14] state dummies α_s, birth cohort dummies α_c, and year dummies α_t.[15] This model is consistent with the theoretical model of Grossman (1972) in which health investments have a cumulative effect on "health capital."

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[13] One might suppose that the denominator of the participation rate should instead be the number of *school*children. However, the NSLP may *cause* higher school enrollment, thereby changing the group of people the participation rate is calculated over if done using the number of schoolchildren in the denominator. My aim is to estimate how the children of a state are affected by the program rather than how some selected subset (those enrolled in school) is affected. Thus, I use the total number of children aged 5-17 in the denominator of the participation rate.

[14] Controlling for per capita income has little effect on the instrumental variables estimates but is done to reduce the bias of the least squares estimates.

[15] Since the 1980 Census is a simple cross-section, the education estimates using the Census data do not allow for year dummies.

There are several reasons why least squares estimates of equation 1 may be inconsistent. First, NSLP participation should be higher when school enrollment is higher. Thus, the models with educational attainment as the outcome variable may suffer from reverse causality. In the health models, education is an omitted variable and there is the possibility of confounding the effects of NSLP participation with those of education; controlling for education does not necessarily solve the problem, since education is potentially affected by participation.[16] Second, because participation in the NSLP is a choice variable, states that have higher participation rates at a point in time may differ from those with lower participation rates along unobservable dimensions that affect the outcomes.[17] Third, NSLP participation rates may be measured poorly.

Instrumental variables offer a potential solution to these problems. I use an instrument related to the amount of funding states receive under the program, defined so that the parameters are identified by the *change in the formula* rather than by year-to-year changes in the *inputs to the formula*. This solves the problems with least squares by using variation in participation that originates from the supply side rather than from the demand side. Moreover, since the estimates are driven by a change in the formula, this variation comes about through a large supply side shock.

There are at least three channels through which funding given to states for the NSLP could affect participation within the state. First, a state that receives a larger amount of funding for the NSLP may be able to reimburse schools within the state at a higher rate

[16] If someone enrolls in school in order to participate in the NSLP and enrollment has a direct effect on outcomes, I take that to be an (indirect) effect of the NSLP.

[17] Participation is a two-stage decision. First, a school must choose to participate in the program. Second, children at participating schools must choose whether to participate. Thus, the effects of the program in a least squares regression may be confounded with either unobserved individual-level characteristics or unobserved school-level characteristics that change differentially by state over time.

for lunches, which would tend to increase the number of participating schools. Second, if a state reimbursed schools at a higher rate, this may result in schools charging lower prices to children for lunches, which may increase participation among children in schools already participating in the NSLP. Third, apart from the reimbursement rate to schools, a state that has a large amount of money available under the NSLP may make greater efforts to convince schools to participate in the program.[18]

B. The Funding Formulas

The main federal cash aid given to states for the NSLP in the time period under consideration was Section 4 "general assistance" funding. This aid was distributed according to a formula. The original formula was in place from 1947-1962, and a new formula was phased in beginning in 1963. In 1963, 75% of funding was distributed according to the old formula and 25% according to the new formula; in 1964, half of the aid was given according to the old formula and half according to the new; and in 1965, 25% was given according to the old formula and 75% the new. The new formula was fully in place in 1966 and continued through the end of the sample period.

The original funding formula operated as follows: at year *t*, each state *s* was given an index defined by

$$index_{st}^{old} = \frac{population_{s,t-3}}{pci_{s,t-3}},$$

[18] All these channels require there to be a "flypaper effect," whereby targeted aid given to a state 'sticks' to the purpose for which it is intended.

where *population* is the size of the population aged 5-17 and *pci* refers to per capita income.[19] Using $totalfund_t$ to denote the amount of funding nationally in year *t*, the amount of funding received by state *s* in year *t* was then

$$fund_{st}^{old} = \frac{index_{st}^{old}}{\sum_r index_{rt}^{old}} * totalfund_t \, .$$

Thus, key features of the original formula are that states with lower per capita incomes and higher population received relatively more funding.

The new funding formula shifted the focus from population-based funding to reimbursement based on past participation and it also changed the way that funding depended on per capita income, although it kept the feature that poorer states received more funding. The new formula can be described as follows: a state's index is

$$index_{st}^{new} = \frac{\overline{pci_{t-2}} + \overline{pci_{t-3}} + \overline{pci_{t-4}}}{pci_{s,t-2} + pci_{s,t-3} + pci_{s,t-4}} \, ,$$

where $\overline{pci_t}$ refers to per capita income in the United States in year *t*. The "assistance need rate" is defined to be

$$anr_{st} = \min\{9, 5 * \max\{1, index_{st}^{new}\}\} \, .$$

Figure 5 shows how the assistance need rate was calculated in 1963. States with per capita incomes that are above average have an assistance need rate of 5, and poorer states have an assistance need rate that rises (up to a maximum of 9) as their income falls. The assistance need rate determined a state's level of funding according to

$$fund_{st}^{new} = \frac{anr_{st} * lunches_{s,t-1}}{\sum_r anr_{rt} * lunches_{r,t-1}} * totalfund_t \, ,$$

[19] Technically, the index also multiplies by the per capita income of the United States, but that factor cancels in the next step.

where *lunches* is the number of lunches served as part of the program.[20]

C. Defining the Instrument

The instrument is based on funding levels, but I make two modifications. First, instead of actual funding levels I use "constant characteristics" funding levels, which are funding levels that would be received if states had constant per capita incomes and populations over time. I make this modification because per capita income and population change over time and may have a direct effect on the outcomes; using "constant characteristics" funding levels ensures that the identifying variation comes about due to the formula change rather than from a change in the inputs that go into the formula. Second, I replace $lunches_{s,t-1}$ with $population_{s,t-1}$ for years when the new formula is used. This is done because funding depends on lagged participation under the new formula, and the instrument should be defined in a way such that the variable I am instrumenting for does not have a causal effect on the instrument.

In particular, the instrument is constructed using the modifications as follows. For years when the old formula is in place, I define $ccindex_s^{old}$ for state *s* as

$$ccindex_s^{old} = \frac{population_s}{pci_s},$$

[20] The law does not specify the exact lag structure of the formula's inputs, but it states that the most recent available data is to be used. With the caveat that I take the timing for missing years (1948-1954, 1969) to be the same as that for the nearest non-missing years, in practice the most recent available data income data had a lag of three years in the time period 1947-1961 and a lag of two years in the period 1962-1973. The population data had a lag of three years for every year it was used except for 1962, where the lag was two years. The data on the number of lunches served was from the previous year for every year it was used.

where $population_s$ is the average population in state s between 1944 and 1971 and pci_s is the average per capita income in state s between 1944 and 1971. I define $ccfund_{st}^{old}$ for state s as

$$ccfund_{st}^{old} = \frac{ccindex_s^{old}}{\sum_r ccindex_r^{old}} * totalfund_t .$$

Here I have measured total funding in 2005 dollars using the annual CPI. For years when the new formula is in place, I define $ccindex_s^{new}$ by

$$ccindex_s^{new} = \frac{\overline{pci}}{pci_s},$$

where $\overline{pci}$ is the average annual per capita income of the United States over the years 1944-1971. I define $ccanr_s$ by

$$ccanr_s = \min\{9, 5 * \max\{1, ccindex_s^{new}\}\},$$

and $ccfund_{st}^{new}$ by

$$ccfund_{st}^{new} = \frac{ccanr_s * population_s}{\sum_r ccanr_r * population_r} * totalfund_t .$$

For each state s and year t, I then generate the constant characteristics funding level for the state and year by using the appropriate combination of "old constant characteristics funding" and "new constant characteristics funding." Stated differently,

$$ccfund_{st} = f(t) * ccfund_{st}^{new} + (1 - f(t)) * ccfund_{st}^{old} .$$

Here $f(t)$ equals 0 in 1947-1962, .25 in 1963, .5 in 1964, .75 in 1965, and 1 in 1966-1973. The final step in constructing the instrument is to combine constant characteristics funding amounts for the years an individual was in school; this captures the idea that the

NSLP is a program individuals could be exposed to throughout their complete stay in elementary and secondary school. For someone born in year *c* and from state *s*, the instrument is

$$z_{sc} = \frac{1}{12}\sum_{t=6+c}^{t=17+c}\ln\left(\frac{ccfund_{st}}{population_{st}}\right).$$

With the equation for the second stage given by equation (1), the first stage then takes the form

$$exposure_{sc} = \tilde{\beta} * z_{sc} + x'_{isct}\tilde{\gamma} + \tilde{\alpha}_s + \tilde{\alpha}_c + \tilde{\alpha}_t + \tilde{\varepsilon}_{isct}. \qquad (2)$$

Identification comes from the fact that different people were exposed to the two formulas to different degrees according to when they were born,[21] combined with the fact that the change in the formula affects states differentially. In particular, the new formula treats states with an above-average per capita income the same; but under the old formula, increases in income for an already-rich state result in lower funding for that state. Moreover, since the total amount of the funding "pie" is fixed within a given year, a change in the formula that benefits states with higher incomes will be to the detriment of states with lower incomes. Figures 6 and 7 illustrate these points graphically. Figure 6 plots the relationship between constant characteristics funding under the new formula and under the old formula for 1964, the year where half of the funding was appropriated under each formula. Figure 7 displays the difference between new and old constant characteristics funding by per capita income for 1964. Figure 7 reveals that the formula change results in a differential effect on funding by per capita income and that this effect is nonlinear.

