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Multi-generational Impacts of Childhood Access to the Safety Net: Early Life Exposure to Medicaid and the Next Generation's Health
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ABSTRACT

We examine multi-generational impacts of positive in utero and early life health interventions. We focus on the 1980s Medicaid expansions, which targeted low-income pregnant women, and were adopted differently across states and over time. We use Vital Statistics Natality files to create unique data linking individuals' in utero Medicaid exposure to the next generation's health outcomes at birth. We find strong evidence that the health benefits associated with treated generations' in utero access to Medicaid extend to later offspring in the form of higher average birth weight and decreased incidence of very low birth weight. Later childhood exposure to Medicaid does not lead to persistent health effects across generations. The return on investment is substantially larger than suggested by evaluations of the program that focus only on treated cohorts.

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There is substantial evidence that health and socioeconomic inequalities persist across generations. A growing number of studies suggest that differences in early life health environments may causally contribute to these disparities. Negative shocks to the *in utero* environment, in particular, have been found to be harmful to individuals' later life health and earnings. A handful of studies also examine positive interventions and find that policies intended to improve early life experiences generate better adult outcomes.[1] By extension, literatures in economics, epidemiology and child development predict that the causal impacts of these interventions should echo beyond the exposed generation. Little is known, however, about the extent to which the early life environment impacts future generations, or the potential for public policy to alter such linkages.

We consider whether positive public health interventions experienced *in utero* and during childhood subsequently affect the next generation's health. We focus on the impact of the largest source of health-related services for low-income children in the United States: the Medicaid Program. Changes in eligibility rules during the 1980s and 1990s, particularly for low-income pregnant women and children who were not otherwise tied to the welfare system, led to a dramatic increase in individuals' prenatal and early childhood Medicaid eligibility.[2] The additional coverage provided to pregnant women under the expansions represents the single largest effort the federal government has ever made to improve birth outcomes. There was considerable variation in the timing and magnitude of these expansions across states, which prior empirical research has harnessed to examine the program's effects on cohorts who gained access

[1] See Almond and Currie (2011a,2011b) and Almond, Currie and Duque (2017) for extensive summaries of this literature.
[2] Our empirical strategy exploits both changes in Medicaid and the creation and expansion of the State Children's Health Insurance Program. In what follows, we refer to both as "Medicaid."

in utero and during childhood.[3] We build on research documenting effects on the "first generation," to investigate whether positive policy interventions in one generation transmit to the next generation.

Our analyses make several contributions to the literature relating the early life environment to later outcomes. First, the vast majority of studies establishing a causal relationship between early life health experiences and adult outcomes confine their analyses to treated cohorts. While an ever-expanding number of animal experiments provide substantive evidence that early life environmental effects can be transmitted to later generations,[4] human studies are nearly non-existent. We move the "early origins" literature forward by using a quasi-experimental design to document similar multi-generational effects in humans.

We are also the first to investigate whether the effects of a large-scale, positive, U.S. health intervention persist to later generations. Most of what we know about the long-run effects of early life conditions comes from studies of extreme, negative health experiences such as famine and disease outbreaks, which are difficult to extrapolate to the current policy environment. A much smaller literature is beginning to leverage variation in means tested programs to investigate whether positive interventions that generate more typical differences in early childhood experiences, affect exposed cohorts' long-term outcomes, but research investigating whether such interventions transmit beyond treated cohorts to subsequent generations is nearly non-existent. This is an important gap--particularly in light of current political debates about the cost of publicly provided health insurance--as substantive multiplier

[3] See for example: Brown, Kowalski and Lurie (2017), Cohodes et. al (2016), Currie and Gruber (1996a,b), Currie, Decker, and Lin (2008), Dave et al. (2008), Howell et al. (2010), Levine and Schanzenbach (2009), Miller and Wherry (2017), Thompson (2017).
[4] Useful reviews of this literature include Daxiger and Whitelaw (2010; 2012), Heard and Martienssen (2014), Hochberg et. al. (2011), Nadeau (2009).

effects would suggest that existing benefit-cost calculations underestimate the true value of government investments in children's health.

Our analyses are based on information that is available in the 1994-2015 Vital Statistics Natality files. We use restricted access versions of the Vital Statistics files that include information on mothers' state and exact date of birth to create a unique dataset that links information on individuals' *in utero* and childhood Medicaid eligibility to later offspring's health at birth. Following the pioneering work of Currie and Gruber (1996a,1996b), we use a simulated measure of maternal eligibility that isolates variation in health insurance access resulting from policy changes, rather than socioeconomic factors, and we employ a variant of a difference-in-differences model, where treatment varies by mothers' state of birth and year of birth. We include treatment variables for mothers' *in utero* and childhood coverage, along with maternal state of birth and year of birth fixed effects. We also include a number of state-year covariates to control for other policies and economic conditions that prevailed in the state and year the mothers were born.

We analyze health outcomes among infants whose mothers were born between 1979 and 1986, when the most dramatic increases in prenatal Medicaid coverage occurred. We estimate Medicaid's impacts on the second generation's average birth weight and probability of being below the low birth weight and very low birth weight thresholds, along with the second generation's average gestational length, probability of being preterm, and probability of being small for gestational age. These infant health measures are known to be affected by maternal health outcomes that improve with early life access to Medicaid. Importantly, birth weight and gestational length are also predictive of later life health and economic outcomes.

We find that mothers' own *in utero* Medicaid eligibility has a substantial, positive impact on their children's health at birth. A 10 percentage point increase in the first generation's *in utero* Medicaid eligibility increases the second generation's average birth weight by 4.4 grams and reduces the incidence of very low birth weight by 0.1 percentage points. The estimates are robust to a variety of specification checks, including alternative state and year control variables, sample definitions, measures of eligibility and weighting. Patterns in the estimates suggest that the observed decline in the incidence of very low birth weight births may result from a reduction in *in utero* conditions that contribute to prematurity.

We consider several possible mechanisms, including changes in the fertility patterns of the women who were exposed to the expansions while they were *in utero*. Medicaid-induced changes in later fertility might affect second-generation outcomes either by changing the composition of women who choose to give birth, or by altering the timing of birth in a way that promotes health during pregnancy, such as avoiding a teenage birth. We find no evidence that changes in overall fertility can explain the effects on infant health, but we do find a shift in the racial composition of women giving birth. First-generation Medicaid exposure increases the fraction of second-generation births that are to white women, and decreases the fraction to non-white women. However, this change in the composition of births can explain at most about 6-17% of the overall change in infant health that we observe. We conclude, therefore, that most of the change reflects direct improvements in the second generation's health.

To gain further insight into which factors drive Medicaid's multi-generational health effects we conduct a back-of-the-envelope calculation. Using estimates from previous research, we evaluate the extent to which our second-generation health estimates might result from Medicaid induced increases in the first generation's (second generation's parents) income due to the first generation's early-life Medicaid access. Our calculations suggest that parental income may play an important role in the transmission process.

Our results establish that public investments in prenatal health have persistent impacts beyond the treated generation. By quantifying these effects, we establish that benefit/cost ratios based only on cohorts immediately affected by Medicaid generate underestimates of the program's overall efficacy.

The remainder of our paper proceeds in the following way: Section I provides further information about the existing literature on "early life" health and multi-generational processes. In Section II, we describe the Medicaid program and the nature of the 1980s expansions. Sections III and IV describe our empirical strategy and data. We present our results in Section V and conclude with a discussion in Section VI.

I. Background

Twenty-five years ago, David Barker (1992) put forward a provocative hypothesis that the period of gestation has significant impacts on individual health that reach well into adulthood. Since then, there has been growing scientific agreement that the time both before, and immediately after, birth are critical periods when the developing body takes cues from its surrounding environment, adapting to that environment in ways that may affect later life health. A key feature of the fetal origins hypothesis is that the health effects of the *in utero* environment can remain latent for many years. We have yet to achieve a full understanding of the processes underlying these phenomena, but a leading theory is that the fetus's surrounding environment alters genetic programming through the "switching on" of specific genes.

Numerous economists and epidemiologists have used quasi-experimental designs to test the fetal origins hypothesis, and have found that *in utero* and early life health experiences can have important effects on later life outcomes. The vast majority of studies in economics have identified these effects using short-term events such as disease outbreaks and famines,[5] which are by nature both negative and extreme. A handful of studies have recently emerged, however, demonstrating that widespread positive health interventions can also influence well-being in adulthood. Hoynes, Schanzenbach and Almond (2016) find that *in utero* and early life access to the U.S. Food Stamp program leads to a large reduction in the incidence of "metabolic syndrome" (conditions related to cardiovascular disease such as obesity, high blood pressure, and diabetes) and, among women, an increase in economic self-sufficiency. Other studies include Butikofer, Loken and Salvanes (2017) who evaluate the long-term impact of mother and child health centers, Glied and Neidell (2010) who study the long-term impact of water fluoridation, and Bhalotra and Venkataramani (2015) who evaluate the long term effects of the introduction of antibiotic therapies. Bharadwaj, Loken and Nielson (2013) find that surfactant and related treatments for very low birth weight babies lead to higher test scores and lower mortality rates, and Fitzsimons and Vera-Hernandez (2014) find that breastfeeding encouragement has large effects on children's cognitive development.[6]

In this vein, recent work has demonstrated that changes to the Medicaid program during the 1980s and 1990s that expanded coverage of pregnant women and children generated

[5] Examples from the literature include Almond (2006), Almond and Mazumder (2005), Barreca (2010), Mazumder et al. (2010), Neelsen and Stratmann (2012) [disease], Chen and Zhou (2007), Painter, Roseboom and Bleker (2005), Ravelli, Stein, and Susser, (1976), Roseboom et al. (2001), Stein et al. (1975), Susser and Lin (1992), Scholte et al. (2015), Almond and Mazumder (2011), van Ewijk (2011), Almond et al. (2010) [nutrition]. Quasi-experimental studies of stress (Persson and Rossin-Slater 2016) and pollution (Sanders 2012) also find detrimental effects.

[6] Related literatures examine the long-term effects of education interventions such as Head Start (e.g. Carneiro and Ginja (2014), Deming (2009), Garces, Thomas and Currie (2002), Ludwig and Miller (2007)) and policies that reduce pollution exposure (Nilsson 2009; Isen, Rossin-Slater and Walker, 2017).

improvements in affected children's later life health. Focusing on variation generated by the 1980s expansions to pregnant women, Miller and Wherry (2017) find that *in utero* exposure to the program reduces the likelihood of having metabolic-syndrome and circulatory-system linked chronic illnesses in adulthood, and reduces hospitalizations for such conditions. Importantly for our study, when these later life diseases are experienced during pregnancy, women and their children are put at risk for a variety of health problems, including an increased risk of gestational diabetes, complications related to high blood pressure, and preterm birth (Catalano and Ehrenberg, 2006).

Other studies evaluate the long-run health effects of the 1980s and 1990s expansions to broader age groups, beyond *in utero* eligibility.[7] Currie, Decker, and Lin (2008) find evidence suggesting early childhood eligibility is associated with better health status in adolescence. Wherry and Meyer (2015) find that childhood Medicaid expansions reduced mortality rates among black teens, while Wherry et al. (forthcoming) find evidence of fewer hospitalizations in adulthood. Thompson (2017) finds that eligibility for Medicaid or the State Children's Health Insurance Program (CHIP) is associated with improvements in a summary index of adult health measures, with eligibility early in childhood (age 0 to 5) generating the largest effects, and Brown, Kowalski, and Lurie (2017) find that childhood eligibility reduces adult mortality.

These long-term effects are consistent with studies documenting that the expansions led to contemporaneous gains in health insurance coverage, health care utilization and children's

[7] Three other studies document how the introduction of Medicaid between 1966 and 1970 improved later life health. Using geographic variation in program roll-out to identify the effects of exposure to Medicaid under age 6, Boudreaux, Golberstein and McAlpine (2016) find that Medicaid reduced the likelihood of having a chronic health condition in adulthood. Using a similar strategy, Sohn (2017) finds that Medicaid's initial roll-out was associated with lower adult mortality. Goodman-Bacon (2016) uses variation in pre-existing welfare eligibility levels, since Medicaid was originally linked to welfare receipt, and finds that the introduction of Medicaid reduced later life mortality and disability for white cohorts who were exposed to the program early in life.

health (Buchmueller, Ham, and Shore-Sheppard, 2016). Beyond health outcomes, several recent studies find that childhood exposure to public health insurance improves later life economic outcomes. Miller and Wherry (2017) find increased rates of high school graduation associated with *in utero* Medicaid eligibility, while Levine and Schanzenbach (2009) find evidence of improved test scores resulting from increased eligibility at the time of birth. Cohodes et al. (2016) examine childhood exposure to Medicaid and CHIP from birth to age 17 and find evidence of increased rates of high school and college completion. Brown, Kowalski, and Lurie (2017) find that childhood exposure to public insurance increased college enrollment, decreased receipt of the Earned Income Tax Credit, and had a positive effect on females' adult earnings.

Taken as a whole, the existing literature generates two broad conclusions. First, early life health shocks have long-term impacts on the health and economic outcomes of those who experience them. Second, many widespread public health interventions targeted at children have substantive positive benefits that last well into adulthood. A natural question is whether these effects endure to the next generation. Economists have previously documented that health and economic status persist across multiple generations (Solon, 2015; Clark, 2014), but quasi-experimental investigations are rare. We know little about what drives the correlations, or the potential for policy based treatments to alter them. The dearth of work among social scientists likely results from multiple challenges of identifying exogenous variation in early life health environments *and* linking that variation to data that provides relevant information on *multiple* generations.

