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Three Essays on the State Children's Health Insurance Program

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By

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M.A., Emory University, 2012

M.A., Central Michigan University, 2008

B.A., Shanghai University, 2004

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Abstract

Three Essays on the State Children's Health Insurance Program

By Jing Xu

This dissertation studies the impact of public health insurance expansions under the 1997 State Children's Health Insurance Program (SCHIP) on different health outcomes. The first chapter estimates the impact of the SCHIP expansion on vaccination status among children under age 2 in a timely manner. I employ a simulated instrumental variables strategy to address the issue of selection into public health insurance programs. I find that being eligible for public health insurance is associated with a higher probability that a child receives recommended vaccine series without lengthy delays. In contrast, I find little effect for the single-dose vaccines such as varicella and MMR. In light of the positive health consequences associated with vaccinations, these results imply that expanding health insurance coverage could improve social welfare and the welfare of children with low socioeconomic status. The second chapter investigates the impact of health insurance expansions under SCHIP on birth outcomes among teenage mothers. I employ ordered probit and quantile regression to evaluate the existence of heterogeneous eligibility effects on birth outcomes of teenage mothers. Results show that increased public insurance income eligibility is associated with significant improvements in prenatal care utilization among teenage mothers. For teenage mothers with singleton births, the expanded insurance eligibility is associated with a small but significant increase in birth weight. I also find that pregnancies with lower health endowments may benefit more from the expanded eligibilities than pregnancies with great endowments. The third paper is co-authored with David Frisvold. In this paper, we examine the impact of SCHIP/Medicaid eligibility expansions for children on the prevalence of food insecurity among families with children. Our results suggest that being eligible for SCHIP/Medicaid reduces the probability that a family with children has low food security. We also find that SCHIP/Medicaid eligibility has stronger effects on families in states that had higher uninsured rates among children before SCHIP expansion and low income families with income less than 185 percent of the Federal Poverty Level.

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Chapter 1
The U.S. Infant Immunization Coverage in the Post-SCHIP Era: An Instrumental Variables Approach

Jing Xu*

Abstract

Childhood immunization coverage is an important measure of health care utilization because of its efficacy in preventing contagious diseases. Previous studies suggest that access to health care is pivotal in increasing vaccination rates. The 1997 State Children's Health Insurance Program (SCHIP) was created to expand health insurance coverage for children, and the program covers the cost and administration of all immunizations recommended by the Advisory Committee on Immunization Practices. Using data from the National Immunization Survey and the Survey of Income and Program Participation, I assess the impact of SCHIP expansions on children's up-to-date vaccination status without lengthy delays. My simulated instrumental variables strategy advances the previous literature by addressing the endogeneity problem present when using eligibility levels directly. My results suggest that being eligible for public insurance increases the probability that a child is up-to-date for the 4:3:1:3 vaccine series and Hepatitis B vaccine series without lengthy delays by 10 and 13 percentage points, respectively. In contrast, I find little effect for the single-dose vaccines such as varicella and MMR. In light of the positive health consequences associated with vaccinations, this study suggests that public insurance expansions improve social welfare and the welfare of children with low socioeconomic status.

*Emory University Department of Economics, 1602 Fishburne Dr. Atlanta, GA 30322. I would like to thank Sara Markowitz, David Frisvold, David Jacho-Chavez , Sue Mialon, Andy Francis, Hugo Mialon, and Xuejuan Su for helpful comments.

1.1. Introduction

Improving access to health insurance for uninsured children has been one of the main goals of recent U.S. health policies. The driving force behind such a policy is the general belief that the availability of health insurance will increase medical care utilization and hence improve health. Although there was a great expansion in Medicaid during the early 1980s, a high uninsured rate for children remains. In 1996, there were 11.5 million uninsured children in the United States.[1] More importantly, two-thirds of all uninsured children come from families in which a parent or guardian works full time and full year. Due to this fact, the 1997 State Children's Health Insurance Program (SCHIP) was created to provide health insurance to uninsured children in families that earn too much to qualify for Medicaid but who cannot afford private insurance. SCHIP legislation mandates that all SCHIP programs cover the cost and administration of all childhood vaccines recommended by the Advisory Committee on Immunization Practice (ACIP).[2] This is partially because the financial cost of vaccines has been identified as one of the main barriers to obtain immunization.

In the economics literature, research on the relationship between health insurance expansions and health care utilization focuses mainly on the eligibility expansions in Medicaid. While the vast majority of these studies find a positive relationship between expansions in Medicaid eligibility and doctor visits, hospital admissions, and access to a regular source of pediatric care (Lurie et al., 1984; Currie and Gruber 1996a; Dubay and Kenney 2001; Finkelstein et al., 2012), some studies also emphasize that increases in the utilization may be of little benefit on health outcomes (Newhouse 1993; Ray et al., 1997).