[21] This includes not just a change from one formula to another but also a period when both formulas were in place at the same time.

Note that the variable $ccfund_{st}$ changes for only three reasons: (1) states have different time-invariant per capita incomes and populations, (2) changes in the total amount of funding at the national level, and (3) the change in the formula. The first type of variation is eliminated by including state effects in the models, the second type is eliminated by the cohort effects, and the third type of variation is the identifying variation. Thus, when I combine constant characteristics funding amounts from different years in order to form the instrument, the variation used in estimation comes from the fact that the formula change affects states differentially and that different people were exposed to the two formulas to different degrees. The only other type of variation comes from the fact that I convert funding amounts to per capita terms by dividing by time-varying population. Dividing by time-varying population reflects the fact that it is the actual size of the population at the time that determines how generously a certain level of funding is spread across the population.

Table 2 shows that funding affects exposure to the National School Lunch Program. Column 1 reports a simple bivariate regression of exposure on the instrument, and it shows that there is a positive correlation between the two. This relationship does not change very much when control variables are added to the model in column 2 but drops in column 3 when cohort and year dummies are included. The cohort dummies absorb changes in the total amount of funding at the national level from year to year, so the drop in the coefficient reflects the fact that both participation and funding are generally rising over time. The coefficient also falls when state dummies are included, as shown in column 4. But the positive relationship between funding and participation persists even after including individual-level control variables, cohort effects, year effects, and state effects. Subject to the caveat that the second stage outcome variables are missing for certain observations, column 4 is the first stage used in the IV regressions.

VI. Results

A. Main Results for Health Outcome Variables

Height is a measure of long-term nutritional status and is determined primarily prior to reaching adulthood, making it a natural first outcome variable to consider.[22] Panel A of Table 3 shows the results for height. All tables report standard errors corrected for clustering at the state-by-cohort level as well as alternative standard errors that correct for clustering at the state level.[23] All health regressions use NHIS weights.[24] The least squares estimates show a positive relationship between height and NSLP exposure for both men and women; this relationship is significant at the 1% level for men, but it is not significant for women at even the 5% level. The least squares estimate for men in column 1 suggests that increasing exposure by ten percentage points is associated with an increase in height of .185 inches. This estimate is similar to the IV estimate in column 3, which suggests that this same increase in exposure results in an increase in height of about .157 inches. However, the IV estimate for men is insignificant due to the large standard error. The IV estimate for women is also not significantly different from 0,

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[22] Strauss and Thomas (1998) contains a discussion of various measures of health status. Steckel (1995) is a detailed examination of using height as a measure of individual welfare. To get a sense of the magnitudes involved, Behrman and Hoddinott (2005) find that Mexico's PROGRESA program increased height by .4 inches, and Chen and Zhou (2007) find that exposure to famine in China reduced height by 1.2 inches. See Persico, Postlewaite, and Silverman (2004) on the return to height in the labor market.

[23] I focus on the standard errors that correct for clustering at the state-by-cohort level. However, if there is serial correlation in the regression error term within a state over time, then these standard errors may not be conservative enough. On the other hand, clustering at the state level may be unnecessarily conservative, since the time period being studied is long and any within-state serial correlation may eventually fade away.

[24] The weights within a NHIS dataset for a given year were normalized to sum to 1 before any observations were dropped.

although it is much larger in magnitude than the least squares estimate in column 4. But the general pattern is that I do not uncover a statistically significant impact of the NSLP on the average height. However, focusing on the average may conceal what is happening in the tails. In particular, the NSLP could have reduced the share of the population that is stunted without having a detectable effect on the average height. In results not shown here but available upon request, I estimate the effects of the NSLP on the cumulative distribution of height. Contrary to the possibility that there may be effects on the distribution of height without affecting the mean, the results are generally insignificant and there is no clear pattern in the estimates.

The next outcome variable I consider is body mass index (BMI). BMI is a measure of weight normalized by height; in particular, the formula for BMI is

$$BMI = 703 * \frac{weight}{height^2},$$

where weight is measured in pounds and height is measured in inches. Whereas height is a measure of long-run nutritional status, BMI is a measure of shorter-run nutritional status. However, there are at least two channels through which school lunch exposure as a child could affect BMI as an adult: (1) the degree of exposure to school lunches as a child could alter eating habits later in life and (2) there could be a physiological effect that carries over from childhood to adulthood.[25] The results for BMI are presented in panel B of Table 3. The least squares estimates are quite small and suggest no effect of the NSLP on BMI. The IV estimates are larger in magnitude than the least squares estimates, but they are insignificant and estimated rather imprecisely. So, on the whole,

[25] Although there are many other determinants of BMI as an adult than just exposure to school lunches as a child and these other determinants add noise to the model, they should be orthogonal to the plausibly exogenous variation in school lunch funding that is used by the IV estimator if the IV strategy is correct. Also, see Case, Fertig, and Paxson (2005) on the issue of persistence of childhood health into adulthood.

the results does not reveal much of an effect of the NSLP on BMI. But as with the case of height, there could be an effect on extreme values of BMI without there being a statistically detectable effect at the mean. Moreover, whereas it is believed that larger height indicates better nutritional status (all else equal), the relationship between BMI and being in good health is non-monotonic in BMI. In particular, having either an extremely high or extremely low BMI is thought to be unhealthy. Thus, Table 4 shows the results of linear probability models of the effects of school lunch exposure on categorical measures of BMI. According to the Centers for Disease Control, someone is underweight if their BMI is less than 18.5, overweight if their BMI is above 25, and obese if their BMI is above 30. To the extent that the program fed an undernourished population, it may result in a lower probability of being underweight. But if the results of Schanzenbach (2009) held in this earlier time period, the program could increase obesity. However, turning to the results in Table 4, the coefficients are generally small in magnitude and statistically insignificant.[26]

Table 5 considers three alternative measures of health. They are weight, a dummy for whether someone reports to be in fair or poor health as opposed to good or excellent health, and a dummy for whether someone reports experiencing limitations in performing "usual activity" due to health problems or disability. The only estimate in Table 5 that is significant at even the 5% level is the IV estimate of the effect of the NSLP on the 'poor or fair health' variable for men, although the least squares estimate of the effect of the NSLP on this variable for women comes close. The IV estimate for men suggests that an increase in NSLP exposure by ten percentage points lowers the probability of being in

[26] I also estimated models that used the squared deviation of BMI from 21.75, the midpoint of the "normal" range, as an outcome variable. The estimates, which are not reported here, are generally insignificant.

poor or fair health by .064. This result could potentially be informative, since self-reported health status may be a useful summary of all the various dimensions of health; moreover, it has been shown to be related to subsequent morbidity and mortality. But on the other hand, this variable is almost certainly measured with error and different individuals may use different scales from one another, making interpretation difficult (Strauss and Thomas 1998). Additionally, the NSLP might affect self-perceptions of health without affecting actual health.

B. Main Results for Education

If time spent in school is more productive for individuals in good nutritional status, then the NSLP could raise the optimal level of education individuals choose. Moreover, the option of receiving a subsidized lunch if a child attends school may directly influence the school participation decision. Table 6 shows the effects of the NSLP on years of completed education using data from the 1980 Census. The least squares estimates in columns 1 and 4 suggest a significant positive relationship between NSLP exposure and educational attainment. However, the least squares estimates likely suffer from reverse causality: since it is necessary that an individual be enrolled in school in order to receive a lunch, higher school enrollment is likely to result in higher NSLP exposure.

Columns 3 and 6 of Table 6 display the IV estimates. The IV point estimates are larger than the least squares estimates, although they are also imprecise.[27] The IV estimate for women suggests than increasing NSLP exposure by ten percentage points

[27] The IV point estimates for education when clustering at the state-by-cohort level are significantly different from 0 at the 1% level for both men and women, but the standard errors are large enough that a 95% confidence interval covers values that are more reasonable than the point estimates and does not cover 0. When the standard errors are instead clustered at the state level, the estimate narrowly fail to be significant at the 5% level.

results in an average increase in education of .365 years, and the IV estimate for men suggests that increasing NSLP exposure by ten percentage points increases average education by nearly a year. These estimates are admittedly large relative to the effects of other policies designed to increase educational attainment, such as compulsory attendance laws (Angrist and Krueger 1991; Acemoglu and Angrist 2000; Oreopoulos 2006).[28] Table 7, which shows estimates of the effects of the NSLP on the cumulative distribution of education, suggests that the effects are largest at around twelve and thirteen years of education. Although the point estimates in Table 6 are quite large, the results in Table 7 are reassuring in that the effects are largest for the levels of education we would expect. Additionally, since the NHIS includes a categorical measure of educational attainment, it is possible to estimate the effects of the NSLP on certain parts of the educational attainment distribution using NHIS data as well. These results, shown in Table 8, are largely consistent with those of Table 7, although fewer of the estimates for women are significant with the NHIS data compared to the Census data. Finally, Table 9 shows estimates of the baseline education equation augmented with linear state-specific time trends. The OLS results drop in magnitude when the time trends are included, although the results for men are still significant. The IV first stage is largely unaffected by the time trends, but the second stage estimates change sign. A case could be made that time trends are unnecessary with the IV identification strategy, although still the results with the time trends are somewhat troubling. In results not shown here, I find that the IV second stage results are not significantly different from zero when Census

[28] For example, Acemoglu and Angrist (2000) find using the 1950-1980 Censuses that "men born in states with a child labor law that required 9 years in school before allowing work ended up with 0.26 more years of school completed than those born in states that required 6 or fewer years."

division time trends or Census region time trends (rather than state time trends) are included in the model.