These challenges can be overcome in biological studies, where an accumulation of evidence based on animal experiments finds that prenatal health shocks have persistent generational effects. As an example, studies have documented that rats that are malnourished before or during pregnancy produce offspring with smaller brains and reduced cognition, even if the offspring receive sufficient nutrition after birth. Importantly, these effects are not only observed in the immediate offspring, but are present in the next generation as well.[8] Similar multi-generational patterns have been found with in-utero exposure to stress, and smoke.[9] One explanation for this pattern is that the biological predecessors of the ovaries and sperm cells, which will produce the next generation, are already present at the fetal stage, and are therefore exposed to any insult experienced by the fetus.

Medicaid may alter these patterns by increasing the use of prenatal care, which provides nutrition and drug counseling, immunizations, and early diagnoses and direct interventions for at-risk infants. Several studies of Medicaid's prenatal eligibility expansions have shown that they were associated with increased use or improved timing and adequacy of prenatal care (Currie and Gruber, 1996b, Dubay et al., 2001, Dave et al., 2008, Howell, 2001). Currie and Gruber (2001) document increases in the number of obstetric procedures among pregnant women who were most likely to gain eligibility through the 1980s and 1990s expansions. Currie and Gruber (1996a, 1996b) link the expansions in prenatal care to reductions in offspring's incidence of infant mortality and low birth weight. Importantly for our study, maternal health at birth is predictive of future generations' birth weight (e.g., Currie and Moretti, 2007; Black, Devereux, and Salvanes, 2007, Royer, 2009;). Projecting forward, it therefore seems probable that the prenatal health interventions that were associated with the Medicaid expansion would have persistent, multi-generational impacts.

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[8] A few examples include Zamenhof, Marthens and Grauel (1971), Cowley and Griesel (1966), Aerts and Van Assche (2006), Dunn and Bale (2009), Jimenez-Chlillaron et. al. (2009), Martinez et. al. (2014). Recent reviews of the literature on transgenerational epigenetic inheritance include Danxiger and Whitelaw (2010),Danxiger and Whitelaw (2012), Grossniklaus (2013), and Heard and Martienssen (2014).
[9] Examples include Iqbal et al. (2012), Grundwald and Brunton (2015), Morgan and Bale (2011), Rehan et al. (2012), and Maritz and Mutemwa (2014).

The availability of Medicaid may also reduce maternal stress: in an analysis of the Oregon Health Insurance Experiment, Finkelstein et al. (2012) finds that those who gained health insurance through the experiment experienced substantive improvements in mental health. Several first generation studies have in turn linked parental and *in utero* stress to children's well-being (Black, Devereux, and Salvanes, 2016; Camacho, 2008; Mansour and Rees, 2012; Persson and Rossin-Slater, 2016; Valente, 2011), with possible ramifications for the next generation's health.

Another likely pathway is through Medicaid-induced changes in the first generation's human capital and earnings, as described above. It is well known that children living in high income families are healthier than children living in low income families, and that the health gap is evident even in early childhood (Currie, 2011; Case, Fertig, and Paxson, 2005; Case, Lubotsky, and Paxson, 2002). Part of the gap may be reduced by policies that increase family income (Kehrer and Wolin, 1979; Almond, Hoynes, and Schanzenbach, 2011; Hoynes, Miller and Simon, 2015). This is intuitive, as parents with more income have more resources to invest in their children. The health of higher income children may also benefit from financially related reductions in parental stress (Aizer, Stroud, and Buka, 2012; Evans and Garthwaite, 2014) or from income induced changes in parental behaviors, such as receipt of prenatal care or reduced smoking (Hoynes, Miller, and Simon, 2015).

In spite of the methodological challenges, a few studies have been able to extend the use of historical "shocks" to look at how they affected the next generation, and have found evidence of persistent effects. Painter et al. (2008) investigate the multi-generational impacts of the Dutch Hunger Winter of 1944-1945, which reduced the food consumption of a previously well-nourished population by more than 75%. They find that the offspring of those who were exposed *in utero* experienced worse health in later life. Van den Berg and Pinger (2014) investigate the transgenerational effects of pre-pubertorial exposure to the German famine of 1916-1918 and find evidence of mental health effects on later generations, which they attribute to biological rather than social processes. Looking beyond the effects of extreme nutritional deprivation to the transgenerational impacts of disease exposure, Richter and Robling (2013) find that the children of those who were exposed to the 1918-1919 influenza pandemic *in utero* grew up to have lower levels of educational attainment. Similarly, Black et al. (2013) find that Norwegian cohorts exposed to radioactive fallout during the *in utero* period had children with lower cognitive ability. Focusing on later childhood disease exposure, Butikofer and Salvanes (2015) find that intergenerational persistence in educational attainment was mitigated by a 1940s Norwegian tuberculosis control program.

One study uses more recent data to examine persistent impacts of broader disease exposure. Almond, Currie and Herrmann (2012) use U.S. Vital Statistics data to examine how state level variation in infant mortality rates at the time of the mothers' birth –which could be driven by many factors, including variation in access to medical care—relate to her offspring's health. They find that higher infant mortality in the year after the mother is born is associated with a reduction in the probability that her baby will be born below the low birth weight threshold.

Finally, two studies investigate multi-generational effects of health interventions targeting the post-natal period.[10] Almond and Chay (2006) find that the racial gap in very low birth weight incidence narrowed by 30% among the offspring of cohorts who benefited from Title VI

[10] Two recent studies examine the multigenerational effects of early life educational interventions. Barr and Gibbs (2017) and Rossin-Slater and Wüst (2016) examine the effects of exposure to preschool in the U.S. and Denmark, respectively, on educational outcomes for the next generation and find positive effects. In addition, Barr and Gibbs find evidence of reduced teen pregnancy and criminal activity in the second generation.

of the Civil Rights Act, which expanded black infants' access to health care. Also, as part of their study on the long-term impacts of Norwegian mother and child care centers, Butikofer, Loken and Salvanes (2017) estimate that the centers reduced the intergenerational persistence of educational attainment by 10 percent.

We build on this small number of studies by harnessing a policy driven increase in access to a widespread public health program that is a critical component of the U.S. safety net. This allows us to establish multi-generational linkages associated with more common and contemporaneous variation in early life health experiences, while simultaneously quantifying long-term benefits of the Medicaid program that have not previously been measured.

II. Medicaid and the 1980s Expansions

Medicaid is the largest means-tested transfer program in the United States and provides insurance coverage for nearly half of all births (Markus et al., 2013). Begun in 1965 as part of the Social Security Amendments, it is a joint federal-state program: the federal government sets important requirements, but states have flexibility in terms of eligibility rules, program benefits, reimbursement amounts and other aspects of their programs.

Until the 1980s, coverage for pregnant women and non-disabled children was primarily limited to families who received cash welfare under the Aid to Families with Dependent Children Program (AFDC). AFDC income eligibility thresholds varied by state, and were generally much lower than the federal poverty line. The average threshold was 61% of the federal poverty line in 1979, and ranged from 24% to 99%.[11] Moreover, AFDC eligibility was

[11] Authors' calculation based on payment standard for a family of 3 in 1979.

largely restricted to single parent families.[12] Although states could choose to cover first-time pregnant women under their AFDC programs, the Omnibus Reconciliation Act of 1981 restricted participation for these women until the sixth month of pregnancy (Currie and Gruber, 1994).

Restrictions on AFDC participation meant that the vast majority of low-income pregnant women and children living in two parent families were not eligible for Medicaid, nor were most unmarried women who were pregnant for the first time. Starting in the 1980s, however, Medicaid coverage was greatly expanded to pregnant women and children not qualifying for AFDC benefits. The first phase of expansions was targeted towards specific groups of pregnant women and young children with very low levels of income who did not qualify for AFDC. These "targeted expansions" predated "broad expansions"[13] that later extended Medicaid eligibility to families with higher income levels (often well above the AFDC income thresholds) and to older children. As described in the next section, our analyses focus on the offspring of first generation cohorts who were born between 1979 and 1986, for whom *in utero* access to Medicaid was affected by the targeted expansions, but later childhood eligibility was affected by both the targeted and the broad expansions.

As described in Buchmueller, Ham and Shore-Sheppard (2016) the targeted expansions occurred first by state option, and then by federal mandate. Under various options, states were able to extend Medicaid eligibility to: 1) first-time pregnant women who would later qualify for AFDC, as well as to pregnant women and "unborn children" who were income eligible for AFDC, but did not meet the family structure requirements for the program 2) pregnant women and children in two parent families who did not qualify for AFDC but had incomes below AFDC

[12] Under the optional AFDC Unemployed Parent program, married parent families were able to receive benefits when the principal earner was unemployed, but the eligibility criteria were stringent, and in 1979 only 6% of families on AFDC included two parents (Duvall, Goudreau and March, 1982).
[13] This terminology was first used by Currie and Gruber (1996b).

levels, and 3) “medically needy” individuals with higher incomes but high medical expenses. The 1984 Deficit Reduction Act included a mandatory expansion of eligibility to first-time pregnant women who would be AFDC eligible once the child was born, pregnant women living in two-parent families whose principal earner was unemployed, and children under age 5 born after September 30, 1983 whose families were income and resource eligible for AFDC. An additional change implemented in 1986 as part of the 1985 Consolidated Omnibus Reconciliation Act required coverage of all pregnant women whose families met the financial standards for cash welfare, regardless of family structure or participation in AFDC.

Many of these changes were motivated by the high infant mortality rate in the U.S. compared with other developed countries, with the goal of reducing infant mortality by enabling access to more comprehensive prenatal care (Howell, 2001). Pregnant women who enrolled in Medicaid received coverage for prenatal care and services, hospital and postpartum care, and one year of Medicaid eligibility for their newborns (Congressional Research Service 1988). Many women also received counseling from medical providers about how to enroll in other social safety net programs, such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (Miller and Wherry, 2017).

A series of additional eligibility expansions for children in the late 1980s and 1990s meant that cohorts born between 1979 and 1986 also experienced increases in later childhood exposure to public health insurance. The expansions extended the ages that were covered, and increased income eligibility cut-offs. The timing and generosity of the expansions varied both within and across states (Buchmueller, Ham and Shore-Sheppard 2016). Details of the targeted and broad expansions are available in Appendix Section A and Appendix Table 1. As described in Section III, we examine the multi-generational effects of both *in utero* and later childhood Medicaid access by including in our regressions two measures of Medicaid access that capture each cohort's *in utero* eligibility and average years of eligibility between ages 1 and 18.

Figure 1 shows how these changes in Medicaid eligibility rules affected the fraction of children who were eligible while *in utero*, and at older ages.[14] Among those born in 1979, about 13% were eligible for *in utero* coverage. This cohort was also eligible for an average of 2.9 years between ages 1 and 18. Among children born in 1986, the fraction who were eligible for Medicaid was much higher: more than 19% of the 1986 cohort was eligible for *in utero* coverage (a 6.8 percentage point increase), and, between ages 1 and 18, the 1986 cohort was eligible for an average of 5.5 years.

There was also substantial heterogeneity in the timing and magnitude of the expansions across states. As an example, Figure 2 shades states by the magnitude of the changes to *in utero* coverage. The bottom quartile states increased *in utero* coverage by less than 4.2 percentage points. In contrast, states in the top quartile increased coverage by more than 10.7 percentage points.

III. Empirical Strategy

We evaluate how state and federal policies that increased early life Medicaid eligibility affected later offspring's birth outcomes. Our main regression equation is:

$$(1)\quad y_{nb} = \alpha + \beta_1 InUteroMedicaid_{nb} + \beta_2 MedicaidAges1\_18_{nb} + \mu_n + \lambda_b + \gamma X_{nb} + \varepsilon_{nb}$$

where y_{nb} is the average health outcome for infants whose mothers were born in state *n* and year *b*. We refer to the mothers as the "first" (exposed) generation, and to the infants as the "second" generation. We estimate the effects of the first generation's childhood Medicaid eligibility

[14] Author's calculations using the Current Population Survey, described in more detail below.

separately from their *in utero* eligibility. The variable $InUteroMedicaid_{nb}$ measures the fraction of women between the ages of 15 and 44 who would have been eligible for Medicaid if they had become pregnant during the first generation's birth year. The coefficient β_1 is the effect of increasing first generation *in utero* eligibility from 0% to 100%. Put differently, it is the effect of providing 100% of the second generation's grandmothers with Medicaid coverage during their pregnancies. The average fraction of women who would have been eligible if they had become pregnant between 1979 and 1986 is 16%. Since children born to Medicaid-enrolled mothers were automatically eligible to receive Medicaid until their first birthday (Congressional Research Service 1988), we follow Miller and Wherry (2017) and assume that *in utero* Medicaid eligibility extends to the first year after birth.

The coefficient β_2 is the effect on the second generation of providing the first generation with an additional year of childhood eligibility. $MedicaidAges1\_18_{nb}$ is the sum, across ages 1-18, of the fraction of the first generation's cohort who were eligible for Medicaid at each age. This variable could change by one unit if 100% of the maternal cohort gained an additional year of eligibility sometime between ages 1 and 18. Alternatively, a one-unit change would occur if 50% of the mother's birth cohort became eligible for an additional 2 years, or if 25% of mothers became eligible for an additional 4 years. In theory, $MedicaidAges1\_18_{nb}$ can take on any value between 0 and 18, but in practice the mean of the variable is 4.1 years.