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[1] Author's calculation based on data from the 1996 Medical Expenditure Panel Survey Round 1 data.
[2] More information is available at
http://www.cms.gov/Medicare/Prevention/Immunizations/index.html?redirect=/immunizations/

Research studies on the effects of health insurance on infant and child health have reached few definitive conclusions. These mixed results are not surprising due to the endogeneity issue of health insurance and the data limitations that I will discuss in more detail below.

Using data from the National Immunization Survey and the Survey of Income and Program Participation, I implement a simulated instrumental variable strategy to identify the effects of SCHIP expansions on the probability of being up-to-date without lengthy delay for the recommended childhood vaccines. I also examine whether the eligibility expansions lead to an increase in the probability of getting vaccines in a comprehensive health care setting. The child up-to-date vaccination rate is an important measure of preventive health care utilization given its efficacy in the prevention of contagious diseases. It not only reflects the level of protection against vaccine preventable diseases but also measures the quality of the general pediatric care. The probability of receiving a vaccine in a comprehensive health care provider is also an important proxy of quality pediatric health care, because visiting a comprehensive health care provider may increase a child's probability of obtaining other necessary and recommended health care services. My results suggest that making a child eligible for SCHIP/Medicaid increases the probability that a child is up-to-date for the 4:3:1:3 vaccine series and Hepatitis B vaccine series by 10 and 13 percentage points, respectively.[3] However, I find little evidence showing that being eligible for public insurance will increase the probability of receiving vaccines at a comprehensive pediatric provider.

[3] I use SCHIP/Medicaid since some states just expanded their Medicaid program as the public insurance eligibility expansion.

This paper provides three main contributions to the literature. First, I employ the simulated instrumental variable estimation to advance the existing literature by addressing the endogeneity problem present when using eligibility level directly. Second, I measure vaccination status in a timely manner. Previous economic studies only measure if children eventually receive vaccines by using up-to-date rate without month information. Given that children who receive recommended vaccines but with lengthy delays are still at risk of dangerous infectious diseases, I assess vaccination status in terms of "up-to-date" status with less than 6 months' delay. Lastly, to examine the existence and strength of the association between public insurance eligibility and children's vaccination outcomes, I also provide reasonable bounds of the point estimate.

The rest of the paper proceeds as follows. Section II discusses SCHIP expansions and provides information on children's immunization coverage in the United States. Section III provides an overview of the relevant literature. Section IV describes the data sources and explains the empirical strategy. Section IV presents the regression results, and the last section concludes.

1.2. Background

1.2.1. SCHIP

The State Children's Health Insurance Program (SCHIP) provides health insurance to uninsured children in families that earn too much to qualify for Medicaid but cannot afford private insurance. While Medicaid aims to decrease the number of uninsured children from low income families, before SCHIP low-income children remained substantially more likely to lack health insurance. In 1996, 23 percent of low-income children were uninsured after the Medicaid expansion (Banthin et al., 2003).

Furthermore, previous research suggests that many children in working poor families experience greater barriers to health care than other groups of children. Two-thirds of all uninsured children actually come from families in which a parent or guardian works full time and full year.[4] Due to this high uninsured rate among children from working poor families and the low take-up rate in Medicaid, SCHIP was enacted in 1997.

As one of the largest public health expansions for children in the U.S., SCHIP had over $40 billion funding with its initial 10-years authorization. Similar to Medicaid, SCHIP is a joint federal-state program, which means the federal government matches state spending on eligible program beneficiaries. However, the matching rate under SCHIP is more generous than in Medicaid. On average, the federal government's share of Medicaid spending is 57 percent, but it is 70 percent under SCHIP. In general, SCHIP also has a more generous provider reimbursement rate and hence encourages health care providers to participate in the program. However, SCHIP is not an entitlement program whose federal funding increases automatically to compensate for increases in health care costs; instead SCHIP is a block grant with a specific annual funding level. As a result, states may impose waiting lists or enrollment caps on SCHIP when state or federal funding limits are reached.