C. Additional Specifications and Robustness Checks

To investigate the possibility that the NSLP had a differential effect on disadvantaged groups, I estimated models that include a righthand side variable for the interaction between NSLP exposure and the percentage of men from a state rejected from service or placed in the limited service class during World War II.[29] The large number of men rejected from military service during World War II played an important role in the passage of the National School Lunch Act, and these models address the question of whether the program had a larger effect in states where the rejection rate was higher. The health results do not give much evidence for a differential effect by World War II rejection rate, but the education results suggest a larger effect in states where the rejection rate is higher. The education effect also appears to be larger in the South, which provides additional evidence that the program may have been more effective in needier states.

I also estimated reduced form models that suggest that NSLP funding has a larger effect on educational attainment among whites than blacks, which may suggest that states channeled their NSLP funding toward whites. There is no clear pattern with the health results. See Appendix Table 1 for the North vs. South and black vs. white comparisons.

Appendix Table 2 explores the possibility that there are differential effects for participating in grades 1-6 versus grades 7-12, while Appendix Table 3 estimates whether there are differential effects for grades 1-9 versus 10-12. These results suggest that participation in later grades has a stronger effect on educational attainment than

[29] The data come from U.S. Congress (1945).

participating in the earlier grades does, whereas there is some evidence suggesting that participation in earlier grades is more important for the health outcomes.

I also find that dropping observations from Louisiana, an outlier in participation, does not change the results noticeably. Finally, I perform a robustness check to determine whether any results are driven by changes in the composition of lunches among type A, type B, and type C by state over time.[30] To do this, I drop five states (California, Illinois, Massachusetts, Michigan, and New York) that show a large drop in overall participation around the time that there was a large drop nationally in type C lunch participation.[31] These are large states, and dropping these observations makes the results less precise, but there are no appreciable changes in the conclusions.

As a falsification test, I re-estimated the education IV regressions for the sample of people born ten years after those in my analysis sample and assigned them the school lunch exposure level of those in their state who were born ten years earlier than them. The coefficient (standard error) on the pseudo treatment variable is -.0107 (.0117) for men and -.0239 (.0106) for women. When I instead re-estimate the models for those born ten years earlier than in my analysis sample and assign them the school lunch exposure level of those who were born in their state ten years later, the coefficient (standard error) on the pseudo treatment variable is .0012 (.0144) for men and -.0033 (.0114) for women.

VII. Conclusion

[30] See footnote 5 for an explanation of type A, type B, and type C lunches.

[31] I have data on type A, type B, and type C lunch participation nationally by year, but I do not have this data by state. The fact that these five states had a large drop in overall participation at a time when participation in type C lunches dropped sharply at the national level may suggest that, for these states, participation in type C lunches may have been a relatively high percentage of total participation.

The NSLP appears to have had no long-term effect on health but may have affected educational attainment. The IV estimates on education suggest that increasing NSLP exposure by ten percentage points is associated with increasing education by .365 years among women and nearly one year among men. These estimates are large, but they are imprecise and not completely robust.

The precision of the estimates is limited by the fact that the variation used to identify the effects of the NSLP occurs only at the level of state of birth and birth cohort. But taking the results at face value, there are at least two potential explanations for why I detect an effect on education but not on health. First, there may be beneficial effects of the NSLP on health in the short-term that have faded away by adulthood. Second, the program may have attracted children to school but displaced nutritional inputs coming from elsewhere, including school lunches that were not part of the federal program. [32] But in either case, the NSLP appears to be ineffective in producing adults who are sufficiently healthy for military service, although the education results are encouraging for other reasons.

The NSLP today is still broad in its reach, but it has some elements of being targeted toward poorer children. These include codified standards for eligibility for free and reduced-price lunches and also special funding for poorer schools. Had these elements been in place at the inception of the NSLP, the NSLP may have had a detectable effect on health in its early years.

[32] My estimates are effects of participating in the NSLP. To the extent that there are school lunch programs that are not part of the NSLP, my estimates of the effects of the NSLP likely understate the effects of eating a school lunch.

A. Data Appendix

This appendix gives the sources for the data on participation, funding, population, and per capita income I assembled. It also describes how I impute missing data.

Participation. Data on the number of students participating at the state level from 1947-1949 comes from a USDA publication entitled "School Lunch and Food Distribution Programs Selected Statistics, Fiscal Years 1939-1950" (United States Department of Agriculture 1950). Data from 1949-1973 comes from the edition of the *Statistical Abstract of the United States* for the subsequent year. The participation data from the two sources agrees for the overlapping year.

Population. Estimates of the size of the population aged 5-17 in each state come from editions of *Biennial Survey of Education in the United States*, editions of the *Statistical Abstract of the United States*, and the NSLP funding tables (U.S. Congress, various years). This population data is available from the funding tables for 1944, 1952-1958, and 1960-1962. It is available from the *Statistical Abstract of the United States* for 1965-1968, 1970-1971, and 1973. It is available in the *Biennial Survey of Education* for 1944, 1946, 1948, 1950, 1951, 1953, 1955, and 1957. Data are available from multiple sources for 1944, 1953, 1955, and 1957; the data from the different sources agree in 1955 and 1957 but not in 1944 and 1953, in which case I use data from the *Biennial Survey of Education*. I use a linear interpolation for years in which this variable is not available in any of the three sources (1945, 1947, 1949, 1959, 1963, 1964, 1969, and 1972.)

Funding. Although the instrument in this paper is based on "constant characteristics" funding levels that I generate rather than on the actual funding levels, I do make use of actual funding levels in some of the preliminary graphical analysis. For the years 1947-1950, I take the data from "School Lunch and Food Distribution Programs Selected Statistics, Fiscal Years 1939-50." For the years 1955-1968 and 1970-1973, I take funding amounts from the funding tables. Data for 1947 is available from both sources and disagrees somewhat between the two sources. For the years 1951-1954 and 1969, I estimate funding. In estimating funding amounts for these years, I excluded the District of Columbia, Alaska, Hawaii, American Samoa, Guam, Puerto Rico, and The Virgin Islands, and applied the appropriate formula (i.e., the old formula for 1951-1954 and the new formula in 1969) to just the continental 48 states using an estimate of the combined amount of funding given to these 48 states. This estimate of the amount of funding given to the continental 48 states is obtained by multiplying the total amount of funding nationally given in those years by the factor .954535, which is the average over the years for which I do have state funding data of the fraction of the total amount of aid going to the continental 48 states. This same factor is also used for the "constant characteristics" funding amounts I use in the regressions; but there the log specification reduces the importance of the particular factor chosen.

Per capita income. Per capita income for 1944 comes from the funding tables and disagrees slightly with the analogous numbers available in the *Statistical Abstract of the United States*. I use the *Statistical Abstract* numbers for 1945-1959 and 1961, and these numbers do agree with the numbers from the funding tables for the years in which the data is available from the funding tables (1952-1958, 1961). For 1960, 1962, 1963, the numbers from the two sources disagree; I use the numbers from the funding tables for those years. For the years 1964-1966 and 1968-1971, the funding tables give the average of per capita income over the past three years by state, which I use along with information from the funding tables for 1962 and 1963 and the *Statistical Abstract* for 1967 in order to obtain per capita income for each year between 1964 and 1971.