Equation (1) includes fixed effects for the mother's state of birth, λ_b, to account for fixed differences in the outcomes of mothers and their children that differ across states. We also include mother year of birth fixed effects, μ_n, to account for national shocks over time. With these controls, our identification relies on changes in Medicaid eligibility within states and over time. The identifying assumption is that changes in Medicaid eligibility were not correlated with other state changes that also affected the first or second generation's outcomes. The fraction of a birth year cohort that was Medicaid-eligible in a given state may vary due to other factors, however. For example, if a state experienced a recession that reduced average income, more of the population may have become eligible for Medicaid, even if the rules surrounding Medicaid eligibility did not change. These changes in the economic environment may have also directly affected health outcomes.

We address this possibility in several ways. First, we employ an instrumental variables approach, pioneered by Currie and Gruber (1996a, 1996b), which isolates changes in eligibility that are driven only by variation in program eligibility rules and are independent of a state's demographic composition. To construct the "simulated eligibility" instrument for *in utero* coverage, we take a national random sample of women ages 15-44 from each survey year of the Current Population Survey (CPS). We apply the Medicaid eligibility rules in each state and year to this national sample, to calculate each woman's Medicaid eligibility if she were to become pregnant in each state and year. We do the same thing for fixed national random samples of children at each age between 1 and 18.[15] This generates measures of the fraction of Medicaid eligible pregnant women and children that are based only on changes in state and federal policies and are independent of variation in demographic characteristics across states or within states over time. The "simulated eligibility" measures are then used as instruments for the actual fraction eligible in each state and year.

We also include a set of maternal state and year of birth control variables (X_{nb}) that include information on state demographic characteristics, economic characteristics, and policy variables.

[15] To create the *in utero* instrument, we use a random sample of 3,000 women from each CPS survey year. We construct measures of eligibility between ages 1 to 18 by taking a random sample of 1,000 children of each age in each CPS survey year.

The variables are described in Section IV. To further control for state and time-varying characteristics, we also estimate variants of equation (1) that include mother's state of birth trends, and state trends together with mother's region of birth by mother's birth year fixed effects.[16]

Our baseline regressions are weighted by the size of the maternal birth cohort, so that the estimated coefficients represent effects on the population. We explore the robustness of our results to alternative weighting schemes, which we discuss in more detail below. Finally, we cluster our standard errors by mothers' state of birth.

IV. Data

Our main analyses are based on restricted-use versions of the 1994-2015 U.S. Vital Statistics Natality Data Files, which contain individual birth records for the full census of U.S. births. The Vital Statistics files include information on infants' health and year of birth, as well as detailed demographic information about each infant's mother (the first generation) including her year of birth and state of birth. The latter variables are critical, as they allow measures of Medicaid eligibility to be matched to each mother. We exclude mothers who were born outside of the United States, and those born in Arizona, which did not adopt a state Medicaid program until 1982.

[16] While recent work by Neumark, Salas and Wascher (2014) and Meer and West (2016) cautions against the inclusion of geographic-specific trends, the Medicaid expansions were motivated largely by a belief that enabling access to more comprehensive prenatal care would help to lower the infant mortality rate. If states were adopting Medicaid expansions in response to local trends in infant health outcomes, then analyses that do not include state trends could reflect these differential trends in the health of the population, rather than the effects of the expansions. In practice, the estimates are similar across specifications.

We examine health outcomes among infants whose mothers who were born between 1979 and 1986. The mothers are old enough to have been affected by the 1980s Medicaid expansions, but are also still quite young: while births can be observed for some cohorts through age 36, the youngest cohort is only observed through age 28. During our time frame, 72% of first births, and 59% of all births, were to women aged 28 or younger.[17] Our main specification restricts the sample to mothers between the ages of 15 and 28, which ensures that each maternal cohort contributes equally to the identifying variation, and that the analysis of second generation birth outcomes is based on births to women who are the same age. We also conduct additional analyses that include all mothers over the age of 15 (born between 1979 and 1986), and that explore heterogeneous effects across teen and non-teen mothers.

We collapse the data into cells based on mother's state of birth and mother's year of birth. For each cell we calculate the second generation's average birth weight, the fraction of births that are low birth weight (<2500 grams), the fraction that are very low birth weight (<1500 grams), average gestational age at birth (in weeks), the fraction of births that are preterm (< 37 weeks), and the fraction who are small for gestational age (birth weight < 10^{th} percentile for a given gestational age). Some analyses examine the fertility of each maternal cohort, for which we calculate the cohort's birthrate, the rate of first births, average age at first birth, and average number of live births at the time of the infant's birth.

We then merge each cell with corresponding measures of actual and simulated Medicaid eligibility, and with information on states' economic conditions, demographic composition, safety net generosity, and abortion policies. Economic variables include the state unemployment rate and state per capita income, which come from the Bureau of Labor Statistics, and Bureau of

[17] Authors' calculations from the Vital Statistics Natality Files.

Economic Analysis Regional Economic Information System, respectively. Age, marital status, educational attainment, and race measures are from the March Current Population Survey data.[18] The maximum AFDC benefit in each state and year is drawn from the University of Kentucky Center for Poverty Research (2014).[19] We use information on state abortion policies from Kearney and Levine (2012). Summary statistics for all dependent variables are provided in the tables of results. Summary statistics for the control variables are shown in Appendix Table 2.

V. Results

Appendix Table 3 provides first stage estimates. Consistent with previous analyses that have used the same empirical approach, there is a strong relationship between the simulated eligibility measures and actual eligibility. The Kleibergen-Paap[20] statistics indicate we have sufficient explanatory power in our first stage to identify the structural parameters of the model. Many of the diagonal coefficient estimates are close to one, indicating that much of the variation in eligibility over this period is driven by policy changes rather than demographic shifts, and confirming that changes in Medicaid eligibility policies over this period had a large impact on the fraction of pregnant women and children who were eligible.

Table 1 presents our main results. To summarize, the first generation's *in utero* Medicaid eligibility is positively associated with the second generation's health. There is no consistent evidence, however, that Medicaid access in later childhood affects future offspring. The results

[18] For each state and year, we construct variables indicating the share of the population that is married, black, or other race; the share of adults who are high school dropouts, high school graduates, or have some college (share with a college degree or higher is the excluded category); and the percent of the population that is ages 0-4, 5-17, 18-24, 25-44, and 45-64.
[19] We were unable to locate the maximum welfare benefit for 1979, and, therefore, assumed that the benefits in place in 1980 were also in effect the prior year.
[20] Kleibergen-Paap (2006)

are consistent with the biological literature documenting the importance of the *in utero* environment's influence on later generations, and they complement Miller and Wherry's (2017) finding that *in utero* Medicaid exposure is more predictive of later life health and socioeconomic outcomes than exposure at later ages.

We present estimates from three specifications: the first panel excludes state trends, the second panel includes state trends, and the third panel includes both state trends and region by maternal birth year fixed effects. The first two columns show the estimated effects of mother's childhood Medicaid eligibility on the second generation's gestational length and incidence of preterm birth. Few of the coefficient estimates are statistically different from zero, but the pattern of the *in utero* Medicaid eligibility estimates is consistent with modest increases in length of gestation and reductions in the probability of a preterm birth. The estimates are strongest when the model includes the full set of fixed effects. As shown in Panel C, the estimated effect of *in utero* access to Medicaid on the next generation's length of gestation is 0.097 (p=0.129) and the estimated effect on the next generation's incidence of preterm birth is -1.1 (p=0.130). The magnitude of the coefficients imply that increasing the share of *in utero* coverage from zero to 1 reduces the next generation's length of gestation by 0.097 weeks, and probability of preterm birth by 1.1 percentage points.

The next three columns focus on the second generation's birth weight. Across specifications, the estimates indicate *in utero* Medicaid access improves later offspring's birth weight outcomes. The point estimates in Panel C indicate that increasing the share with *in utero* coverage from zero to 1 increases the second generation's average birth weight by 43.9 grams (p<0.01) and reduces the incidence of very low birth weight by 0.7 percentage points (p<0.01). To put these estimates in context, between 1979 and 1986 *in utero* eligibility increased by 6.8

percentage points. The targeted expansions thus increased the second generation's average birth weight by about 3 grams and reduced the incidence of very low birth weight by about 0.05 percentage points. Although not statistically significant, the pattern of estimates also suggest that *in utero* Medicaid coverage reduces the second generation's incidence of low birth weight.

Existing program evaluations rarely focus on the very low birth weight margin, where we find the largest and most consistent effects. A point of interest is that the outcome "small for gestational age" does not appear to be affected by the first generation's exposure to Medicaid. This suggests that the reduction in the incidence of very low birth weight results from processes that increase gestation, as hinted at by the coefficient estimates associated with gestation length and the incidence of preterm births. To further explore this possibility, we estimate equation (1) replacing the dependent variables with measures of gestational age and birth weight that are binned by group. We follow World Health Organization (2016) classifications and estimate models with indicators for less than 28 weeks gestation (extremely preterm), 28 to 31 weeks gestation (very preterm), and 32 to 36 weeks gestation (moderate to late preterm). Similarly, we group birth weight categories into 500 gram bins with a category < 1000 grams as the smallest bin and another category >=5000 grams as the largest category. Figure 3 presents the results of the analyses, which confirm that *in utero* Medicaid eligibility significantly reduced the most extreme categories of prematurity and low birth weight among later offspring.

In contrast with the estimated effects of *in utero* eligibility, estimates associated with maternal eligibility in later childhood (ages 1-18) provide no consistent evidence of second-generation effects. The later childhood estimates are much smaller than the *in utero* estimates, and are not stable across specifications. In Appendix Table 5 we show that this result is not due to broad aggregation of the eligibility measure across childhood, as the estimates are similar when we disaggregate our measure of later childhood access into more narrowly defined age groups. We therefore focus most of the remaining discussion on the estimated impacts of *in utero* Medicaid eligibility.[21]

The estimates in Table 1 are intent-to-treat estimates, averaging together the effects on participants and non-participants. To obtain a treatment on the treated estimate of the effect of *in utero* Medicaid receipt on the next generation's outcomes one should divide the estimates in Table 1 by the take-up rate among the first generation's mothers. Using the Current Population Survey, Currie and Gruber (1996b) estimate that 49 percent of pregnant mothers who gained eligibility through the targeted expansions enrolled in Medicaid.[22] Meyer, Mok and Sullivan (2009) document that program participation is underreported in surveys, however, so Currie and Gruber's estimate is likely an under estimate of *in utero* receipt. Klerman et al. (2009) find that Medicaid receipt in the CPS is under-reported by 30 percent. One way of converting the estimates in Table 1 into treatment on treated effects would therefore be to divide by 0.7 (0.49/(1-0.3)). Any treatment on the treated interpretation should also take into account that treated individuals were more disadvantaged than the full sample, however, and, given the strong relationship between income and health, they would almost certainly have been less healthy at birth than our sample means suggest (Kramer, Lydon and Goulet, 2000). As an example, women born into poverty give birth to babies that are, on average, about 200 grams lighter than babies

[21] Estimates for later childhood eligibility produced by the regressions in Table 2 and 3, are available in Appendix Table 4 and 6.

[22] This takeup rate was calculated by dividing the estimate of the change in Medicaid coverage among women of reproductive age associated with the targeted eligibility expansions (5.6 percent increase as reported in Table 5 in Currie and Gruber 1996b) by the authors' estimate of the share of women who were pregnant at some point during the year (11.4 percent found on pg. 1282 in Currie and Gruber 1996b).

born to women not born into poverty.[23] Take-up among the first generation was probably more likely among those who were at the greatest risk of health problems.

Sensitivity Analyses

We examine the sensitivity of our estimates, by running a series of regressions that include additional controls, employ different weighting schemes, use alternative definitions of the policy variables, or change the sample of mothers. The results, displayed in Tables 2 and 3, are very similar to the estimates produced by our main specification. We briefly describe these analyses below.

Identification in our sample comes from state variation in the timing and magnitude of the Medicaid expansions. The validity of this approach requires that state policies in the year of mother's birth are not correlated with other conditions at the time of the child's birth that might influence the child's health. Table 2 explores the estimates' sensitivity to additional controls for state conditions and resources in the year of the child's birth. For comparison, the first column shows the main estimates from Table 1. The second column shows how the estimates change when we include controls specific to the first generation's state of birth and *second* generation's year of birth.[24] The variables include measures of the state's demographic composition, economic conditions, welfare policies and access to family planning.[25] The third column

[23] Author's calculation using cohorts of women born between 1970-1979 from the 1985-2005 Panel Study of Income Dynamics.

[24] The control variables are determined by the mother's state of birth, instead of the child's state of birth, since mobility may be endogenous to Medicaid exposure.

[25] Specifically, we include the following demographic controls: the fraction of the state population between the ages of 0-4, 5-17, 18-24, 25-44, 44-64; state fraction black and other race; state fraction with a high school degree, some college, college or more. We include the following economic controls: state median household income and unemployment rate. We include the following measures of welfare generosity: maximum welfare benefits, state welfare family cap; whether the state had an EITC program, whether the state had implemented TANF. We include the following family planning measures: variables indicating the presence of state parental and notification laws for abortion, mandatory delay for abortion laws, state Medicaid restrictions for abortion, income based and duration based Medicaid family planning waivers, state mandate for private health insurance coverage of contraceptives, an

controls for the child's own *in utero* Medicaid eligibility, which we calculate using a similar simulated instrument strategy as in our main analysis. Similarly, the fourth column includes a measure of the mother's cumulative adult Medicaid eligibility through the year of her child's birth.[26] The final column shows how the results change when all three sets of controls are included simultaneously. Across specifications, the point estimates are similar, although the inclusion of additional state-year controls reduces some precision.