Another important feature of SCHIP is that states have great flexibility to design their own SCHIP programs in terms of the implementation date, income eligibility level, program type, and application process. Title XXI authorized that SCHIP enrollment could begin as early as October 1, 1997. As a result, eight states started SCHIP in 1997, thirty-three states started SCHIP in 1998, eight states in 1999, and two states in 2000. Given the great flexibility in designing the SCHIP program, SCHIP income eligibility

[4] Employee Benefit Research Institute Estimates from the March Current Population Survey, 1997

levels also vary across states and time. The majority of the states expanded the income cutoff to the level of at least 200 percent of the Federal Poverty Line. Insurance eligibility levels range from 133% of the Federal Poverty Line in Wyoming (2000) to 350 percent of the Federal Poverty Line in New Jersey (2000). State also varies eligibility cutoffs across different age groups of children. States usually have more generous eligibility criteria for younger children who are under age 6. Finally, states also can choose different implementation strategies to expand their public insurance programs. There are three different types of SCHIP across states. First, states can choose to build a separately administrated SCHIP. They also have the option of extending their existing Medicaid programs by increasing income eligibility cutoffs. Finally, states can have a combined SCHIP/Medicaid program. For those states choosing to have the combined program, they usually have a Medicaid expansion for one age group and a separate-administrated SCHIP for other designated age groups such as children under age 1. By 2002, eighteen states and D.C. chose to extend Medicaid, fifteen states created a stand-alone SCHIP, and seventeen have the combined SCHIPs. Table 1.1 lists states' SCHIP types, eligibility levels, and the date of implementation.

Researchers have different opinions on the effects of different types of SCHIPs. Lo Sasso and Buchmueller (2004) suggest that the distinction among the three different SCHIPs is not important with respect to its impact on the lack of insurance among children. Kronebusch and Elbel (2004) suggest that Medicaid expansion programs are more effective, while Wolfe and Scrivner (2005) find that stand-alone programs are associated with increased public health insurance coverage.

In addition to the great flexibility, state governments also place great efforts to simplify the SCHIP application process and prevent possible crowd-out effects. Substantial evidence suggests that simplifying enrollment and the renewal process can improve enrollment and promote continuous coverage for children (Bansak et al., 2007; Wachino and Weiss 2009). To simplify the application process, every state instituted a number of administrative reforms for the SCHIP application. For example, the application forms for SCHIP have been simplified. Most states also eliminated the face-to-face interview, which had previously been required of Medicaid applicants. Four Medicaid expansion SCHIP programs (Alabama, New York, Tennessee, and Utah) still require face-to-face interviews. To further streamline the process, some separate SCHIP programs accept self-reported family income when determining financial eligibility.[5] SCHIP administrators also have lessened the paperwork burden for individuals to renew coverage. As of July 2004, 48 states have dropped the face-to-face interview for renewing children's coverage; 40 states including D.C. allow children to renew coverage every 12 months.[6] States are required to include outreach programs in their SCHIP . This allows the program to reach the real “unreached” and hence increases the program take-up rates. Meanwhile, to prevent the public insurance “crowd-out” of private insurance and reach the “unreached”, most states also impose the waiting-time requirement for SCHIP enrollment, which mandates that children must be uninsured for 3-6 months prior to enrolling in SCHIP. As a result, the enrollment for SCHIP steadily increases across years. Interestingly, studies show that the aggressive outreach program also increased the

[5]Alabama, Arizona, Connecticut, Florida, Georgia, Maryland, Michigan, Mississippi, Vermont, Washington, and Wyoming accept self-reporting.

[6] Statistics came from the 50-State Children’s Health Coverage Report conducted by The Henry J. Kaiser Family Foundation.

enrollment of children in Medicaid (Mann 2002). Figure 1.1 shows the enrollment in SCHIP from 1998 to 2009. More than 7.4 million children enrolled in different types of SCHIP in 2009.

Despite the flexibilities in state SCHIP policies, all state programs are mandated to cover the cost and administration of all childhood vaccines as recommended by the Advisory Committee on Immunization Practices (ACIP) without cost sharing.

1.2.2. Childhood Vaccines

Immunizing children against infectious diseases has been one of the central missions for the public health systems in the United States. Declining vaccination rates are contributing to outbreaks of preventable diseases, which impose great threats to public health. Chickenpox killed 100 children and hospitalized 10,000 a year before a vaccine became available in 1995. Immunization is generally considered as one of the most cost-effective public health interventions. For example, every dollar spent on measles, mumps, and rubella (MMR) immunization would save $14 in costs to society (Ehreth, 2003). Completing recommended immunization series for children becomes more important as more children are exposed to infectious diseases in day-care settings and elsewhere. Failure to fully immunize can lead to new outbreaks of vaccine-preventable diseases given that unvaccinated children are more likely to contract the vaccine-preventable diseases. However, immunization rates in the United States were surprisingly low when compared with other countries with similar economic development in the early 1990s (Abbots and Osborne 1993). For example, Denmark's immunization rate for diphtheria, tetanus, and pertussis series was greater than 94 % for children less than 3 years old, while the U.S. rate was around 78.4 % in 1995.[7] Similar disparities occurred between the U.S. and France. Today in the U.S., childhood immunization rates are still suboptimal. Many children are still not receiving required immunizations against preventable diseases in a timely manner. Although most childhood vaccine-preventable diseases have declined dramatically in the past few decades, some preventable diseases are still a problem for under-immunized groups. For example, preventable diseases such as pneumonia are still part of the leading causes of infant mortality in the United States. Washington declared a pertussis epidemic in April, 2012. As of July 2012, the nation has reported more than 18,000 cases of pertussis, which represents the peak level since 1959. There were 11,000 cases of measles involved hospitalizations and 166 cases of measles that resulted in death between 1989 and 1991 (Elliman et al., 2009).