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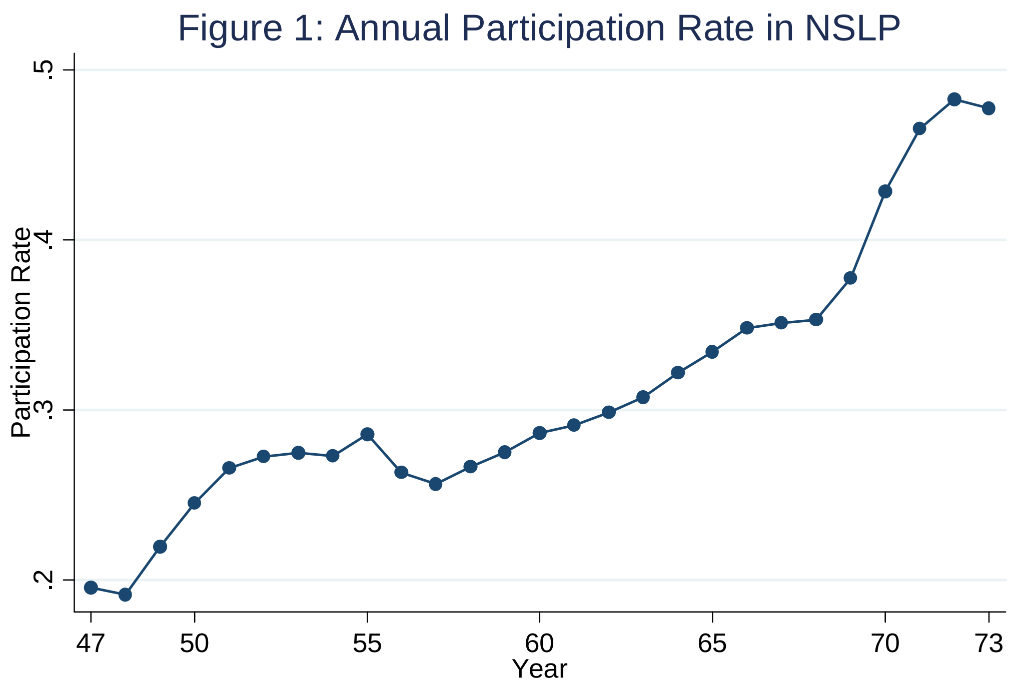
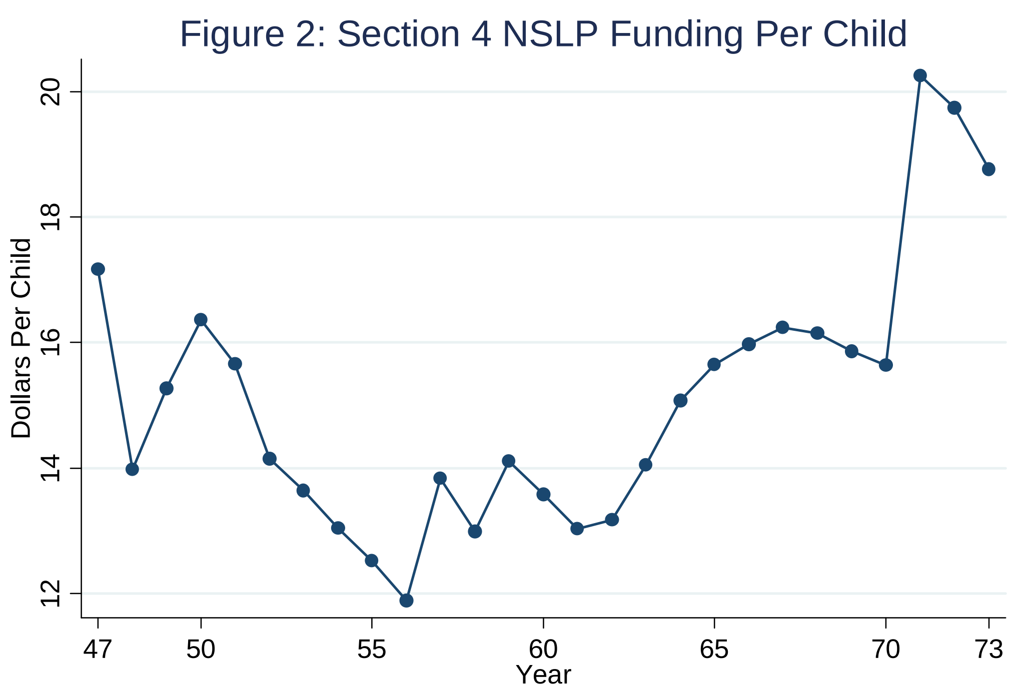
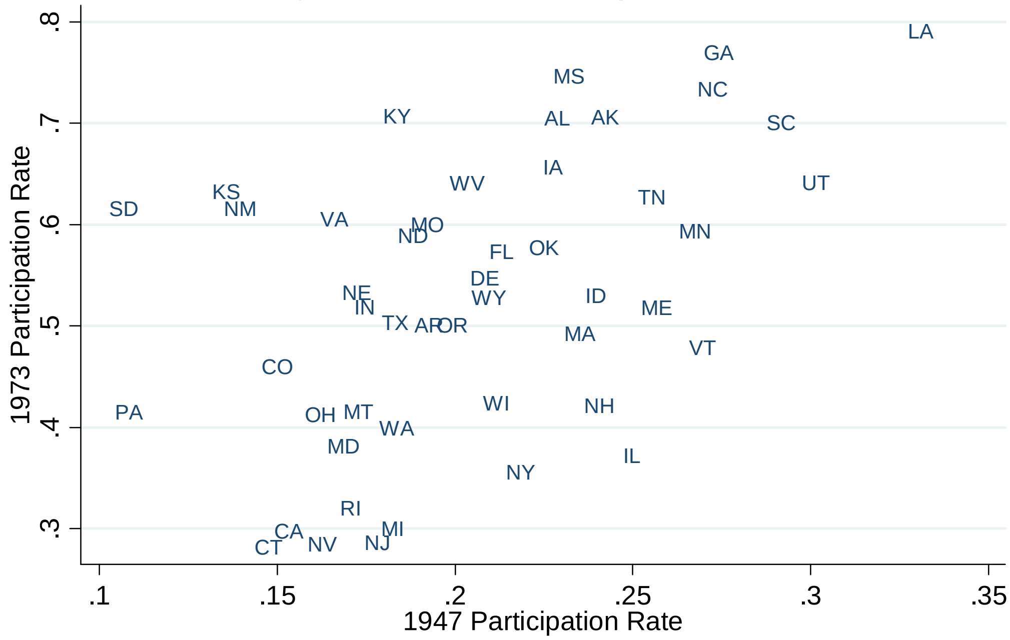


Note: Figure shows average national participation in peak month divided by size of population aged 5-17.



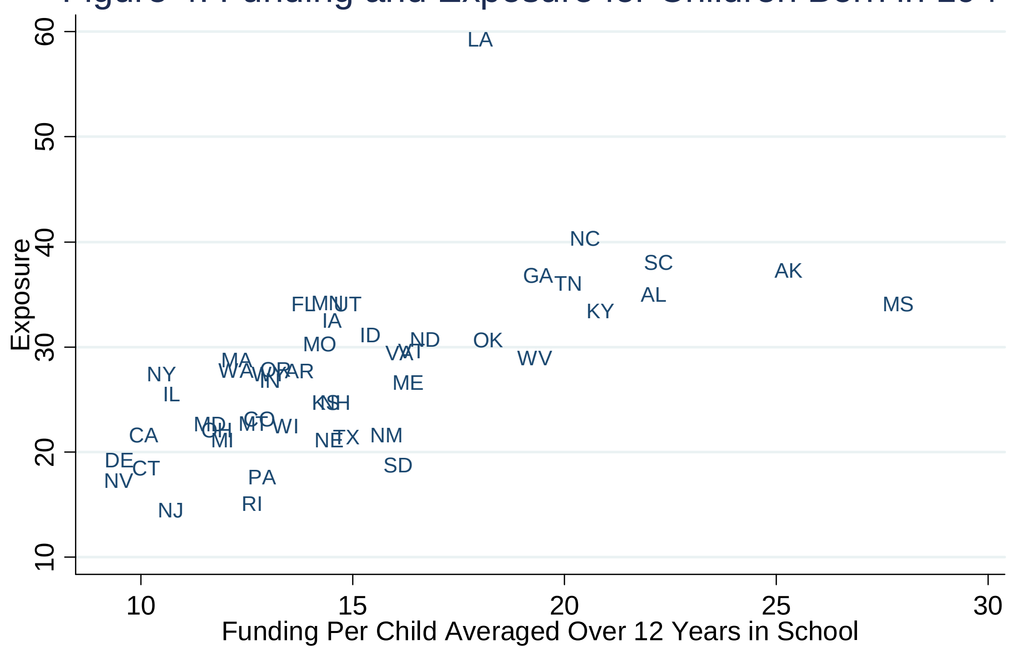
Note: Funding is measured in 2005 dollars.