Results from additional sensitivity analyses are displayed in Table 3. Column 1 again shows the main estimates from Table 1, followed by estimates produced by unweighted regressions, and regressions that are weighted by the number of second-generation births. The estimates are all very similar. Next, we show how the results change when we redefine mother's *in utero* Medicaid eligibility using a sample of mothers with children of age zero. Recall that because we cannot identify which women are pregnant in the CPS, our main analyses are based on a measure *of in utero* eligibility that is derived by estimating which women between the ages of 15 and 44 would be eligible if they were to get pregnant. Since only about 10% of women in the CPS will be pregnant in a given year during our sample period (Currie and Gruber, 1996a), the sample may not yield an accurate approximation of the income distribution among women who were actually pregnant.[27] If we instead determine eligibility for a sample of mothers with children of age zero, we ensure that we are capturing the distribution of income among families who have recently added a child. On the other hand, a drawback of measuring *in utero* eligibility

indicator that emergency contraceptives can be provided over-the-counter, and an indicator that minors may consent to contraceptive services in all or limited circumstances.

[26] Cumulative adult Medicaid eligibility is calculated based on the mother's state of birth, year of birth, and age at child's birth using a similar simulated instrument methodology as in our main analysis.

[27] Using the full sample of women, rather than conditioning on pregnancy status, may be preferred if fertility decisions are related to Medicaid generosity, which would cause the sample of pregnant women to be endogenously determined. However, existing evidence suggests there are no large effects of the 1980-1990s Medicaid eligibility expansions on contemporaneous fertility decisions (e.g. Zavodny and Bitler, 2010; DeLeire, Lopoo, and Simon, 2011).

using a sample of mothers with children who are already born is that there are often substantive shifts in family income after the birth of a child. We estimate larger effects when we use this alternative eligibility measure.

In the next column, we attempt to isolate the changes in Medicaid eligibility that were driven by changes in federal and state Medicaid policy from changes in Medicaid eligibility that resulted from changes in AFDC eligibility criteria. This is an important sensitivity check because state changes to AFDC eligibility criteria affected not only the receipt of Medicaid, but also the receipt of AFDC cash benefits, which may have an independent effect. We use as an alternative instrument a measure of simulated eligibility constructed only from state and federal policies that changed eligibility for Medicaid; fixing state policies regarding AFDC eligibility as they were in 1979, but incorporating changes to Medicaid eligibility operating through optional state Medicaid programs and federally mandated Medicaid expansions for low-income pregnant women. The modified instrument produces an estimate for very low birth weight that is similar to the main estimate. The estimate for average birth weight is slightly attenuated and no longer statistically significant, but similar in magnitude to the main specification. This suggests that the estimates in Table 1 are not driven primarily by changes in eligibility for AFDC cash benefits.

The remainder of the table shows what happens to the results when we change the sample. In column 6 we expand the sample to include infants born to women up to age 36, rather than age 28. This leads to an unbalanced sample (we are only able to observe later births among our oldest cohorts) but allows us to look at outcomes for a wider range of births. Moving in the other direction, column 7 limits the sample to first births. This allows us to get a more complete picture of the outcomes for first-born children since 72% of first births are to women under age 29. These sample definitions have little effect on our estimate for very low birth weight. The average birth weight estimate is similar when the sample of mothers is extended to ages 15-36 but decreases in size when the sample is restricted to first births only. The magnitude of estimated effects on gestational outcomes also decline when the sample is restricted to first births, suggesting the possibility of biological processes that are more salient among higher parity births.[28]

When considered as a whole, the estimates in Tables 1-3 provide strong evidence that the first generation's prenatal Medicaid access increased average birth weight and reduced the incidence of very low birth weight in the second generation. The patterns in the estimates also suggest that the improvements in infant health were generated by processes that increase gestation length. This is notable because risk factors for preterm birth include maternal health characteristics such as chronic hypertension, pre-pregnancy diabetes, and obesity,[29] three conditions that have been shown to improve as a result of positive policy interventions in the *in utero* period (Institute of Medicine, US 2007; Hoynes, Schanzenbach, and Almond 2016, Miller and Wherry 2017).

Magnitudes

Our analyses indicate that *in utero* Medicaid coverage generates large improvements in second generation birth outcomes. Comparisons to our very low birth weight estimates are difficult to find in related literatures, but our low birth weight estimate is approximately half the size of Currie and Gruber's estimate of the targeted expansions' effect on the first generation's incidence of low birth weight. The result is consistent with Currie and Moretti (2007) who find that the probability of being a low birth weight infant is nearly 50 percent higher among children

[28] Notably, more disadvantaged women have higher rates of second and higher order births.
[29] See https://www.ncbi.nlm.nih.gov/books/NBK11363/

whose mothers were themselves below the low birth weight threshold. Other studies estimate smaller intergenerational birth weight correlations (Black, Devereux, and Salvanes 2007, Royer 2009) but Currie and Moretti find that poverty increases the transmission of low birth weight from mother to child.

Few studies have employed natural experiment designs to investigate multi-generational effects of early life environments, although we note that many analyses of positive early life health interventions have generated large point estimates for the first generation's long-term outcomes (e.g. Hoynes, Almond and Schanzenbach 2016, Cohodes et al. 2016). The closest study to ours is Almond and Chay (2006), who compare infant health outcomes among the offspring of black and white women who were born between the early and late 1960s, when the rapid adoption of Great Society programs (particularly Title VI of the Civil Rights Act) lead to dramatic improvements in black infants' health conditions. The treated generation's access to better quality care reduced the black-white gap in very low birth weight incidence among the second generation by 30%.

The only other multi-generational examination of a targeted early life health intervention that we are aware of is Butikofer, Loken and Salvanes' (2016) study of the 1930s roll-out of Norwegian mother and child health care centers. Like the Medicaid program, the centers served a broad population. Services targeted the postnatal period, with the provision of free infant check-ups and advice to mothers on infant nutrition, and tools to decrease infant mortality. Access to these services improved treated cohorts' later life health and earnings. In addition, it reduced intergenerational persistence in educational attainment by 10 percent.

A handful of evidence on the generational persistence of negative *in utero* health shocks also help to put our estimates in context. Comparing the offspring of cohorts conceived before, during, and after the 1918-19 flu epidemic, Richter and Robling (2013) find that for female offspring, maternal *in utero* exposure reduced the probability of college attendance by 12%, and for male offspring, paternal exposure *in utero* reduced the probability of college attendance by a similar magnitude. Interestingly, for females, second generation effects of *in utero* influenza exposure on later life educational attainment are larger than first generation impacts. Two studies investigate intergenerational persistence of health effects resulting from famine exposure. Almond et. al. (2010) use the 1959-1961 Chinese famine as a natural experiment, and find that first generation fetal exposure to malnutrition increases the incidence of low birth weight among the second generation by 8%. Using a similar approach, Painter et. al. (2008) find that the children of cohorts who were exposed *in utero* to the 1944-1945 Dutch famine were almost twice as likely to experience poor health in later life as the offspring of unexposed cohorts. Black et. al. (2013) investigate long-term effects of *in utero* exposure to radiation using geographic and time variation in nuclear weapons testing in 1950s and 1960s Norway. They find that more than half of the adverse cognitive effects of *in utero* radiation exposure is passed from treated fathers to their sons. The intergenerational correlation coefficient of the effect of radiation exposure is 0.625.

Taken together, the weight of the evidence is that early childhood environments generate substantive spillover effects onto later generations. While differences in research settings, time frame, and outcomes examined make it difficult to make exact comparisons, our estimates are consistent with large, persistent benefits of health interventions suggested by the most related research.

Mechanisms

What are the mechanisms by which prenatal Medicaid access leads to improved health in the second generation? One possible channel is through changes in fertility.[30] The same (or related) biological processes that generated later life improvements in the first generation's health may have also affected the first generation's fecundity. Another channel is through the *composition* of women giving birth. For example, if children are a normal good then increases in the first generation's earnings might also lead to increases in the desired number of children. On the other hand, improvements in the first generation's economic opportunities may have lead to delays in childbearing, as has been posited by Brown, Kowalski, and Lurie (2017).

We investigate these different possibilities in Table 4. We estimate regressions similar to equation (1) replacing the dependent variable with measures of total fertility and maternal characteristics (age, educational attainment, marital status and race).[31] The results suggest that *in*

[30] It is important to note that we are not able to measure total fertility, because we only observe women between the ages of 15 and 28 in our main sample.

[31] Two of the outcomes analyzed in this section (mother's educational attainment and prenatal care utilization) were affected by the introduction of the 2003 revision of the U.S. Standard Certificate of Live Birth during the period covered by our analyses. State adoption of the revision is staggered over the period. . By January 2011, 36 states and the District of Columbia had implemented the revised birth certificate. These states represent 83 percent of births to U.S. residents (Center for Disease Control and Prevention, 2011). Starting in 2011, the CDC no longer made available certain data items from the unrevised birth certificate, including maternal education and prenatal care utilization. As a result, information on these variables is incomplete, and only available for states that had fully implemented the 2003 revision. Fourteen states in 2011, 12 states in 2012, 9 states in 2013, 3 states in 2014, and 2 states in 2015 have incomplete information for these data fields. Our main analyses use data from all states and all years, but as a sensitivity check, we also run the main analyses excluding births to mothers who were themselves born in any of the states with incomplete data (Appendix Table 7). This does not meaningfully change our main results. In addition, even when the data fields are available, these two measures are not considered comparable before and after the revision. Prior to the revision, mother's education was classified into years of education: no formal education, 1-8 years of elementary school, 1-4 years of high school, 1-4 years of college, and 5 or more years of college. The 2003 revision classified mother's education into the following categories: 8th grade or less; 9th through 12th grade with no diploma; high school graduate or GED completed; some college credit, but not a degree; associate degree; Bachelor's degree; Master's degree; and, doctorate or professional degree. In our analyses, we code high school or less as having at least 4 years of high school under the 1989 revision, and being a high school graduate or having a GED completed under the 2003 revision. We also address this incomparability after the revision by including in regressions for which maternal education or prenatal care utilization are dependent variables, a measure of the fraction of birth records in that cell (mother's birth year x state of birth) with a revised birth certificate. Also, to be sure that the timing of state implementation of the 2003 revision is not correlated with a cohort's exposure to Medicaid, we run our model with the share of revised birth certificate records for each mother's birth year and birth state cell on the left hand side. We find no evidence of a correlation (see Appendix Table 7).

utero Medicaid access had no effect on the overall number of births, the probability of delaying first birth, or the average number of births per mother.[32,33]

Although we do not find changes in overall fertility, we do find that the effect of expanding first generation *in utero* coverage shifted the racial composition of second generation births: specifically, the 6.8 percentage point increase in *in utero* Medicaid eligibility during our time period increased the fraction of births to white mothers by 0.4% and reduced the fraction of births to non-white mothers by 1.3%.[34] White infants are typically healthier than non-white infants, so, to gauge the extent to which a Medicaid induced shift towards white births contributes to the estimates in Table 1, we perform the following calculation: first, we assume that Medicaid did not have a direct effect on second generation infant health. We then multiply the mean of the race-specific infant health outcome in the pre-treatment period (1979) by the change in the fraction of births to each race. This provides an estimate of the overall change in the second generation's health that results purely from compositional shifts. Details behind these calculations are provided in Appendix Section E. We find that, at most, about 6% of the improvement in very low birth weight and 17% of the change in average birth weight can be attributed to changes in who is giving birth.

[32] Appendix Tables 9, 10, and 11 report estimates corresponding to Tables 4, 5, and 6 for Medicaid eligibility between the ages of 1 and 18.

[33] This result contrasts with Brown, Kowalski, and Lurie (2017), who find that childhood exposure to Medicaid reduces fertility before age 28, particularly between ages 18 and 22. Our approach and data differ from theirs in a number of ways, however. First, we observe the universe of all births for our cohorts, rather than births recorded on tax filings. This may be important, as many low-income individuals do not file taxes. Second, our analyses focus on measures of *in utero* eligibility that are not incorporated as part of Brown, Kowalski, and Lurie's study. Third, Brown, Kowalski, and Lurie use tax data that allows them to identify individuals in households that would have likely been affected by the expansions, whereas we use cohort-level measures of treatment. Finally, their analyses consider cohorts born between 1981 and 1984, whereas we focus on cohorts born between 1979 and 1986. These differences likely account for the differences in our findings.

[34] We obtain these estimates by multiplying the estimates in Table 4 by the change in prenatal eligibility induced by the Medicaid expansions (6.8 percentage points) and dividing by the fraction of births comprised by each racial group in our sample.

Subgroup analyses provided in Table 5 also confirm that our main estimates are not driven solely by changes in composition. Within each racial group, the effects on average birth weight are similar to the full sample in Table 1, although they are less precisely estimated. This lends credence to the hypothesis that effects on the second generation's health are mostly due to changes in mothers' health or behaviors, rather than selection into fertility. Interestingly, the effect on the incidence of very low birth weight among blacks is three times the effect for whites. This is consistent with previous studies' findings that, compared to first generation white children, the Medicaid expansions had relatively larger effects on blacks (Miller and Wherry 2017).