It is also important for children to receive recommended vaccines in a timely manner. Skipping or delaying vaccines puts children at high risk for deadly diseases. This is particularly true for infants and toddlers since they are more vulnerable to communicable diseases. For example, an outbreak of whooping cough (pertussis) can be devastating for infants, especially for infants less than 6 months. The Pneumococcal conjugate vaccine can help infants from contracting meningitis which also can be a fatal disease (Eskola et al., 2001). Additionally, the recommended immunization schedule is designed to work best with a child's immune system. The up-to-date vaccination status only measures whether children eventually obtain immunizations. Therefore, vaccination coverage measured solely on the up-to-date status tends to overestimate the childhood immunization coverage. Consequently, the low rate of age-appropriate immunization not only poses a risk to those unvaccinated children but also imposes a negative externality

[7] The data is available at http://www.cdc.gov/vaccines/stats-surv/nis/data/tables_1995.htm.

on the community. In the medical literature, a population is protected from encountering certain diseases if at least 90% of the population, including those who have medical exemptions, has been vaccinated (Fine, 1993). This is so-called herd immunity or community immunity. The herd immunity also explains why high child immunization coverage is important. However, recent reports on the exemptions from school immunization requirements find that the number of young children who are not fully vaccinated has been steadily increasing over the last decade. In response to this low rate of immunization at the recommended age, U.S. department of Health and Human Services' *Healthy People 2010* initiative has set vaccination coverage goals to 90 percent for each vaccine in the 4:3:1:3 vaccine series and a goal of 80 percent for all other recommended vaccines for children aged less than 2 years old (Human Service, 2000). The 4:3:1:3 vaccine series consists of 4 or more doses of diphtheria, tetanus and acellular pertussis vaccines (DTaP) vaccines, 3 or more doses of poliovirus vaccines, 1 or more doses of measles-containing vaccine (MCV), 3 doses of Haemophilus influenza vaccines.

Nevertheless, there are several significant barriers to improve the vaccination rate in children. First, the financial cost of completing recommended vaccines for children increased dramatically in the past few decades. The increased unit cost of a vaccine and the increased number of vaccines recommended by ACIP both drive up the costs of being fully vaccinated. As of 2010, the Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) recommend vaccination against 16 diseases including influenza. More importantly, children may need to receive several shots to complete the whole vaccine series to be effectively protected from diseases such as Hepatitis B. As a result, children now may receive up to 29 shots by the time they are 2 years old. This is almost two times greater than the number of doses in 1987 for children under age 2. Consequently, costs of vaccines to fully immunize a child have risen from $155 in 1995 to $ 1,170 in 2007 (Lee et al., 2007). This increased cost is also partly due to the use of new and more expensive technologies in vaccine production and distribution. Given that the up-to-date immunization rate of low-income children is particularly sensitive to the ability to pay; this financial barrier is more of a problem for socioeconomically disadvantaged children to receive vaccines in a timely manner. Previous studies conclude that significant disparities exist in age-appropriate vaccination coverage between low- and high-income children for all childhood vaccines. To be fully vaccinated, a child has to receive the potential 29 doses in at least 5 visits.[8] This is because ACIP restricts the maximum shot in a single visit to a certain number of shots to ensure the safety and efficacy of being vaccinated.[9] Additionally, for vaccines that require several shots to complete the whole series, there is a recommended time interval to the next shot. For example, the recommended interval between the second dose of DTaP and the third dose of DTaP is 6 months. This recommend time interval between shots for a certain vaccine also increases the number of visits and complexity of being up-to-date for all recommended vaccines.

The eligibility criteria of public insurance change the marginal costs and benefits of receiving vaccines. A large body of economic research finds that health insurance is correlated to appropriate immunization coverage (Lurie et al., 1987; Joyce and Racine, 2005). According to standard health economics theory, health insurance coverage induces greater medical care utilization by reducing the out-of pocket cost from patients (Phelps,

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[8] Author's calculation based on the recommended childhood vaccine in 2010.
[9]This information is from Vaccine Administration Guidelines which is available at http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/D/vacc_admin.pdf.

1997). Hence, the 1997 enacted SCHIP may have a significant impact on the utilization of preventive medical services. This impact may be especially important for vaccination utilization due to the increased complexity as well as financial cost of full immunization. In other words, being eligible for SCHIP may substantially reduce the out-of-pocket cost of being fully vaccinated and hence increases the utilization of vaccination services.