Figure 3: State Participation Rates



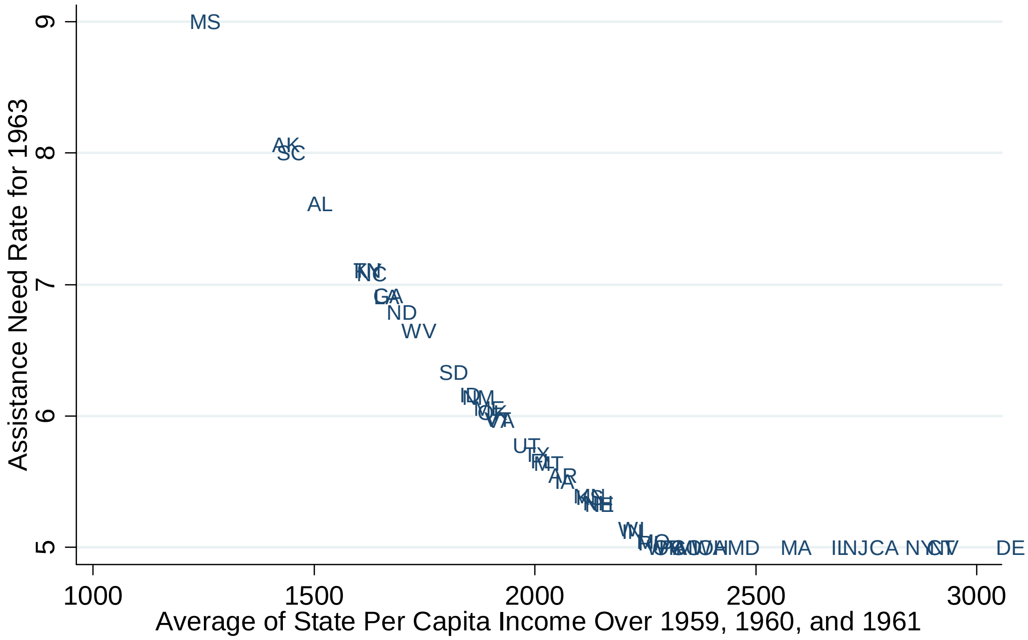
Note: 'Participation rate' is defined in note to Figure 1.

Figure 4: Funding and Exposure for Children Born in 1944



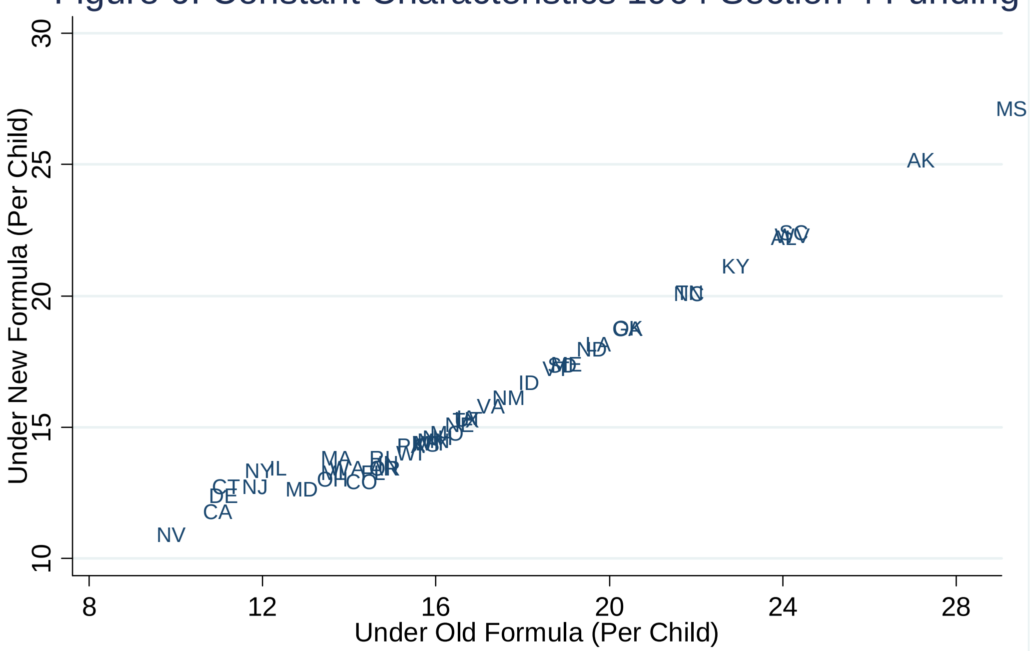
Notes: Funding is measured in 2005 dollars. Exposure is as defined in the text.

Figure 5: Assistance Need Rate and Per Capita Income



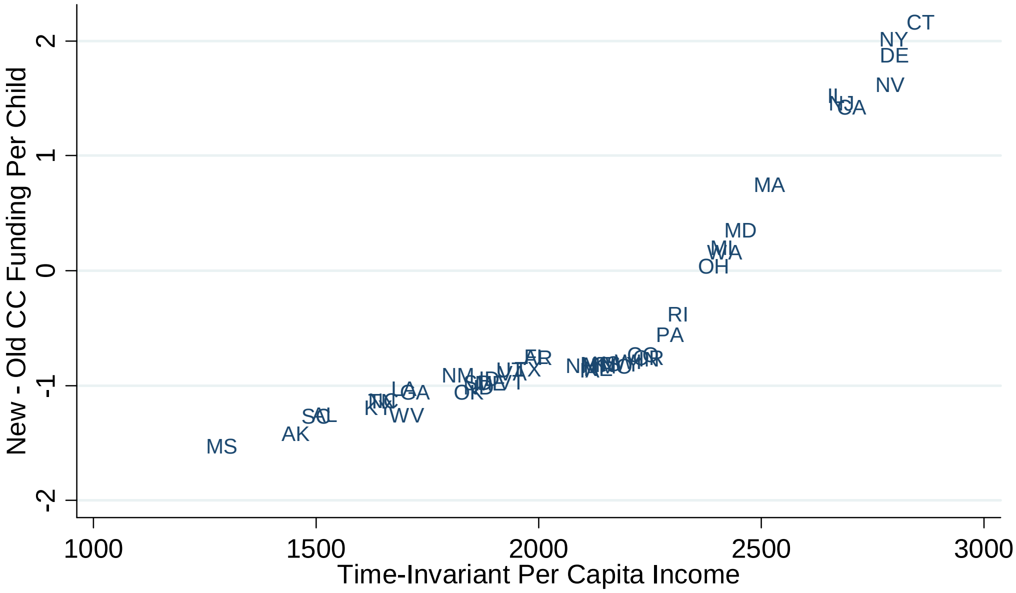
Note: Per capita income is measured in nominal dollars.

Figure 6: Constant Characteristics 1964 Section 4 Funding



Note: Funding amounts per child are measured with 2005 dollars.

Figure 7: Effect of Formula Change on Section 4 Constant Characteristics Funding for 1964



Note: Funding amounts on the vertical axis are measured using 2005 dollars.

Table 1: Summary Statistics

A. NHIS Data (Health Outcomes)

	Men			Women		
	All	White	Black	All	White	Black
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Height	70.2	70.3	69.9	64.4	64.5	64.5
	(3.0)	(2.9)	(3.3)	(2.7)	(2.7)	(2.8)
BMI	24.8	24.8	24.8	22.9	22.7	24.7
	(3.7)	(3.6)	(4.0)	(4.4)	(4.3)	(5.2)
Underweight	0.014	0.013	0.019	0.080	0.083	0.052
	(0.118)	(0.113)	(0.136)	(0.272)	(0.275)	(0.221)
Overweight	0.425	0.429	0.418	0.224	0.205	0.374
	(0.494)	(0.495)	(0.493)	(0.417)	(0.403)	(0.484)
Obese	0.080	0.079	0.093	0.074	0.066	0.136
	(0.272)	(0.270)	(0.291)	(0.262)	(0.249)	(0.343)
Weight	174	174	172	135	134	146
	(29)	(29)	(30)	(27)	(26)	(32)
Limitations	0.093	0.092	0.111	0.078	0.076	0.102
	(0.291)	(0.289)	(0.314)	(0.269)	(0.264)	(0.303)
Poor or Fair Health	0.068	0.062	0.121	0.097	0.084	0.183
	(0.251)	(0.240)	(0.327)	(0.296)	(0.278)	(0.387)
Exposure	30.0	29.8	32.9	30.1	29.8	32.6
	(10.7)	(10.4)	(12.5)	(10.8)	(10.5)	(12.4)
Average PCI	2199	2203	2134	2200	2203	2154
	(587)	(583)	(620)	(589)	(584)	(621)
Instrument	2.62	2.62	2.68	2.63	2.62	2.67
	(0.20)	(0.20)	(0.24)	(0.20)	(0.20)	(0.24)
N	61798	55211	5612	68555	59560	7836

B. Census Data (Education)

	Men			Women		
	All	White	Black	All	White	Black
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Education	13.3	13.4	12.1	12.8	13.0	12.1
	(2.9)	(2.9)	(2.8)	(2.5)	(2.5)	(2.5)
Exposure	31.0	30.3	37.3	31.2	30.3	37.4
	(10.8)	(10.3)	(12.8)	(10.9)	(10.3)	(12.7)
Average PCI	2155	2182	1905	2149	2184	1900
	(608)	(597)	(649)	(613)	(599)	(652)
Instrument	2.65	2.64	2.80	2.66	2.64	2.80
	(0.21)	(0.20)	(0.25)	(0.22)	(0.20)	(0.25)
N	1209769	1072230	123280	1260264	1089721	155727

Notes: Panel A shows means and standard deviations of the NHIS data using using sample weights. Panel B shows means and standard deviations of the Census data.