Next, we investigate the extent to which the estimates may be attributed to Medicaid's effect on the first generation's adult income. To do this, we rely on point estimates from multiple studies, acknowledging that estimates in the related literature are often quite large and accompanied by large confidence intervals. We begin with Miller and Wherry's (2017) finding that *in utero* Medicaid eligibility under the targeted expansions generated an increase in annual personal income of 20 percent between ages 23 and 36, or approximately $5,974 (2009$s). Using our estimated take-up rate of 0.70, this translates into a TOT estimate of $8,534. Putting this together with Hoynes, Miller, and Simon's (2015) estimate that a $1000 increase in EITC income (2009$s) increases average birth weight by around 6.4 grams, suggests that Medicaid induced improvements in parental income should increase average birth weight by 55 grams. This estimate is close to our TOT estimate, and suggests that Medicaid's long run effect on the first generation's income may be an important mediator. When we apply the same calculation to Hoynes, Miller and Simon's low birth weight estimates, we find that Medicaid induced increases in parental income would be expected to reduce the incidence of low birth weight in the second generation by about 2 percentage points, which is larger than our insignificant estimate. Although these calculations are based on an imprecise set of estimates, they suggest that the program's effect on the first generation's income is likely to be an important mediator.

Finally, we use information recorded on the birth certificate to examine how *in utero* Medicaid affects maternal health and health behaviors in later life.[35] As reported in Table 6, there are no statistically significant effects on the first generation's use of prenatal care or self-reported use of tobacco or alcohol during pregnancy. Nor is there a significant effect on diabetes, chronic or pregnancy-related hypertension, or eclampsia. We note, however, that health conditions reported on birth certificates are relatively limited, and are known to be underreported (Lain et al., 2012). Analyses of other health data have found that early life Medicaid eligibility is associated with better health outcomes in adulthood (e.g., Thompson, 2017, Miller and Wherry, 2017).

VI. Discussion

This paper advances the "early origins" literature by investigating multi-generational effects of early life health environments. We present new evidence that expanding health related services *in utero* has persistent impacts on later generations' health. Specifically, we use

[35] See footnote 29 for a description of how these analyses are affected by the 2003 revision to the U.S. Standard Certificate of Life Birth. In addition, information on alcohol and tobacco use is not available on the birth certificate for all states and years. Alcohol use is only available through 2006. Therefore, we examine reported alcohol use only for cohorts between the ages of 15-19. Information on tobacco use is available through 2008. For this outcome, we examine reported use at ages 15-21. Information on cigarette use is available for all years, but not all states. In addition, the questions regarding cigarette use differ before and after the 2003 revision. Prior to the revision, cigarette use refers to any use during pregnancy. Following the revision, cigarette use is asked about by trimester of pregnancy. We have coded cigarette use as any use during pregnancy (prior to revision) or any trimester during pregnancy (after revision). All regressions with cigarette use as the dependent variable include a variable indicating the share of birth records with the 2003 revision in a given mother's year of birth and state of birth cell. Finally, to confirm that the availability of any of these outcomes is not correlated with state Medicaid policy, we have also run our main regression model with the share of birth records that have alcohol, tobacco, and cigarette use information as the dependent variable. We find no evidence of a relationship with Medicaid eligibility (see Appendix Table 8).

variation induced by the 1980s targeted Medicaid expansions and find that greater *in utero* eligibility leads to significant reductions in the incidence of very low birthweight and increases in average birth weight among later offspring. We find no evidence that Medicaid-induced shifts in the composition of second generation births drive our results. Further, we provide suggestive evidence that birth weight improvements are generated by changes in underlying (unobserved) health processes that are associated with extreme prematurity. These results are robust to a number of specification tests, including controlling for second generation environmental conditions, alternative definitions of *in utero* eligibility, and using different samples of mothers.

The exact mechanisms that lead to multi-generational linkages are not clear. Animal experiments provide biological evidence that the importance of early life health environments extends beyond treated generations, and there is growing evidence from these experiments that in at least some settings, epigenetics play a role. Such processes are obviously harder to document in humans, where corresponding experiments are nearly impossible to invoke, but our some of our calculations suggest that Medicaid induced improvements in the first generation's economic outcomes may also be an important mechanism driving later generations' health gains.

Our analyses offer a fresh perspective on health inequalities and the potential role for government intervention. Generational persistence in the impacts of early life environments suggest that historical differences in fetal health conditions between advantaged and disadvantaged groups may undermine contemporaneous efforts to close health and economic gaps. At the same time, our results indicate that early life health investments have payoffs that extend well beyond those that social policymakers usually consider. It is notable that Medicaid's second generation effects are observed among cohorts who were born during roughly the same time frame for which recent studies by Aizer and Currie (2014) and Currie and Schwandt (2016a, 2016b) document large improvements and declining health inequality among children. Investigating a more complete range of program benefits to later generations is an important goal of future work, and is critical in light of increasing debates about the efficacy of the U.S. safety net.

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Table 1:
Effects of Mother's Childhood Medicaid Exposure on Infant Health

	Length of gestation	Preterm birth	Average birth weight	Low birth weight	Very low birth weight	Small for gestational age
			Panel A: Without state trends			
In-utero eligibility	0.082	-0.000	30.498*	-0.005	-0.002	-0.008
	(0.089)	(0.006)	(17.925)	(0.006)	(0.002)	(0.007)
Eligibility at ages 1-18	0.005	-0.001**	2.554**	-0.000	-0.000	0.000
	(0.005)	(0.000)	(1.245)	(0.000)	(0.000)	(0.000)
			Panel B: With state trends			
In-utero eligibility	0.065	-0.009	36.003**	-0.007	-0.007***	-0.003
	(0.071)	(0.010)	(17.626)	(0.006)	(0.002)	(0.006)
Eligibility at ages 1-18	-0.009	0.002	-0.722	0.001	-0.000	0.000
	(0.010)	(0.001)	(2.679)	(0.001)	(0.000)	(0.001)
			Panel C: With state trends and region x year fixed effects			
In-utero eligibility	0.097	-0.011	43.853***	-0.007	-0.007***	0.001
	(0.064)	(0.007)	(16.211)	(0.006)	(0.002)	(0.007)
Eligibility at ages 1-18	-0.017	0.003**	-2.708	0.002*	0.000	0.000
	(0.012)	(0.002)	(3.037)	(0.001)	(0.000)	(0.001)
Mean	38.78	0.11	3270.52	0.07	0.01	0.09

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). When indicated, regressions include mother's state of birth linear trends in mother's birth year, and/or mother's region of birth by mother's year of birth fixed effects. Robust standard errors are clustered by mother's state of birth.

Table 2:
Effects of Parental Medicaid Access: Alternative Specifications

	Main specification	Second generation state-year controls: State-year characteristics	Child's prenatal eligibility	Mother's cumulative adult eligibility	All three state-year controls
Outcome: Length of gestation					
In-utero eligibility	0.097	0.075	0.093	0.097	0.083
	(0.064)	(0.093)	(0.063)	(0.062)	(0.095)
Outcome: Preterm birth					
In-utero eligibility	-0.011	-0.004	-0.011	-0.011*	-0.004
	(0.007)	(0.011)	(0.007)	(0.007)	(0.012)
Outcome: Average birth weight					
In-utero eligibility	43.853***	35.011	42.248***	43.760***	37.774
	(16.211)	(22.415)	(16.054)	(15.305)	(23.160)
Outcome: Low birth weight					
In-utero eligibility	-0.007	-0.009	-0.007	-0.007	-0.010
	(0.006)	(0.008)	(0.006)	(0.006)	(0.009)
Outcome: Very low birth weight					
In-utero eligibility	-0.007***	-0.006*	-0.007***	-0.007***	-0.006
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Outcome: Small for gestation age					
In-utero eligibility	0.001	0.006	0.001	0.001	0.008
	(0.007)	(0.009)	(0.007)	(0.007)	(0.010)

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Second generation state-year controls are also included when indicated and are described in more detail in the text and appendix. Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. Robust standard errors are clustered by mother's state of birth.

Table 3:
Effects of Parental Medicaid Access: Alternative Specifications

	Main specification	Unweighted	Weighted by number of births	Alternative prenatal measure	Medicaid policy-only variation	Ages 15-36	First births only
Outcome: Length of gestation							
In-utero eligibility	0.097	0.134	0.106*	0.190**	0.126*	0.102*	-0.014
	(0.064)	(0.106)	(0.061)	(0.096)	(0.077)	(0.057)	(0.067)
Outcome: Preterm birth							
In-utero eligibility	-0.011	-0.020*	-0.011*	-0.021*	-0.006	-0.011*	0.013
	(0.007)	(0.011)	(0.006)	(0.013)	(0.009)	(0.007)	(0.008)
Outcome: Average birth weight							
In-utero eligibility	43.853***	57.271**	45.386***	79.854**	30.799	39.524***	9.479
	(16.211)	(22.856)	(14.466)	(31.815)	(20.100)	(14.758)	(21.256)
Outcome: Low birth weight							
In-utero eligibility	-0.007	-0.014	-0.008	-0.016*	0.000	-0.006	0.005
	(0.006)	(0.009)	(0.006)	(0.009)	(0.009)	(0.006)	(0.009)
Outcome: Very low birth weight							
In-utero eligibility	-0.007***	-0.006*	-0.007***	-0.012***	-0.006**	-0.006***	-0.007**
	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)
Outcome: Small for gestation age							
In-utero eligibility	0.001	-0.001	0.001	-0.002	0.010	-0.003	-0.002
	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)	(0.006)	(0.010)

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28 (unless otherwise indicated). Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size unless otherwise indicated. Regressions include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. Robust standard errors are clustered by mother's state of birth.

Table 4:

Effects of Mother's Childhood Medicaid Exposure on Fertility and Mother's Characteristics

	Total Birth Rate	First Birth Rate	Age at First Birth	Average Number of Births	High School Graduate	Married	White	Black	Other
In-utero eligibility	0.079	0.030	-0.511	-0.035	-0.035	-0.013	0.047***	-0.027*	-0.020**
	(0.057)	(0.028)	(0.364)	(0.044)	(0.022)	(0.016)	(0.016)	(0.016)	(0.010)
Mean	1.01	0.51	21.87	1.77	0.76	0.45	0.76	0.21	0.03

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the outcome of high school graduation. Robust standard errors are clustered by mother's state of birth.

Table 5:
Effects of Mother's Childhood Medicatid Exposure on Infant Health by Subgroups

	Black	White	Other	Teen	Nonteen	High School Dropout	High School Graduate	Married	Unmarried
Outcome: Length of gestation									
In-utero eligibility	0.210	0.043	-0.419	-0.021	0.129*	0.248*	0.067	0.013	0.174
	(0.149)	(0.076)	(0.493)	(0.165)	(0.072)	(0.148)	(0.087)	(0.080)	(0.111)
Mean	38.33	38.90	38.79	38.90	38.78	38.69	38.81	38.89	38.69
Outcome: Preterm birth									
In-utero eligibility	-0.008	-0.008	0.019	0.012	-0.018**	-0.039	-0.019	-0.007	-0.024**
	(0.021)	(0.008)	(0.065)	(0.017)	(0.008)	(0.024)	(0.013)	(0.009)	(0.012)
Mean	0.16	0.10	0.11	0.13	0.11	0.14	0.10	0.09	0.13
Outcome: Average birth weight									
In-utero eligibility	42.483*	30.094	52.366	46.391	47.225***	54.383	81.613***	57.824**	34.560*
	(23.253)	(20.126)	(157.396)	(37.298)	(16.839)	(37.254)	(26.830)	(24.528)	(20.288)
Mean	3092.22	3318.37	3262.30	3211.99	3288.33	3184.75	3297.08	3345.10	3210.58
Outcome: Low birth weight									
In-utero eligibility	-0.002	-0.011	0.089**	0.001	-0.010*	-0.007	-0.017**	-0.011	-0.006
	(0.014)	(0.007)	(0.042)	(0.019)	(0.006)	(0.016)	(0.008)	(0.007)	(0.010)
Mean	0.12	0.06	0.07	0.09	0.07	0.09	0.06	0.05	0.09
Outcome: Very low birth weight									
In-utero eligibility	-0.018**	-0.006**	0.023	-0.018**	-0.004	-0.018**	-0.004	-0.003	-0.013***
	(0.009)	(0.002)	(0.020)	(0.007)	(0.003)	(0.007)	(0.003)	(0.003)	(0.004)
Mean	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.02
Outcome: Small for gestation age									
In-utero eligibility	0.017	-0.002	0.071	0.004	-0.001	-0.026	0.002	-0.007	0.012
	(0.015)	(0.009)	(0.048)	(0.016)	(0.007)	(0.019)	(0.009)	(0.009)	(0.011)
Mean	0.14	0.08	0.10	0.09	0.09	0.11	0.09	0.07	0.11