1.3. Literature Review

There is a large literature that analyzes the effects of insurance expansions on medical care utilization. Most of this literature focuses on the impact of Medicaid expansions in the 1980s and 1990s (Currie and Gruber, 1996b; Newacheck et al., 1998; Kaestner et al., 2001; Racine et al., 2001; Dubay 2002; Lykens and Jargowsky, 2002; Finkelstein et al., 2012). Currie and Gruber (1996b) study the effect of expansions for Medicaid to low-income children on their utilization of medical care and health outcomes. They conclude that expanded eligibilities for Medicaid significantly increased the utilization of medical care, particularly the utilization of care delivered in physicians' office. Using data from the National Health Interview Survey, Lykens and Jargowsky (2002) explore whether the Medicaid expansions improve the health and functional status of children. Their results suggest that for non-Hispanic white children, the earlier Medicaid expansions in the late 1980s and 1990s did make significant improvements in their health conditions and functional status. Using the data from the Oregon health insurance experiment in 2008, Finkelstein et al. (2012) find that expanded access to health insurance for low-income and uninsured adults in Oregon is associated with increased health care utilization, reduced out-of pocket medical expenditures, and improved self-reported health status.

The literature on the evaluation of SCHIP programs mostly focuses on the program take-up rates. Lo Sasso and Buchmueller (2004) find that the implementation of SCHIP is associated with a statistically significant increase in insurance coverage. Szilagyi et al. (2004) use usual source of care (USC) and unmet needs for health care as measures of health care access. They find improved access and quality of care after enrollment in the New York SCHIP.

While the prediction that insurance is likely to increase the use of care is well accepted, the main issue of these studies is the possibility that estimates of the effects of insurance on utilization may be biased. As Levy and Meltzer (2004) point out the majority of the literature assessing the relationship between health insurance and health either treat insurance status as exogenous or address the endogeneity issue by controlling for relevant observables at best. Individuals may self-select to have high level of health care utilization. For example, parents who have poor health are more likely to be eligible for health insurance and have more frequent use of medical services for themselves and their children. Another concern is the lack of objective measures in the health care utilization. Most surveys provide self-reported measures of health care utilization such as the number of doctor visits in the previous year. Additionally, measures such as the number of hospitalization are affected by individuals' pre-existing health conditions. Therefore, most recent paper focuses on the preventive care utilization to address this issue.

A few papers also study the effects of SCHIP expansions on children's up-to-date immunization rates. Rodewald et al. (1997) employ a pre- and post-design to evaluate the effects of New York Child Health Plus (CHPlus) and they find that insurance coverage for low-income working families is associated with an increase in the immunization coverage. However, their study has limited ability to draw conclusions on the national effects of SCHIP on children's immunization coverage. Joyce and Racine (2005) analyze the SCHIP effects at the national level and they find that insurance expansions increase the probability that a child was up-to-date for the varicella vaccine by 7 to 8 percentage points more among poor and near-poor relative to non-poor children. One potential problem of these studies is that they treat insurance coverage as exogenous. As Levy and Meltzer (2004) suggests the endogeneity of individual health insurance status is among one of the least carefully considered and potentially most important issues to be addressed in reviewing the literature on whether health insurance affects health and health care utilization. To the extent that factors that affect the health insurance status also affect medical care utilization, the estimated effects from these studies will be biased and should be interpreted with caution. An additional limitation is that vaccine status measured by up-to-date rate only may underestimate the effects of health insurance expansions on immunization coverage. Given that benefits of vaccination may be manifested in terms of receiving vaccines in a timely manner among children, it is important to measure childhood vaccination status in a timely manner. Finally, given the on-going disparities in preventive health care utilization among children, the assumption of vaccination behavior of poor children and non-poor children would follow the same path in the absence of insurance eligibility expansions is implausible.

In this paper, I employ the simulated instrumental variables strategy developed by Currie and Gruber (1996a) to identify the effects of SCHIP/Medicaid on children's vaccination status in a timely manner. My IV strategy advances the previous literature by addressing the endogeneity problem present when using eligibility levels directly. I also further the literature by providing reasonable bounds of the point estimate.