Table 2: First Stage for Men in NHIS Data

Variable	(1)	(2)	(3)	(4)
Instrument	40.7	43.3	10.0	8.0
	[1.5]**	[1.8]**	[4.6]*	[2.2]**
	(5.0)**	(4.9)**	(9.7)	(6.6)
White		-0.216	-0.656	0.026
		[0.309]	[0.303]*	[0.051]
		(0.851)	(0.748)	(0.049)
Black		0.521	0.134	0.052
		[0.360]	[0.332]	[0.060]
		(0.953)	(0.846)	(0.055)
Average PCI		2.06	-14.5	-36.8
(in 1000s)		[0.62]**	[2.2]**	[1.9]**
		(1.16)	[5.4]**	[5.4]**
YoB dummies?	no	no	yes	yes
Age Dummies?	no	no	yes	yes
State Dummies?	no	no	no	yes
F-statistic	704.21	611.26	4.79	13.09
p-value	0.0000	0.0000	0.0289	0.0003
N	61798	61798	61798	61798

Notes: The tables shows estimates of equation (2). Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. A single asterisk denotes significance at the 5% level and a double asterisk denotes significance at the 1% level. All models are estimated using NHIS sample weights. The F-statistic and associated p-value are for a test of whether the coefficient on the excluded instrument equals 0 when the standard errors are clustered at the year of birth*level.

Table 3: Effect of NSLP Exposure on Height (in Inches) and Body Mass Index

A. Height

	Men			*Women*		
Variable	Least Squares (1)	IV First Stage (2)	IV Second Stage (3)	Least Squares (4)	IV First Stage (5)	IV Second Stage (6)
Exposure	0.0185		0.0157	0.0070		0.0334
	[0.0063]**		[0.0346]	[0.0049]		[0.0260]
	(0.0088)*		(0.0556)	(0.0076)		(0.0248)
Instrument		8.04			8.31	
		[2.21]**			[2.31]**	
		(6.62)			(6.83)	
White	2.74	0.0159	2.74	1.98	-0.0229	1.98
	[0.11]**	[0.0579]	[0.11]**	[0.08]**	[0.0651]	[0.08]**
	(0.15)**	(0.0602)	(0.15)**	(0.10)**	(0.0514)	(0.10)**
Black	2.37	0.0309	2.37	2.01	0.0033	2.01
	[0.13]**	[0.0664]	[0.13]**	[0.09]**	[0.0693]	[0.09]**
	(0.20)**	(0.0619)	(0.20)**	(0.11)**	(0.0584)	(0.11)**
Average PCI	0.716	-36.6	0.609	0.393	-36.7	1.41
(in 1000s)	[0.329]*	[1.9]**	[1.339]	[0.259]	[2.0]**	[1.03]
	(0.382)	(5.4)**	(2.051)	(0.288)	(5.6)**	(1.09)
N	52224	52224	52224	58376	58376	58376

B. Body Mass Index

	Men			*Women*		
Variable	Least Squares (1)	IV First Stage (2)	IV Second Stage (3)	Least Squares (4)	IV First Stage (5)	IV Second Stage (6)
Exposure	-0.0104		-0.0497	0.0002		-0.0489
	[0.0081]		[0.0365]	[0.0090]		[0.0403]
	[0.0111]		[0.0459]	[0.0152]		[0.0529]
Instrument		8.02			8.33	
		[2.21]**			[2.30]**	
		(6.62)			(6.84)	
White	1.47	0.0217	1.47	0.714	-0.0273	0.713
	[0.12]**	[0.0583]	[0.12]**	[0.132]**	[0.0653]	[0.132]**
	(0.17)**	(0.0602)	(0.17)**	(0.197)**	(0.0504)	(0.197)**
Black	1.50	0.0304	1.51	2.77	0.0004	2.77
	[0.13]**	[0.0667]	[0.13]**	[0.14]**	[0.0702]	[0.14]**
	(0.16)**	(0.0595)	(0.16)**	(0.17)**	(0.0570)	(0.17)**
Average PCI	-0.095	-36.5	-1.602	-0.110	-36.6	-1.999
(in 1000s)	[0.382]	[1.9]**	[1.384]	[0.465]	[2.0]**	[1.544]
	(0.477)	(5.5)**	(1.801)	(0.532)	(5.6)**	(2.076)
N	51975	51975	51975	57576	57576	57576

Notes: Columns 2 and 5 show estimates of equation (2), and other columns show estimates of equation (1). Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level. All models are estimated using NHIS sample weights. All models also include year of birth, age, and state dummies.

Table 4: Effects of NSLP Exposure on BMI Categories

A. Men

	underweight		overweight/obese		obese	
	LS	IV	LS	IV	LS	IV
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	-0.0001	-0.0013	-0.0015	-0.0090	-0.0002	-0.0007
	[0.0002]	[0.0013]	[0.0011]	[0.0055]	[0.0005]	[0.0026]
	(0.0002)	(0.0017)	(0.0014)	(0.0075)	(0.0006)	(0.0029)
White	-0.0336	-0.0335	0.165	0.166	0.0281	0.0282
	[0.0065]**	[0.0065]**	[0.016]**	[0.016]**	[0.0073]**	[0.0073]**
	(0.0051)**	(0.0051)**	(0.025)**	(0.025)**	(0.0087)**	(0.0087)**
Black	-0.0297	-0.0297	0.156	0.156	0.040	0.040
	[0.0066]**	[0.0066]**	[0.017]**	[0.017]**	[0.008]**	[0.008]**
	(0.0060)**	(0.0060)**	(0.022)**	(0.022)**	(0.009)**	(0.009)**
Average PCI	-0.0212	-0.0641	-0.0440	-0.3314	-0.0076	-0.0274
(in 1000s)	[0.0140]	[0.0505]	[0.0519]	[0.2126]	[0.0294]	[0.1002]
	(0.0147)	(0.0661)	(0.0529)	(0.2913)	(0.0343)	(0.1133)
N	51975	51975	51975	51975	51975	51975

B. Women

	underweight		overweight/obese		obese	
	LS	IV	LS	IV	LS	IV
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.0008	0.0002	0.0000	-0.0042	0.0002	-0.0009
	[0.0006]	[0.0024]	[0.0008]	[0.0037]	[0.0005]	[0.0024]
	(0.0006)	(0.0024)	(0.0012)	(0.0054)	(0.0007)	(0.0025)
White	-0.0625	-0.0625	0.0561	0.0560	0.0181	0.0181
	[0.0111]**	[0.0111]**	[0.0119]**	[0.0119]**	[0.0066]**	[0.0066]**
	(0.0108)**	(0.0108)**	(0.0160)**	(0.0159)**	(0.0081)*	(0.0081)*
Black	-0.098	-0.098	0.229	0.229	0.0872	0.0872
	[0.0116]**	[0.0116]**	[0.013]**	[0.013]**	[0.0075]**	[0.0075]**
	(0.0105)**	(0.0105)**	(0.015)**	(0.015)**	(0.0077)**	(0.0077)**
Average PCI	0.0145	-0.0086	-0.0151	-0.1759	-0.0010	-0.0449
(in 1000s)	[0.0283]	[0.0938]	[0.0439]	[0.1405]	[0.0272]	[0.0906]
	(0.0229)	(0.0916)	(0.0567)	(0.2166)	(0.0346)	(0.0980)
N	57656	57656	57656	57656	57656	57656

Notes: The table shows estimates of equation (1). "Underweight" is defined as having a body mass index (BMI) below 18.5, "overweight/obese" is defined as having a BMI above 25, and "obese" is defined as having a BMI above 30. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level. All models are estimated using NHIS sample weights. All models include year of birth dummies, age dummies, and state dummies.

Table 5: Effects of NSLP Exposure on Other Outcomes

	Men		Women	
	LS	IV	LS	IV
Outcome	(1)	(2)	(3)	(4)
Weight	0.0131	-0.2122	0.0244	-0.1375
	[0.0617]	[0.3021]	[0.0520]	[0.2188]
	(0.0615)	(0.4310)	(0.0715)	(0.2898)
Health Limitations	0.0009	-0.0004	0.0000	-0.0028
	[0.0006]	[0.0042]	[0.0005]	[0.0030]
	(0.0006)	(0.0043)	(0.0005)	(0.0035)
Poor or Fair Health	-0.0003	-0.0064	-0.0010	-0.0036
	[0.0004]	[0.0027]*	[0.0005]	[0.0027]
	(0.0004)	(0.0055)	(0.0006)	(0.0042)

Notes: The table shows estimates of equation (1). The "Health Limitations" variable measures whether the respondent reports to experience limitations in performing "usual activity" due to disability or health. Each entry corresponds to a separate regression. Control variables are white and black dummies, per capita income while in school (lagged two years), year of birth dummies, age dummies, and state dummies. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. All models are estimated using NHIS sample weights. A single asterisk denotes significance at the 5% level.