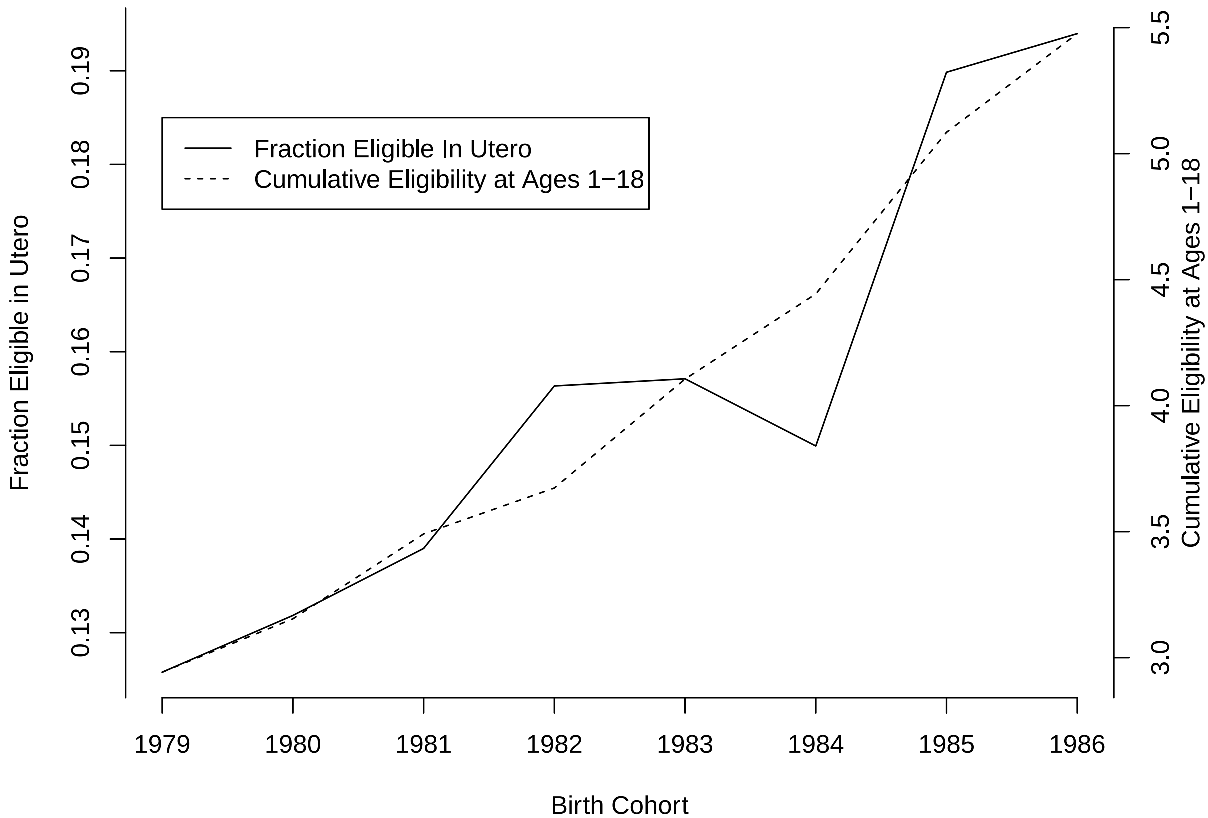
Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the models for subgroups defined by high school graduation. Robust standard errors are clustered by mother's state of birth.

Table 6:
Effects of Mother's Childhood Medicaid Exposure on Maternal Health and Behaviors

	Any Prenatal Care	Number of Prenatal Visits	Prenatal Care in First Trimester	Diabetes	Chronic Hyper-tension	Pregnancy-related Hyper-tension	Eclampsia	Alcohol use During Pregnancy	Tobacco use During Pregnancy	Cigarette use During Pregnancy
In-utero eligibility	0.001	0.210	-0.010	-0.001	0.000	0.007	0.001	-0.007	-0.019	-0.001
	(0.003)	(0.153)	(0.017)	(0.004)	(0.002)	(0.006)	(0.001)	(0.008)	(0.065)	(0.022)
Mean	0.99	11.13	0.76	0.03	0.01	0.04	0.00	0.008	0.199	0.169

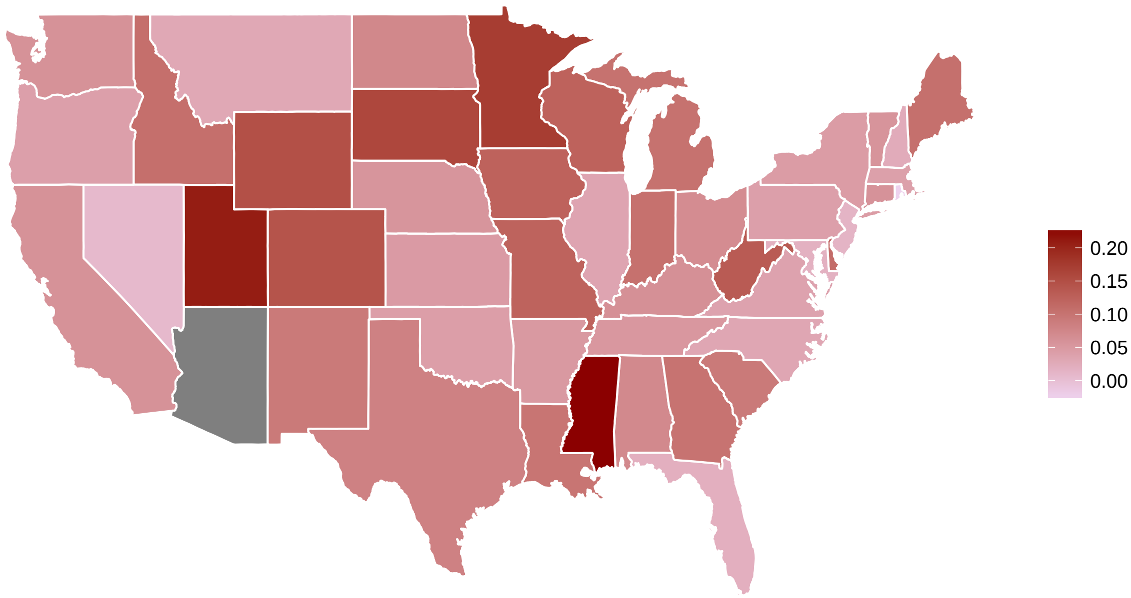
Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. The analysis for alcohol use is restricted to ages 15-19 and the analysis for tobacco use to ages 15-21. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the outcomes related to prenatal care utilization and cigarette use. Robust standard errors are clustered by mother's state of birth.

Figure 1: Trends in *In Utero* and Cumulative Childhood Eligibility by Cohort



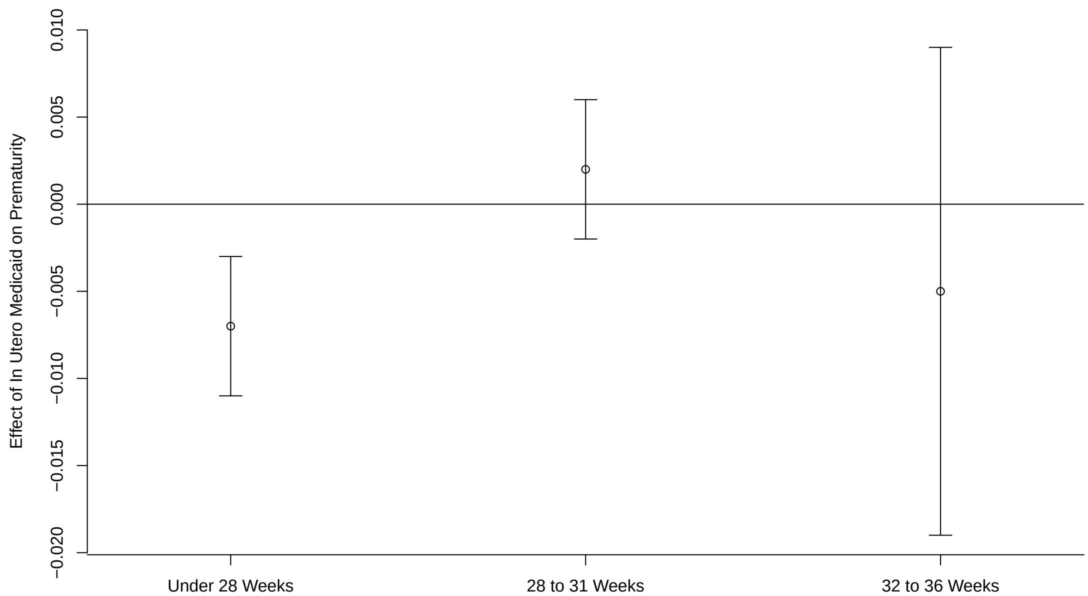
Notes: Authors' calculation from Current Population Survey and Medicaid eligibility rules. See text for further details.

Figure 2: Changes in *In Utero* Medicaid Eligibility by State, 1979 to 1986

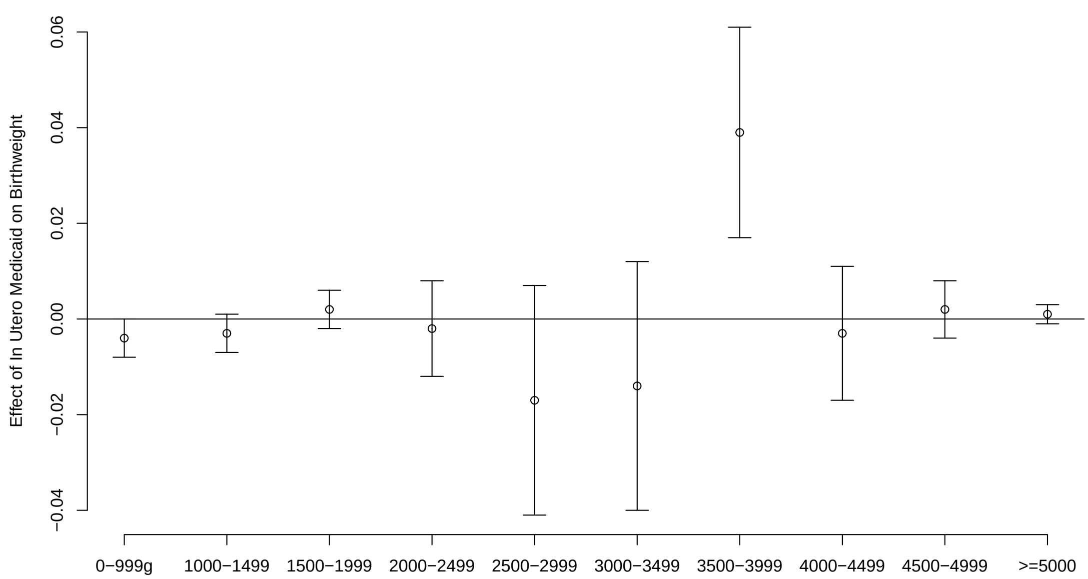


Notes: Authors' calculation from Current Population Survey and Medicaid eligibility rules. See text for further details.

Figure 3: Effect of *In Utero* Medicaid Eligibility on Length of Gestation and Birthweight



(a) Length of Gestation



(b) Birthweight

Notes: See text for details.

APPENDIX

A. Mother's Eligibility at the Time of Birth and During Childhood

Additional Details on Prenatal and Child Eligibility Expansions

Starting in the 1980s, a series of acts by Congress expanded eligibility to pregnant women and children who were not traditionally eligible for AFDC and with family income levels exceeding AFDC cutoffs. These eligibility changes were first introduced as a state option and later by federal mandate. In addition the eligibility changes were first more "targeted" (following the terminology first used by Currie and Gruber 1996b) to the lowest income pregnant women and children – those whose families met the income and resource eligibility criteria for AFDC but who did not otherwise meet the family structure requirements for the AFDC program. The later "broad" eligibility expansions extended eligibility to pregnant women and children with incomes that exceeded the AFDC eligibility levels. These expansions occurred beginning in the late 1980s and through the early 1990s. Eligibility levels for pregnant women and children continued to grow during the 1990s as Medicaid eligibility changes continued to be phased in, and later through the 2000s under optional state expansions to higher income pregnant women and children under the Children's Health Insurance Program (CHIP). Please see Appendix Table 1, recreated from Miller and Wherry (2017), for details on the federal legislation authorizing these expansions.

Construction of Eligibility Measures

To construct measures of the mother's eligibility at time of birth and during childhood (ages 1-18), we used detailed eligibility rules compiled by state and year for eligibility under AFDC qualifying criteria (including AFDC-Unemployed Parents), state Ribicoff rules and Medically Needy programs, and federal and state Medicaid expansions between 1979 and 2005. Eligibility was estimated using the year of the eligibility determination and family characteristics, including family structure, income, and information on parental employment.

We used the 1980-1987 Annual Social and Economic Supplements (ASEC) of the Current Population Survey (CPS) to estimate mother's eligibility for public health insurance at the time of birth. This measure of prenatal eligibility was estimated using women ages 15-44 and determined their eligibility in event of a pregnancy by state and year during the period 1979-1986. To construct a simulated eligibility measure, we drew national sample of 3,000 women ages 15-44 for each year and estimated eligibility for this sample using state-specific eligibility rules during that year.

We used the 1981-2005 ASEC to estimate eligibility for childhood Medicaid coverage by single year of age for cohorts born between 1979-1986. We assumed that birth year was equal to calendar year minus age in order to estimate eligibility by birth year x age x state. These estimates were then added across ages 1-18 in order to create a measure of cumulative childhood eligibility for each birth year x state. To construct a simulated eligibility measure, we used a national sample of 1,000 children of each age for each year and estimated eligibility for this sample using state-specific eligibility rules during that year.

Source Information for Eligibility Rules

For the years 1979 to 1996, Medicaid eligibility is calculated under the eligibility rules for the AFDC and the AFDC-Unemployed Parents (AFDC-UP) programs, optional state programs (e.g. Ribicoff children, Medically Needy), and poverty-related expansions for pregnant women and children. For the years 1997 to 2004, public eligibility under Medicaid and CHIP are calculated under the rules for Medicaid Section 1931 eligibility, poverty-related Medicaid expansions and additional Medicaid expansions or new state programs under CHIP.

AFDC and AFDC-UP program parameters for 1979-1996 were provided by the Urban Institute through their Transfer Income Model, version 3 (TRIM3), which may be accessed at http://trim3.urban.org/T3Welcome.php. Using these parameters, we were able to calculate whether a family was eligible for either program based on state rules, monthly total family income and family size.