1.4. Identification Strategy

To evaluate the effects of insurance eligibility on the probability of a child is up-to-date for recommended vaccines without lengthy delays; I first estimate the following equation using linear probability models (LPM):

$$Y_{ist} = \alpha + \beta \cdot ELIG_{ist} + \Theta X_{ist} + \varphi \cdot Z_{st} + \gamma T_t + \delta S_s + \varepsilon_{ist} \qquad (1)$$

Y_{ist} is a dummy variable values 1 if child i in state s and year t is up-to-date for a particular vaccine or vaccine series with less than 6 months' delay, otherwise Y_{ist} values 0. $ELIG_{ist}$ is a dichotomous indicator measures the eligibility for SCHIP/Medicaid of child i in state s and year t. Following the previous work (Bush and Duchovny, 2005; Leininger et al., 2010), I assign the eligibility based on family structure and gross income thresholds. For years before SCHIP implementation, I use the eligibility level for Medicaid. I do not utilize other measures such as earnings disregards since various rules applied to different states. Furthermore, since individuals may be eligible for public health insurance through the Temporary Assistance for Needy Families (TANF) program which replaced the Aid to Families with Dependent Children (AFDC) after 1996, I also utilize information on income eligibility thresholds for AFDC/TANF in order to determine whether individuals may be eligible for Medicaid through AFDC/TANF. The information on the state TANF application is from the Urban Institute's TRIM3 model and Welfare Rules Database.

X is a vector of individual control variables including gender, age, and maternal information such as ethics, education attainment, marital status, and geographic characteristics. Z is a vector of the state level characteristics. It includes state unemployment rate, state level child population, state Hepatitis B vaccine requirement, state level child population, and state TANF caseload numbers. I also include state indicators S as well as year indicators T to capture the unobservables that are constant within a state or constant across states within a year. All of these variables are included to broadly control for characteristics of the population and economic conditions that may be related to family insurance eligibility and vaccine decision. ε_{ist} is a random error term. Finally, all standard errors are clustered at the state level to allow for arbitrary correlation within state cells over time (Bertrand et al., 2004).

However, the simple LPM estimator is subject to potential endogeneity issues. First, insurance eligibility itself may be a function of health status, which could bias the estimates of the insurance eligibilities on health care utilization. For example, a child with a weakened immune system may reduce ties to the labor market if their parents need to spent more time to take care of the child, which leads to a reverse causal relationship between public insurance eligibility and vaccine outcomes. Additionally, state insurance eligibility polices are chosen based on economic and demographic characteristics of individuals in that specific state, which may also be correlated with vaccine outcomes. Third, unobserved factors such as parents' taste of health may affect both insurance eligibility and health care utilization. In other words, children who are eligible for public insurance programs may have other unobserved characteristics which affect their health and health care utilization. For instance, if a child's parents have relatively poor health status, their families are more likely to be eligible for health insurance. Meanwhile, their children may have less health care utilization in general. In this case, the effects of insurance eligibility on the utilization of preventive health care services such as vaccination behavior would be underestimated. It is also possible that public insurance eligible children are more likely to live in areas with limited access to health care services. Therefore, estimates that fail to account for the disadvantaged characteristics of the eligible children are likely to be biased towards zero. Finally, the presence of measurement errors in the calculation of individual eligibility due to the limitations of the income data also motivates the use of instrumental variable strategy.

To address the endogenous issue of individual eligibility and potential measurement errors in assigning eligibility, I adopt the simulated instrumental variables strategy. As Angrist (2001) and Wooldridge (2002, pg. 622) suggest that researchers can, and in many cases should, use IV estimator even when both the endogenous and outcome variables are dummy variables. [10] The simulated instrumental variables strategy is pioneered by Currie and Gruber (1996a, 1996b). The idea is to use a measure of the generosity of state's public insurance program in a specific year, the simulated eligibility fraction, to instrument for an individual's actual public insurance eligibility. The simulated eligibility fraction is calculated by applying the annual state public health insurance cutoff to a constant national sample of children. I do not use the actual eligibility fraction at state-year level since it is likely to correlate with a state's socioeconomic characteristics. There are two steps to construct the simulated instrumental variable. First, I randomly select 5000 children who are under age 2 from a nationally representative sample in year t; I then calculate the fraction of the 5000 sample that would be eligible for the SCHIP/Medicaid in state i and year t. I repeat this for all

[10] I also tested IV models using a two-step GMM estimator, which uses a weighting matrix that makes it efficient in the presence of heteroskedasticity and the results are similar.

states using the same group of 5000 children. In the literature, one can choose to implement a random draw with or without replacement to construct a simulated instrumental variable. The results from the two methods are similar if the sample size is very large as the probability of any given observation being selected into the sample for the second time is very low in a large dataset. In this paper, I implement a random draw without replacement. This eligibility fraction measure can be viewed as a practical parameterization of state program legislative differences for children. My "simulated instrument" only varies with a state's legislative environment but not with its economic or demographic characteristics as I calculate the fraction using rules across states and time to a national constant example. Put differently, by using this national sample to construct the instrument, I purge the estimates of the state and year-specific economic effects, such as business cycle, which might be correlated with eligibility and vaccination service utilization. Therefore, the instrument is arguably exogenous to preventive health care utilization (vaccine services). Furthermore, by using the fraction of eligible children in each state and year, I abstract from any individual-level omitted variables correlated with both eligibility and vaccination outcomes. To the extent that the measurement error in the instrument is uncorrelated with the measurement error in the individual eligibility measure, I also surmount the measurement error issue.[11] Hence, the simulated instrument shall satisfy both exogeneity and relevance assumptions for a valid instrument.