Table 6: Effect of NSLP Exposure on Years of Completed Education

	Men			*Women*		
	Least Squares	IV First Stage	IV Second Stage	Least Squares	IV First Stage	IV Second Stage
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.0220		0.0942	0.0134		0.0365
	[0.0025]**		[0.0183]**	[0.0018]**		[0.0095]**
	(0.0064)**		(0.0495)	(0.0044)**		(0.0201)
Instrument		9.15			9.10	
		[2.07]**			[2.07]**	
		(6.17)			(6.15)	
White	0.661	0.0533	0.658	0.516	0.0784	0.514
	[0.062]**	[0.0229]*	[0.062]**	[0.059]**	[0.0192]**	[0.059]**
	(0.197)**	(0.0343)	(0.199)**	(0.183)**	(0.0251)**	(0.183)**
Black	-0.344	-0.0159	-0.343	-0.0435	0.0086	-0.0438
	[0.064]**	[0.0254]	[0.065]**	[0.0622]	[0.0211]	[0.0622]
	(0.210)	(0.0402)	(0.213)	(0.1963)	(0.0296)	(0.1967)
Average PCI	-0.522	-34.1	2.096	-0.064	-34.1	0.774
(in 1000s)	[0.110]**	[1.8]**	[0.691]**	[0.085]	[1.8]**	[0.366]*
	(0.252)*	(5.0)**	(1.818)	(0.189)	(5.0)**	(0.779)
N	1209769	1209769	1209769	1260264	1260264	1260264

Notes: Columns 2 and 5 show estimates of equation (2), and other columns show estimates of equation (1). Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level. All models also include year of birth and state dummies.

Table 7: Effect of NSLP Exposure on the Cumulative Distribution of Education with Census

	Men			Women		
	Value of CDF	LS	IV	Value of CDF	LS	IV
Education	(1)	(2)	(3)	(4)	(5)	(6)
7	0.0247	-0.0010	-0.0016	0.0190	-0.0006	0.0011
		[0.0002]**	[0.0006]**		[0.0001]**	[0.0007]
		(0.0004)*	(0.0016)		(0.0003)*	(0.0019)
8	0.0473	-0.0016	-0.0039	0.0395	-0.0010	0.0004
		[0.0002]**	[0.0010]**		[0.0002]**	[0.0008]
		(0.0005)**	(0.0025)		(0.0004)*	(0.0022)
9	0.0764	-0.0018	-0.0050	0.0711	-0.0013	0.0007
		[0.0002]**	[0.0011]**		[0.0002]**	[0.0010]
		(0.0006)**	(0.0029)		(0.0005)*	(0.0024)
10	0.1131	-0.0022	-0.0070	0.1149	-0.0017	-0.0005
		[0.0002]**	[0.0014]**		[0.0002]**	[0.0010]
		(0.0006)**	(0.0037)		(0.0005)**	(0.0021)
11	0.1513	-0.0026	-0.0093	0.1575	-0.0019	-0.0027
		[0.0002]**	[0.0018]**		[0.0002]**	[0.0010]**
		(0.0005)**	(0.0049)		(0.0006)**	(0.0021)
12	0.5146	-0.0028	-0.0169	0.5948	-0.0020	-0.0119
		[0.0004]**	[0.0033]**		[0.0004]**	[0.0024]**
		(0.0010)**	(0.0093)		(0.0009)*	(0.0064)
13	0.5954	-0.0026	-0.0174	0.6841	-0.0015	-0.0111
		[0.0004]**	[0.0034]**		[0.0003]**	[0.0024]**
		(0.0011)*	(0.0096)		(0.0008)	(0.0062)
14	0.6940	-0.0018	-0.0133	0.7678	-0.0012	-0.0084
		[0.0004]**	[0.0028]**		[0.0003]**	[0.0019]**
		(0.0009)	(0.0075)		(0.0007)	(0.0046)
15	0.7414	-0.0017	-0.0130	0.8081	-0.0011	-0.0092
		[0.0003]**	[0.0028]**		[0.0003]**	[0.0021]**
		(0.0009)	(0.0073)		(0.0007)	(0.0052)
16	0.8760	-0.0010	-0.0041	0.9249	-0.0003	-0.0007
		[0.0002]**	[0.0015]**		[0.0002]	[0.0012]
		(0.0005)	(0.0028)		(0.0004)	(0.0010)
17	0.9169	-0.0007	-0.0015	0.9597	-0.0002	-0.0002
		[0.0002]**	[0.0010]		[0.0001]	[0.0008]
		(0.0004)	(0.0016)		(0.0002)	(0.0006)
18	0.9517	-0.0005	0.0001	0.9843	-0.0001	0.0004
		[0.0001]**	[0.0008]		[0.0001]	[0.0004]
		(0.0003)*	(0.0015)		(0.0001)	(0.0005)
19	0.9755	-0.0004	0.0008	0.9935	-0.00007	0.0005
		[0.0001]**	[0.0006]		[0.00004]	[0.0003]
		(0.0002)*	(0.0016)		(0.0001)	(0.0005)

Notes: The table shows estimates of equation (1) where the dependent variable is a dummy for having completed years of education less than or equal to the given value. Columns 1 and 4 show values of the cumulative distribution function, columns 2 and 5 show results of least squares regressions, and columns 3 and 6 show results of instrumental variables regressions. Results are estimated with Census data. Control variables are white and black dummies, average per capita income while in school (lagged two years), year of birth dummies, and state dummies. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level.

Table 8: Effect of NSLP Exposure on the Cumulative Distribution of Education with NHIS

	Men			Women		
	Value of CDF	LS	IV	Value of CDF	LS	IV
Education	(1)	(2)	(3)	(4)	(5)	(6)
0	0.0031	-0.0001	-0.0002	0.0024	-0.0001	-0.0004
		[0.0001]	[0.0005]		[0.0001]	[0.0005]
		(0.0001)	(0.0005)		(0.0001)	(0.0003)
4	0.0095	-0.0001	-0.0010	0.0084	-0.0002	-0.0009
		[0.0002]	[0.0009]		[0.0002]	[0.0010]
		(0.0002)	(0.0010)		(0.0002)	(0.0011)
7	0.0304	-0.0009	-0.0054	0.0290	-0.0006	-0.0010
		[0.0003]**	[0.0019]**		[0.0003]	[0.0019]
		(0.0004)**	(0.0033)		(0.0003)	(0.0026)
8	0.0552	-0.0014	-0.0082	0.0521	-0.0003	-0.0025
		[0.0005]**	[0.0030]**		[0.0004]	[0.0026]
		(0.0006)*	(0.0049)		(0.0004)	(0.0029)
11	0.1657	-0.0017	-0.0128	0.1776	-0.0006	-0.0074
		[0.0008]*	[0.0051]*		[0.0007]	[0.0042]
		(0.0011)	(0.0075)		(0.0006)	(0.0061)
12	0.5335	-0.0034	-0.0244	0.6208	-0.0014	-0.0181
		[0.0010]**	[0.0069]**		[0.0009]	[0.0052]**
		(0.0019)	(0.0155)		(0.0016)	(0.0105)
14	0.7115	-0.0026	-0.0283	0.7839	-0.0016	-0.0120
		[0.0010]**	[0.0074]**		[0.0008]*	[0.0046]**
		(0.0016)	(0.0182)		(0.0011)	(0.0091)
15	0.7587	-0.0026	-0.0257	0.8225	-0.0020	-0.0113
		[0.0009]**	[0.0067]**		[0.0007]**	[0.0038]**
		(0.0015)	(0.0152)		(0.0011)	(0.0068)
16	0.8934	-0.0012	-0.0116	0.9370	-0.0001	-0.0006
		[0.0006]	[0.0039]**		[0.0005]	[0.0024]
		(0.0009)	(0.0059)		(0.0006)	(0.0024)

Notes: The table shows estimates of equation (1) where the dependent variable is a dummy for having completed years of education less than or equal to the given value. Columns 1 and 4 show values of the cumulative distribution function, columns 2 and 5 show results of least squares regressions, and columns 3 and 6 show results of instrumental variables regressions. Results are estimated with NHIS data. All models are estimated using NHIS sample weights. Control variables are white and black dummies, average per capita income while in school (lagged two years), year of birth dummies, age dummies, and state dummies. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level.

Table 9: Census Education Results With Time Trends

	Men				*Women*			
Type of Trend	Least Squares (1)	First Stage (2)	Reduced Form (3)	IV (4)	Least Squares (5)	First Stage (6)	Reduced Form (7)	IV (8)
Without Trends	0.0220	9.15	0.862	0.0942	0.0134	9.10	0.332	0.0365
	[0.0025]**	[2.07]**	[0.099]**	[0.0183]**	[0.0018]**	[2.07]**	[0.082]**	[0.0095]**
	(0.0064)**	(6.17)	(0.211)**	(0.0495)	(0.0044)**	(6.15)	(0.167)	(0.0201)
With State Time Trends	0.0107	9.38	-1.131	-0.1206	0.0058	9.31	-1.167	-0.1253
	[0.0049]*	[2.41]**	[0.264]**	[0.0477]*	[0.0044]	[2.41]**	[0.204]**	[0.0351]**
	(0.0099)	(4.93)	(0.419)**	(0.0740)	(0.0081)	(4.94)	(0.185)**	(0.0712)

Notes: Each cell corresponds to a separate regression. In the top row, columns 2 and 8 show estimates of equation (2), columns 3 and 6 show results from regressing education on the instrument, and other columns show estimates of equation (1). The second row augments the models with linear state-specific time trends. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level. Control variables are white and black dummies, average per capita income while in school (lagged two years), year of birth dummies, and state dummies.