Optional state programs include Ribicoff children, under which children may meet the financial standards for AFDC but do not qualify on the basis of family structure. Information on Ribicoff children programs for 1988 forward were drawn from materials provided by Bruce Meyer and used in Meyer and Rosenbaum (2001). Rules for earlier years were drawn from the TRIM3 model, as well as from the 1983 Health Care Financing Administration (HCFA)'s *Analysis of State Medicaid Program Characteristics* report. State rules regarding coverage of unborn children under Ribicoff programs, which meant coverage of pregnant women whose income qualified them for AFDC, were taken from the 1983 HCFA report as well.

General information on state options for Medicaid coverage for pregnant women prior to 1985 was drawn from the Appendix in Currie and Gruber (1995). Detailed information on states exercising options under AFDC to cover women with a first-time pregnancy, options under AFDC-UP to cover pregnant women in a two-parent family where the principal earner is unemployed, and later to provide pregnant women not yet qualifying for AFDC benefits with Medicaid were taken from the sources below.

- 1978-1981 *Characteristics of State Plans for Aid to Families with Dependent Children* reports published by the Department of Health and Human Services
- Hill IT. *Broadening Medicaid Coverage of Pregnant Women and Children*. Washington, DC: National Governors' Association; 1987.

State Medically Needy thresholds were drawn from TRIM3, Hill (1987), and the 1981, 1983, 1984, and 1986 *Medicare and Medicaid Data Books* issued by the Health Care Financing Administration.

Finally, information on federally mandated changes in eligibility were collected from a variety of sources (see Appendix Table A.1). Information on expansions in eligibility by state, including the population targeted, implementation date, and income cutoffs under the poverty-related Medicaid - and later CHIP-related expansions - were compiled from the sources below. Income disregard rules by state and year were downloaded from the Urban Institute's TRIM3 database.

- Maternal and Child Update, National Governors Association: 9/97, 9/98, 2/99, 1/00, 2/01, 2/02, 2/03, accessed here: http://www.nga.org/cms/home/nga-center-for-best-practices/center-publications/page-health-publications/col2-content/main-content-list/maternal-and-child-health-mch-up.html
- Enrollment Increases in State CHIP Programs: December 1998 to June 1999, prepared by Vernon K. Smith at Health Management Associates for the Kaiser Commission on Medicaid and the Uninsured, July 30, 1999
- *Implementation of the State Children's Health Insurance Program: Momentum is Increasing After a Modest Start: First Annual Report*, January 2001 report prepared by Mathematica Policy Research, Inc. by Rosenbach, et al.
- Kaiser Commission on Medicaid and the Uninsured (mostly) annual surveys of state Medicaid/CHIP programs beginning in 2000: available for years 2000, 2002, and 2003-2004 at http://www.kff.org/medicaid/50StateSurvey.cfm

B. Mother's Adult Eligibility

When examining public health insurance eligibility for mothers during adulthood, we consider eligibility for low-income parents under Medicaid Section 1931 criteria in each state, as well as expanded eligibility for health care coverage for parents and childless adults under both waiver and state-funded programs. Information on state eligibility thresholds for coverage for adults for the years 1998-2015 were compiled from the sources listed below.

Sources of Eligibility Criteria

- Maternal and Child Update, National Governors Association: 2002 through 2010 reports, accessed here: http://www.nga.org/cms/home/nga-center-for-best-practices/center-publications/page-health-publications/col2-content/main-content-list/maternal-and-child-health-mch-up.html
- Kaiser Commission on Medicaid and the Uninsured annual surveys of state Medicaid/CHIP programs: 2002-2005, 2007-2009, and 2011-2013, 2015 reports, accessed here: http://www.kff.org/medicaid/50StateSurvey.cfm
- Broaddus M, Blaney S, Dude A, Guyer J, Ku L, Peterson J. *Expanding Family Coverage: States' Medicaid Eligibility Policies for Working Families in the Year 2000*. Washington, DC: Center on Budget and Policy Priorities; 2001.
- Busch SH, Duchovny N. Family coverage expansions: Impact on insurance coverage and health care utilization of parents. *Journal of Health Economics*. 2005;24(5):876-890.
- Hearne J. *Medicaid Eligibility for Adults and Children*. Washington, DC: Congressional Research Service, The Library of Congress; 2005.

- Indiana Legislative Services Agency. *The Healthy Indiana Plan and Health Coverage of Childless Adults Across the States*. Indianapolis, IN: Health Finance Committee, Indiana Legislative Services Agency; 2011.
- National Conference of State Legislatures. State Health Programs to Covered the Uninsured, 2009-10. 2010. Available at: http://www.ncsl.org/research/health/state-health-programs-to-cover-the-uninsured-2009.aspx. Accessed May 19, 2014.
- National Conference of State Legislatures. Using Medicaid Dollars to Cover the Uninsured: States Use of Medicaid Dollars to Cover the Uninsured. 2009. Available at: http://echealthinsurance.com/public-assistance/medicaid-coverage-information/using-medicaid-dollars-to-cover-the-uninsured/. Accessed May 19, 2014.
- Somers SA, Hamblin A, Verdier JM, Byrd VL. *Covering Low-Income Childless Adults in Medicaid: Experiences from Selected States*. Center for Health Care Strategies, Inc.; 2010.

Federal law for family coverage under Section 1931 requires that states disregard at least $90 of earned income per month when assessing Medicaid eligibility (Birnbaum 2000). In 2000, most states were using this minimum earnings disregard in eligibility determinations (Broaddus et al. 2001). Therefore, we chose to apply this rule for all states for the years 1998-2013. For 2014-2015, following the implementation of the Affordable Care Act Medicaid expansions, a standard disregard of five percentage points of the federal poverty level is built into the eligibility thresholds.

We construct a measure of average cumulative adult Medicaid eligibility from age 19 to the current age by state, age, and birth year cohort. This measure is constructed using a sample of adults of ages 19-28 from each year of the 1999-2016 Annual Social and Economic Supplements (ASEC) of the Current Population Survey (CPS). As with our measures of childhood eligibility, we instrument for actual cumulative adult eligibility with a simulated adult eligibility measure. This measure is constructed using a national sample of 1,000 adults per year of age and survey year.

C. Mother's Prenatal Eligibility at the Time of Infant's Birth

To calculate mother's prenatal eligibility at the time of infant's birth, we use the eligibility rules under Medicaid Section 1931 eligibility, poverty-related Medicaid expansions for pregnant women, expanded Medicaid rules authorized under the Balanced Budget Act of 1997, and separate state programs created under the State Children's Health Insurance Program over the period 1989-2015. Income eligibility cutoffs by state and year were compiled from the sources listed under Appendix Sections A and B.

We use the 1990-2016 Annual Social and Economic Supplements (ASEC) of the Current Population Survey (CPS) to estimate mother's eligibility for public health insurance at the time of infant's birth. This measure of prenatal eligibility was estimated using women ages 15-44 and determined their eligibility in event of a pregnancy by state and year during the period 1980-2015. To construct a simulated eligibility measure, we drew national sample of 3,000 women ages 15-44 for each year and estimated eligibility for this sample using state-specific eligibility rules during that year.

D. State-Year Control Variables at the Time of Infant's Birth, 1989-2015

In certain specifications, we control for state demographic, economic, and policy characteristics in the child's year of birth. Specifically, we include the following demographic controls: the fraction of the state population between the ages of 0-4, 5-17, 18-24, 25-44, 44-64; state fraction black and claiming a race other than white or black; state fraction with a high school degree, some college, college or more. These were constructed by the authors using ASEC data.

We include the following economic controls: state median household income (from the U.S. Bureau of Labor Statistics) and unemployment rate (from the U.S. Census Bureau).

We include the following measures of welfare generosity: maximum welfare benefits, state welfare family cap; whether the state had an EITC program, whether the state had implemented TANF. The sources are:

- Crouse, Gil. 1999. "State Implementation of Major Changes to Welfare Policies, 1992-1998." Office of Human Services Policy, ASPE, U.S. Department of Health and Human Services
- Urban Institute TRIM3 Program Rules for 1990-1995
- Urban Institute Welfare Rules Database for 1996-2015
- NBER TAXSIM: http://users.nber.org/~taxsim/state-eitc.html
- Tax Credits for Working Families: http://www.taxcreditsforworkingfamilies.org/earned-income-tax-credit/states-with-eitcs/
- Urban Institute Tax Policy Center
- University of Kentucky Center for Poverty Research National Welfare Data, 1980-2015: http://www.ukcpr.org/data

We include the following measures of family planning coverage: state parental and notification laws for abortion, mandatory delay for abortion laws; state Medicaid restrictions for abortion; income based and duration based Medicaid family planning waivers; state mandate for private health insurance coverage of contraceptives; an indicator that emergency contraceptives can be provided over-the-counter; an indicator that minor may consent to contraceptive services in all or limited circumstances. The sources are:

- *Our Daughters' Decision: The Conflict in State Law on Abortion and Other Issues* by Patricia Donovan, The Alan Guttmacher Institute 1992.
- "Minors and the Right to Consent to Health Care" by Heather Boonstra and Elizabeth Nash, *The Guttmacher Report on Public Policy,* August 2000
- State Policies in Brief from the Guttmacher Institute on Medicaid Family Planning Eligibility Expansions, Minors' Access to Contraception, State Funding of Abortion Under Medicaid, Mandatory Waiving Periods for Abortion and Parental Involvement in Minors' Abortions

- Kearney, Melissa S. and Phillip B. Levine. 2009. "Subsidized Contraception, Fertility, and Sexual Behavior." *Review of Economics and Statistics* 91(1): 137-151
- Insurance Coverage for Contraception Laws by the National Conference of State Legislatures
- Oza, Anjali D. The Economics of Emergency Contraception. 2010. University of Chicago PhD Dissertation.
- Levine, Phillip. 2004. Sex and Consequences: Abortion, Public Policy, and the Economics of Fertility

E. Magnitude of Racial Composition Shifts

In order to determine how much of the effects on infant health may be due to changes in the racial composition of women giving birth, we conduct the following back of the envelope calculation. First, the point estimates in Table 4 indicate the 6.8 percentage point increase in mothers' *in utero* eligibility increased the fraction of white births by 0.3 percentage points and reduced the fraction of births to black women and women of other races by 0.2 and 0.1 percentage points, respectively. If we apply these estimates to the race specific averages reported in Table 5, we predict an increase in average birth weight of 0.5 grams and a decrease in the likelihood of very low birth weight by 0.003 percentage points, due solely to the expansion's effect on the racial composition of births. Of the total effects of a 6.8 percentage point increase in eligibility on average birth weight and very low birth weight, the changes in racial composition explain at most 17% (average birth weight) and 6% (very low birth weight).

Appendix Table 1

Federal Legislation Expanding Public Health Insurance Eligibility for Pregnant Women, Infants and Children

Year	**Legislation**	**Date Effective**	**Mandatory Expansion**	**State Option**
1984	Deficit Reduction Act, 1984 (DEFRA)	1-Oct-84	First-time pregnant women and those in two-parent families whose principal earner was unemployed, as well as children under age 5 born after September 30, 1983 whose families are income and resource eligible for AFDC	
1985	Consolidated Omnibus Budget Reconciliation Act, 1985 (COBRA)	1-Jul-86	Pregnant women whose families are income and resource eligible for AFDC	
1986	Omnibus Budget Reconciliation Act, 1986	1-Apr-87		Pregnant women and infants in families with incomes below 100%
		1-Oct-87		Increase age level by 1 year each FY for all children under age 5 with incomes below 100% FPL
1987	Omnibus Budget Reconciliation Act, 1987	1-Jul-88		Pregnant women and infants in families with incomes below 185% Children under age 2, 3, 4, or 5 and born after September 30, 1983 in families with incomes below 100% FPL
		1-Oct-88	Children under age 7 born after September 30, 1983 whose families are income and resource eligible for AFDC	Children under age 8 born after September 30, 1983 whose families are income and resource eligible for AFDC Children under age 8 born after September 30, 1983 with incomes below 100% FPL
1988	Medicare Catastrophic Coverage Act, 1988 (MCCA)	1-Jul-89	Pregnant women and infants in families with incomes below 75% FPL	
		1-Jul-90	Pregnant women and infants in families with incomes below 100% FPL	
1989	Omnibus Budget Reconciliation Act, 1989 (OBRA89)	1-Apr-90	Pregnant women and children under age 6 with family incomes below 133% FPL	
1990	Omnibus Budget Reconciliation Act, 1990 (OBRA90)	1-Jul-91	Children under age 19 born after September 30, 1983 with incomes below 100% FPL	
1996	Personal Responsibility and Work Opportunity Act of 1996 (PRWORA)	1-Jul-97	Established "Section 1931" family coverage category with minimum eligibility critera based on 1996 AFDC eligibility standards	Families with children at higher income levels
1997	Balanced Budget Act (BBA)	5-Aug-97		Children under age 19 in families with incomes below 200% FPL or higher

Notes: Reproduced from Miller and Wherry (2017). Legislative history is compiled from Congressional Research Service (1988, 1993), Kaiser Family Foundation (2002), Currie and Gruber (1994), Gruber (2003), and Broaddus et al. (2001).