1.5. Data

This paper utilizes data from the National Immunization Survey (NIS) and the Survey of Income and Program Participation (SIPP) to examine the impact of health

[11] See Currie and Gruber's 1996a paper for more detailed information.

insurance eligibility expansions on children's up-to-date vaccination rate. Data on vaccines come from the 1996-2002 NIS data. The NIS is conducted jointly by National Center for Immunizations and Respiratory Diseases (NCIRD), the National Center for Health Statistics (NCHS) and Centers for Disease Control and Prevention (CDC). It is the only population based survey to monitor childhood vaccine-specific coverage at the nation, states and selected urban areas. The target population for the NIS is children aged 19 to 35 months living in the United States at the time of the interview. A random-digit-dialing (RDD) telephone survey is employed to identify households containing children in the target age range and interview an adult who is most knowledgeable about the child's vaccinations. To address the concern of sample selection, the NIS employs a weighting-class approach to account for households that do not have a telephone. Moreover, with the consent of the child's parent or guardian, the NIS also contacts (by mail) the child's health care providers to request vaccine information from the child's medical records. The yearly average sample size of the NIS is around 30,324 children. 78 Immunization Action Plan (IAP) construct a nationally representative sample in the NIS. Households are drawn randomly within each IAP area. Provider response rate in the NIS is very high with an average of 93%. However, those with complete provider data are more likely to be white, better educated, and have greater incomes than households without complete provider data. Thus, the NIS adjusts by providing propensity scores to adjust sampling weights for households with non-provider data within each IAP (Smith et al., 2001).

The NIS provides detailed information on children's immunization coverage including the number of vaccines received and the information regarding the site where vaccines occurred. Particularly, NIS asks if the child is up-to-date for a specific vaccine. A child is considered as up-to-date if he or she receives all the recommended numbers of doses of a specific vaccine. For example, children are considered up-to-date for the 4:3:1:3 series when they have received at least 4 diphtheria, tetanus and acellular pertussis vaccines, 3 poliovirus vaccines, 1 measles-containing vaccine (MCV), and 3 Haemophilus influenza vaccines at the time of interview. Based on this survey question and children's age information, I construct a binary variable to indicate if the child is up-to-date for a certain vaccine and/or the whole vaccine series in a timely manner. In addition to immunization data, the NIS also collects detailed demographic information such as race, sex, and residence information. Respondents are also asked about maternal schooling, family income, family size, marital status and other household-level information. The NIS categorizes children's age into three categories: 19 to 23 months, 24 to 29 months and 30-35 months. I restrict my entire sample to children who are aged 19 to 23 months since children receive approximately 80 percent of all recommended vaccine doses by age 2. In addition, as I discussed in the previous section, it is important to measure vaccine outcomes in a timely manner as children who eventually receive vaccines but with lengthy delays are still at a risk of contracting diseases. Vaccine outcomes measured based solely on up-to-date status are likely to underestimate the effects of insurance expansions as well as the degree of under-immunization in a population. Ideally, I should construct a vaccine measure using up-to-date status with regard to the age at which every dose was actually received. However, NIS has no information on the age at time of vaccination. To address the importance of receiving vaccines in a timely manner, I focus on children aged 19 to 23 months to exclude those children that may old enough to experience delays with duration of longer than 6 months.[12] Lastly, respondents with children within this age group also have a relatively short recall period and therefore can provide more accurate information (Suarez et al. 1997).

The relevant household income threshold is the one when children are scheduled for vaccines rather than the household income at the time of the interview. To have a better estimate of household income thresholds, I follow Joyce and Racine (2005) who use the median age of the age group to calculate the exposure to different SCHIP/Medicaid eligibilities. The median age of my sample is 21 months. Therefore, a child in 1999 spends 12 of the 21 month in 1998 and 9 of 21months in 1999. The average income eligibility threshold for this child is 54% eligibility threshold in 1998 plus 43% of eligibility threshold in 1999. Following the previous literature, I assign the child eligibility for SCHIP/Medicaid solely based on gross income thresholds and family size as the NIS has no detailed source of income to calculate various earnings disregards.[13] The potential measurement error in assigning eligibility status is another reason to employ instrumental variable strategy.