Appendix B: Additional Results

Appendix Table 1: Differential Effects of NSLP for Men by Race and North/South

	Race		Race Reduced Form		North/South	
	White	Black	White	Black	North	South
Outcome	(1)	(2)	(3)	(4)	(5)	(6)
Education	0.103	0.068	1.000	0.311	0.053	0.109
	[0.020]**	[0.041]	[0.104]**	[0.176]	[0.007]**	[0.020]**
	(0.055)	(0.070)	(0.216)**	(0.322)	(0.016)**	(0.060)
Height	0.021	0.098	0.167	0.553	0.049	-0.025
	[0.037]	[0.147]	[0.315]	[0.809]	[0.019]*	[0.059]
	(0.053)	(0.142)	(0.534)	(0.750)	(0.0255)	(0.090)
BMI	-0.0814	0.199	-0.662	1.12	-0.0610	-0.0442
	[0.0402]*	[0.181]	[0.316]*	[0.96]	[0.0228]**	[0.0568]
	(0.0629)	(0.229)	(0.320)*	(0.66)	(0.0254)*	(0.0729)
Underweight	-0.0010	-0.0028	-0.0081	-0.0157	-0.0004	-0.0015
	[0.0014]	[0.0049]	[0.0110]	[0.0270]	[0.0008]	[0.0020]
	(0.0016)	(0.0063)	(0.0084)	(0.0341)	(0.0004)	(0.0024)
Overweight	-0.0143	0.0357	-0.116	0.201	-0.0115	-0.0019
	[0.0058]*	[0.0271]	[0.046]*	[0.151]	[0.0034]**	[0.0086]
	(0.0097)	(0.0285)	(0.048)*	(0.166)	(0.0046)*	(0.0091)
Obese	-0.0020	0.0037	-0.0160	0.0207	-0.0014	-0.0043
	[0.0029]	[0.0118]	[0.0232]	[0.0682]	[0.0016]	[0.0039]
	(0.0032)	(0.0091)	(0.0245)	(0.0565)	(0.0015)	(0.0056)
Weight	-0.415	2.04	-3.36	11.5	-0.153	-0.412
	[0.334]	[1.51]	[2.52]	[7.8]	[0.178]	[0.508]
	(0.538)	(2.11)	(2.34)	(5.9)	(0.221)	(0.795)
Health Limitations	-0.0020	0.0120	-0.0164	0.0615	0.0023	-0.0030
	[0.0041]	[0.0200]	[0.0316]	[0.1032]	[0.0022]	[0.0059]
	(0.0047)	(0.0226)	(0.0279)	(0.1389)	(0.0020)	(0.0042)
Poor or Fair Health	-0.0069	-0.0084	-0.0561	-0.0480	-0.0019	-0.0064
	[0.0027]**	[0.0157]	[0.0186]**	[0.0836]	[0.0013]	[0.0037]
	(0.0051)	(0.0254)	(0.0191)*	(0.1046)	(0.0014)	(0.0053)

Notes: Columns 1, 2, 5, and 6 show IV estimates of equation (1) for subsamples. Columns 3 and 4 show estimates of the reduced form of columns 1 and 2. Each row corresponds to an outcome variable. Each entry corresponds to a separate regression. Education results are estimated with Census data, and other results are estimated with NHIS data. Control variables are white and black dummies, average per capita income while in school (lagged two years), birth dummies, year dummies (with the NHIS data only), and state dummies. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. All models estimated with NHIS data are estimated using sample weights. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level.

Appendix Table 2: Differential Effects for Grades 1-6 and 7-12

	Men		Women	
	Grades 1-6	Grades 7-12	Grades 1-6	Grades 7-12
Outcome	(1)	(2)	(3)	(4)
Education	-0.0167	0.0941	-0.0091	0.0394
	[0.0117]	[0.0198]**	[0.0048]	[0.0080]**
	(0.0229)	(0.0398)*	(0.0079)	(0.0141)**
Height	0.0171	0.0027	0.0208	0.0065
	[0.0177]	[0.0272]	[0.0136]	[0.0199]
	(0.0170)	(0.0361)	(0.0146)	(0.0181)
BMI	-0.0202	-0.0146	-0.0193	-0.0140
	[0.0209]	[0.0291]	[0.0240]	[0.0318]
	(0.0239)	(0.0378)	(0.0291)	(0.0405)
Underweight	-0.0006	-0.0001	0.0005	0.0006
	[0.0007]	[0.0011]	[0.0014]	[0.0019]
	(0.0007)	(0.0012)	(0.0012)	(0.0018)
Overweight	-0.0035	-0.0024	-0.0017	-0.0008
	[0.0029]	[0.0043]	[0.0023]	[0.0030]
	(0.0032)	(0.0055)	(0.0028)	(0.0042)
Obese	-0.0005	0.0003	-0.0001	0.0001
	[0.0014]	[0.0020]	[0.0013]	[0.0019]
	(0.0016)	(0.0026)	(0.0015)	(0.0021)
Weight	-0.0579	-0.0638	-0.0171	-0.0493
	[0.1699]	[0.2372]	[0.1410]	[0.1824]
	(0.1784)	(0.3142)	(0.1543)	(0.2224)
Health Limitations	0.0027	-0.0017	0.0028	-0.0032
	[0.0018]	[0.0031]	[0.0017]	[0.0025]
	(0.0018)	(0.0024)	(0.0018)	(0.0027)
Poor or Fair Health	0.0034	-0.0059	0.0042	-0.0049
	[0.0015]*	[0.0021]**	[0.0016]**	[0.0027]
	(0.0018)	(0.0025)*	(0.0019)*	(0.0047)

Notes: The table shows IV estimates that allow for different effects in grades 1-6 from those in grades 7-12. To create two instruments, I separate the instrument used in the main results into grades 1-6 and grades 7-12. Each row corresponds to an outcome variable. Within a given row, columns 1 and 2 show the results of an IV regression for men, and columns 3 and 4 show the results of an IV regression for women. Education results are estimated with Census data, and other results are estimated with NHIS data. Control variables are white and black dummies, average per capita income while in school (lagged two years), birth dummies, year dummies (in NHIS data only), and state dummies. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. All models estimated with NHIS data are estimated with sample weights. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level.

Appendix Table 3: Differential Effects for Grades 1-9 and 10-12

	Men		Women	
	Grades 1-9	Grades 10-12	Grades 1-9	Grades 10-12
Outcome	(1)	(2)	(3)	(4)
Education	0.0120	0.0695	-0.0018	0.0320
	[0.0086]	[0.0125]**	[0.0041]	[0.0059]**
	(0.0185)	(0.0276)	(0.0066)	(0.0106)**
Height	0.0037	0.0059	0.0302	-0.0021
	[0.0179]	[0.0223]	[0.0132]*	[0.0164]
	(0.0254)	(0.0292)	(0.0149)*	(0.0159)
BMI	0.0007	-0.0197	-0.0083	-0.0146
	[0.0190]	[0.0234]	[0.0208]	[0.0255]
	(0.0189)	(0.0280)	(0.0248)	(0.0326)
Underweight	-0.0017	0.0005	-0.0001	0.0008
	[0.0007]*	[0.0009]	[0.0013]	[0.0016]
	(0.0008)	(0.0011)	(0.0010)	(0.0016)
Overweight	-0.0004	-0.0031	-0.0014	-0.0006
	[0.0027]	[0.0034]	[0.0019]	[0.0024]
	(0.0026)	(0.0040)	(0.0022)	(0.0033)
Obese	0.0001	0.0001	0.0007	-0.0002
	[0.0013]	[0.0016]	[0.0013]	[0.0015]
	(0.0013)	(0.0020)	(0.0015)	(0.0017)
Weight	0.0376	-0.0932	0.0739	-0.0851
	[0.1587]	[0.1907]	[0.1169]	[0.1493]
	(0.1657)	(0.2314)	(0.1264)	(0.1815)
Health Limitations	0.0017	-0.0015	0.0010	-0.0026
	[0.0019]	[0.0024]	[0.0015]	[0.0020]
	(0.0023)	(0.0021)	(0.0017)	(0.0019)
Poor or Fair Health	0.0004	-0.0045	0.0029	-0.0045
	[0.0015]	[0.0017]*	[0.0015]	[0.0020]*
	(0.0021)	(0.0019)*	(0.0021)	(0.0032)

Notes: The table shows IV estimates that allow for different effects in grades 1-9 from those in grades 10-12. To create two instruments, I separate the instrument used in the main results into grades 1-9 and grades 10-12. Each row corresponds to an outcome variable. Within a given row, columns 1 and 2 show the results of an IV regression for men, and columns 3 and 4 show the results of an IV regression for women. Education results are estimated with Census data, and other results are estimated with NHIS data. Control variables are white and black dummies, average per capita income while in school (lagged two years), birth dummies, year dummies (in NHIS data only), and state dummies. Standard errors corrected for clustering at the year of birth*state level are in brackets, and standard errors corrected for clustering at the state level are in parentheses. All models estimated with NHIS data are estimated with sample weights. A single asterisk denotes significance at the 5% level, and a double asterisk denotes significance at the 1% level.