Appendix Table 2
Descriptive Statistics

Variable	Mean
Infant health	
Gestation length	38.779
Preterm birth	0.110
Birth weight	3270.524
Low birth weight	0.071
Very low birth weight	0.012
Small for gestational age	0.093
Fertility	
Birth rate	1.010
First birth rate	0.511
Number of births	1.766
Age at first birth	21.875
Mother's characteristics	
High school graduate	0.759
Married	0.453
White	0.762
Black	0.210
Other race	0.028
Mother's health and behaviors	
Diabetes	0.028
Chronic hypertension	0.008
Pregnancy-related hypertension	0.044
Eclampsia	0.003
Alcohol use during pregnancy	0.008
Tobacco use during pregnancy	0.199
Cigarette use during pregnancy	0.169
Medicaid eligibility	
In utero eligibility	0.156
Simulated in utero eligibility	0.158
Eligibility at ages 1-18	4.071
Simulated eligibility at ages 1-18	4.147
State-year controls	
Age 0-4	0.235
Age 5-17	0.197
Age 18-24	0.123
Age 25-44	0.3
Age 45-64	0.191
Married	0.44
Black	0.12
Other race	0.029
High school dropout	0.267
High school degree	0.39
Some college	0.343
Unemployment rate	7.732
Personal income per capita	19.635
Maximum AFDC benefit for family of 4	586.642
Medicaid funding restriction for abortion	0.024
Parental consent and notification law for abort	0.443

Appendix Table 3

First Stage Estimates

	Without state trends		With state trends		With state trends and region x year fixed effects	
	In utero eligibility	Eligibility at ages 1-18	In utero eligibility	Eligibility at ages 1-18	In utero eligibility	Eligibility at ages 1-18
Simulated in utero eligibility	0.950***	-0.549	0.926***	-0.372	0.937***	-0.096
	(0.049)	(1.282)	(0.064)	(1.422)	(0.072)	(1.247)
Simulated eligibility at ages 1-18	-0.001	1.020***	-0.022**	0.875***	-0.020**	0.680***
	(0.002)	(0.071)	(0.009)	(0.195)	(0.009)	(0.188)
Kleibergen-Paap Rank Statistic (p-value)	8.763 (0.003)		8.614 (0.003)		10.644 (0.001)	

Notes: This table displays statistics from the first stage regression of each eligibility measure on the simulated eligibility measures. Regressions are weighted by mother's birth cohort size and include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth specific linear trends in mother's birth year and/or mother's region of birth by year of birth fixed effects when indicated. Robust standard errors are clustered by mother's state of birth.

Appendix Table 4
Effects of Parental Medicaid Access: Alternative Specifications
Estimated Effects of Medicaid Eligibility at ages 1-18

	Main specification	Second generation state-year controls: State-year characteristics	Child's prenatal eligibility	Mother's cumulative adult eligibility	All three
Outcome: Length of gestation					
Eligibility at ages 1-18	-0.017	-0.034*	-0.014	-0.014	-0.025
	(0.012)	(0.019)	(0.012)	(0.014)	(0.030)
Outcome: Preterm birth					
Eligibility at ages 1-18	0.003**	0.006**	0.003**	0.003*	0.005
	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)
Outcome: Average birth weight					
Eligibility at ages 1-18	-2.708	-7.128	-1.899	-1.789	-4.421
	(3.037)	(4.458)	(3.277)	(3.304)	(7.464)
Outcome: Low birth weight					
Eligibility at ages 1-18	0.002*	0.004**	0.002	0.002*	0.003
	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)
Outcome: Very low birth weight					
Eligibility at ages 1-18	0.000	0.001	-0.000	-0.000	0.001
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Outcome: Small for gestation age					
Eligibility at ages 1-18	0.000	0.002	0.000	0.001	0.003
	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Second generation state-year controls are also included when indicated and are described in more detail in the text and appendix. Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. Robust standard errors are clustered by mother's state of birth.

Appendix Table 5

Effects of Mother's Childhood Medicaid Exposure on Infant Health

	Length of gestation	Preterm birth	Average birth weight	Low birth weight	Very low birth weight	Small for gestational age
			Panel A: Without state trends			
In utero eligibility	0.093	0.002	31.404*	-0.004	-0.002	-0.009
	(0.085)	(0.006)	(18.854)	(0.006)	(0.002)	(0.007)
Eligibility at ages 1-5	-0.007	0.002*	6.241**	-0.000	-0.000	0.000
	(0.011)	(0.001)	(2.877)	(0.001)	(0.000)	(0.001)
Eligibility at ages 6-14	0.014**	-0.001	1.811	0.000	-0.000	0.000
	(0.006)	(0.001)	(1.770)	(0.000)	(0.000)	(0.001)
Eligibility at ages 15-18	-0.004	-0.002***	2.153	-0.001	0.000	0.001
	(0.008)	(0.001)	(1.829)	(0.001)	(0.000)	(0.001)
			Panel B: With state trends			
In utero eligibility	0.057	-0.009	30.310	-0.006	-0.007***	-0.002
	(0.073)	(0.009)	(18.868)	(0.007)	(0.002)	(0.006)
Eligibility at ages 1-5	0.000	0.002	6.741	-0.000	0.001	-0.000
	(0.013)	(0.002)	(4.282)	(0.002)	(0.001)	(0.002)
Eligibility at ages 6-14	-0.022	0.002	-10.209**	0.004*	-0.001	0.002
	(0.021)	(0.003)	(4.931)	(0.002)	(0.001)	(0.002)
Eligibility at ages 15-18	-0.013	0.002	-6.598	0.002	-0.000	0.001
	(0.018)	(0.003)	(4.620)	(0.002)	(0.001)	(0.002)
			Panel C: With state trends and region x year fixed effects			
In utero eligibility	0.103	-0.011	42.301**	-0.008	-0.007***	0.001
	(0.066)	(0.007)	(16.728)	(0.007)	(0.003)	(0.007)
Eligibility at ages 1-5	-0.021	0.004**	0.163	0.001	0.001	0.000
	(0.014)	(0.002)	(3.878)	(0.002)	(0.001)	(0.002)
Eligibility at ages 6-14	-0.013	0.003	-7.128	0.003	-0.001	0.001
	(0.023)	(0.003)	(5.429)	(0.003)	(0.001)	(0.002)
Eligibility at ages 15-18	-0.009	0.003	-4.596	0.002	-0.001	-0.000
	(0.021)	(0.003)	(5.467)	(0.002)	(0.001)	(0.002)
Mean	38.78	0.11	3270.52	0.07	0.01	0.09

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). When indicated, regressions include mother's state of birth linear trends in mother's birth year, and/or mother's region of birth by mother's year of birth fixed effects. Robust standard errors are clustered by mother's state of birth.

Appendix Table 6
Effects of Parental Medicaid Access: Alternative Specifications
Effects of Medicaid Eligibility at Ages 1-18

	Main specification	Unweighted	Weighted by number of births	Alternative prenatal measure	Medicaid policy-only variation	Ages 15-36	First births only
Outcome: Length of gestation							
Eligibility at ages 1-18	-0.017	-0.053**	-0.017	-0.011	-0.018	0.002	-0.005
	(0.012)	(0.024)	(0.013)	(0.013)	(0.012)	(0.011)	(0.015)
Outcome: Preterm birth							
Eligibility at ages 1-18	0.003**	0.004**	0.003**	0.003	0.003**	0.000	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Outcome: Average birth weight							
Eligibility at ages 1-18	-2.708	-1.210	-2.234	-0.288	-2.849	-1.912	-0.955
	(3.037)	(4.592)	(2.907)	(4.735)	(2.872)	(2.897)	(3.723)
Outcome: Low birth weight							
Eligibility at ages 1-18	0.002*	0.004*	0.002	0.001	0.002*	0.001	0.001
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Outcome: Very low birth weight							
Eligibility at ages 1-18	0.000	0.001	0.000	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Outcome: Small for gestation age							
Eligibility at ages 1-18	0.000	0.001	0.000	0.000	0.000	0.001	0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28 (unless otherwise indicated). Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size unless otherwise indicated. Regressions include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. Robust standard errors are clustered by mother's state of birth.

Appendix Table 7
Sensitivity analyses for 2003 birth certificate revision

	Revised birth certificate	Dropping 14 states without revised birth certificates in 2011 from sample			
		High school education	Any prenatal care	Number of prenatal visits	Prenatal care in first trimester
In utero eligibility	-0.168	-0.044*	-0.001	0.121	-0.016
	(0.133)	(0.023)	(0.003)	(0.156)	(0.019)

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the outcomes related to education and prenatal care utilization. Robust standard errors are clustered by mother's state of birth.

Appendix Table 8

Testing for association between variable availability and Medicaid eligibility

	Alcohol use	Tobacco use	Cigarette use
In utero eligibility	-0.217	-1.126*	-0.315
	(0.329)	(0.614)	(0.208)

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. The analysis for alcohol use is restricted to ages 15-19 and the analysis for tobacco use to ages 15-21. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the outcomes related to cigarette use. Robust standard errors are clustered by mother's state of birth.

Appendix Table 9

Effects of Mother's Childhood Medicaid Exposure on Fertility and Mother's Characteristics

Estimated Effects of Medicaid Eligibility at ages 1-18

	Total Birth Rate	First Birth Rate	Age at First Birth	Average Number of Births	High School Graduate	Married	White	Black	Other
Eligibility at ages 1-18	-0.022*	-0.013**	-0.084	-0.003	-0.009	-0.001	0.001	-0.004	0.003*
	(0.013)	(0.006)	(0.086)	(0.010)	(0.006)	(0.004)	(0.004)	(0.004)	(0.002)
Mean	1.01	0.51	21.87	1.77	0.76	0.45	0.76	0.21	0.03

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the outcome of high school graduation. Robust standard errors are clustered by mother's state of birth.

Appendix Table 10

Effects of Mother's Childhood Medicatid Exposure on Infant Health by Subgroups

	Estimated Effects of Medicaid Eligibility at ages 1-18								
	Black	White	Other	Teen	Nonteen	High School Dropout	High School Graduate	Married	Unmarried
Outcome: Length of gestation									
Eligibility at ages 1-18	0.004	-0.021	-0.168*	0.038	-0.026**	0.248*	-0.018	-0.034*	0.002
	(0.030)	(0.014)	(0.102)	(0.035)	(0.013)	(0.148)	(0.015)	(0.018)	(0.021)
Mean	38.33	38.90	38.79	38.90	38.78	38.69	38.81	38.89	38.69
Outcome: Preterm birth									
Eligibility at ages 1-18	0.001	0.004**	0.025*	-0.003	0.005***	-0.039	0.006***	0.006***	0.001
	(0.004)	(0.002)	(0.013)	(0.004)	(0.002)	(0.024)	(0.002)	(0.002)	(0.002)
Mean	0.16	0.10	0.11	0.13	0.11	0.14	0.10	0.09	0.13
Outcome: Average birth weight									
Eligibility at ages 1-18	-3.831	-2.497	-64.287*	7.872	-4.173	54.383	-4.734	-9.634**	4.817
	(6.145)	(3.041)	(35.078)	(8.331)	(3.123)	(37.254)	(4.770)	(4.341)	(4.089)
Mean	3092.22	3318.37	3262.30	3211.99	3288.33	3184.75	3297.08	3345.10	3210.58
Outcome: Low birth weight									
Eligibility at ages 1-18	0.005**	0.001	0.013*	0.002	0.001	-0.007	0.002	0.001	0.002
	(0.002)	(0.001)	(0.008)	(0.004)	(0.001)	(0.016)	(0.002)	(0.002)	(0.001)
Mean	0.12	0.06	0.07	0.09	0.07	0.09	0.06	0.05	0.09
Outcome: Very low birth weight									
Eligibility at ages 1-18	-0.003**	0.001	0.007	-0.002	0.000	-0.018**	0.000	0.001*	-0.001
	(0.001)	(0.000)	(0.005)	(0.001)	(0.000)	(0.007)	(0.001)	(0.001)	(0.001)
Mean	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.02
Outcome: Small for gestation age									
Eligibility at ages 1-18	0.006**	-0.001	0.015	-0.001	0.000	-0.026	-0.001	-0.000	-0.000
	(0.002)	(0.002)	(0.011)	(0.003)	(0.001)	(0.019)	(0.002)	(0.002)	(0.002)
Mean	0.14	0.08	0.10	0.09	0.09	0.11	0.09	0.07	0.11

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the models for subgroups defined by high school graduation. Robust standard errors are clustered by mother's state of birth.

Appendix Table 11:
Effects of Mother's Childhood Medicaid Exposure on Maternal Health and Behaviors
Estimated Effects of Medicaid Eligibility at ages 1-18

	Any Prenatal Care	Number of Prenatal Visits	Prenatal Care in First Trimester	Diabetes	Chronic Hyper-tension	Pregnancy-related Hyper-tension	Eclampsia	Alcohol use During Pregnancy	Tobacco use During Pregnancy	Cigarette use During Pregnancy
Eligibility at ages 1-18	-0.000	0.007	-0.007*	-0.001	0.000	0.000	0.000	0.002	0.025	0.008**
	(0.001)	(0.032)	(0.004)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.020)	(0.004)
Mean	0.99	11.13	0.76	0.03	0.01	0.04	0.00	0.009	0.199	0.306

Notes: Data are from the 1989-2015 detailed birth data files aggregated by mother's state of birth and mother's year of birth. Sample is composed of all non-multiple births to women born in 1979-1986 at ages 15-28. Births to women born in Arizona are excluded from the sample. The analysis for alcohol use is restricted to ages 15-19 and the analysis for tobacco use to ages 15-21. Coefficients are from IV regressions weighted by mother's birth cohort size that include mother's state of birth and mother's year of birth fixed effects, and additional control variables (unemployment rate, personal income per capita, maximum welfare benefit for a family of 4, indicators for state parental consent and notification laws and state Medicaid restrictions for abortion, and demographic controls for each state and year). Regressions also include mother's state of birth linear trends in mother's birth year and mother's region of birth by mother's year of birth fixed effects. An additional control for the share of births with revised birth certificate records is included for the outcomes related to prenatal care utilization and cigarette use. Robust standard errors are clustered by mother's state of birth.