My first set of the outcome variables are NIS measures on the up-to-date vaccination rate for 4:3:1:3 vaccine series, Hepatitis B vaccine series, mumps and rubella vaccine (MMR) and varicella, respectively. Table 1.2 lists the recommended vaccine schedule for children in 1996 which is the first year of the sample period. As Table 1.2 suggests, all dependent variables are routinely recommended vaccines by ACIP. In

[12] From this point on, the lengthy delay in this paper refers to children receive recommended vaccine but with a delay of more than 6 months. This cutoff criterion is also consistent with the previous work (e.g. Dombkowski et al., 2002)

[13] The NIS has the income to poverty ratio since 1999, so I use the reported family income and family size to create the poverty ratio for 1995-1999 NIS data.

addition, they are all suggested to be completed by 18 months old. Hence, I can assess vaccination outcomes among children aged 19-23 months in a timely manner by using up-to-date status without lengthy delays.

Vaccine 4:3:1:3 series include four doses of diphtheria, tetanus and acellular pertussis vaccines, three doses of polio vaccines, one dose of measles containing vaccine, and three doses of Haemophilus influenza vaccines. Hepatitis B vaccine series is a relatively new vaccine series compared to 4:3:1:3 vaccine series. In November 1991, the ACIP recommended Hepatitis B vaccine to be integrated into infant vaccination schedules (CDC, 1991). Additionally, the Hepatitis B vaccine is considered as one of the safest and most effective vaccines. To prevent the potential outbreak, children are required to have the Hepatitis B vaccine to enter school in some states. As discussed above, the *Healthy people 2010* immunization goal for all recommended vaccines, such as 4:3:1:3 vaccine series is 90% for children age 19-35 months. Hence, the immunization rates of these vaccine series are of particular interest to public health policy makers.

Besides the two aforementioned vaccine series, I also measure children's vaccine status for two individual vaccines, varicella vaccine and the measles, mumps and rubella vaccine (MMR). Varicella, as a relatively new recommended vaccine in my study period, was licensed by the FDA in March 1995. Estimates of varicella immunization outcome can assess the potential impact of insurance eligibility on newly introduced vaccines and therefore provides policy implications. The last vaccine of particular interest is for MMR. I choose this vaccine for two reasons. First, a measles epidemic occurred in 1989-1991 and resulted in more than 55,000 reported cases, 11,000 hospitalizations, and more than 120 deaths. Over half of the deaths were children under 5 years of age (CDC, 1992).

Second, there has been increasing public concern regarding the safety of MMR vaccine, primarily resulting from one study that suggested that autism spectrum disorders could be caused by the MMR vaccine.[14] While the journal that published the study later retracted this article as a discredited study and while the Institute of Medicine also reports that no relationship between the risk of autistic spectrum disorder and MMR vaccine exists (Immunization Safety Review Committee, 2004), the MMR controversy remains.

Finally, I also investigate the site at which vaccines are obtained. Specifically, I am interested in the probability that children obtain vaccines at a provider with comprehensive pediatric care settings. Every visit to health care providers may help to meet other preventive and non-preventive pediatric care needs such as annual routine check, general health screening, developmental assessment, and nutritional counseling (Joyce and Racine 2005). Put differently, children vaccinated in providers that also offer comprehensive pediatric services may obtain other important assessments and increase the utilization of other medical services for both preventive and non-preventive purposes. Moreover, given the growing complexity of being up-to-date for all recommended vaccines, visiting a provider with comprehensive pediatric care settings may increase the likelihood of being up-to-date for vaccines in a timely manner. Hence, I also examine the impact of SCHIP/Medicaid eligibility on the probability of receiving vaccines from a provider with comprehensive health care services.

I utilize the 1996 and 2001 panels of Survey of Income and Program Participation (SIPP) data to implement the simulation of eligibility at the state and year level. The simulated instrumental variable measures the state level generosity of SCHIP/Medicaid

[14] Wakefield A.J., et al., 1998 "Lleal-lymphoid-nodular hyperplasia non-specific colitis, and pervasive developmental disorder in children." *Lancet*. 351(9103):637-641.This study was retracted later.

towards children under age 2. The SIPP data is a multi-panel, nationally representative dataset that began in 1983. The SIPP was then redesigned 1996 panel with a target of interviewing 37,000 households. The SIPP respondents are asked questions every four months about their individual as well as family information over the prior four months. To simplify the interview process, the entire SIPP sample is randomly split into four rotation groups and each rotation group is interviewed once every four months. The SIPP content is built around a "core" questionnaire that covers labor force, program participation, and income questions. In addition to this core section, the SIPP also provides broader information by adding questions on various topics such as living arrangements, child care, wealth, program eligibility, disability and taxes. I mainly use information from the household and family relation section and the income and poverty section to assign the insurance eligibility.

However, panel data generally has more changes observed across interviews than changes observed within reference periods; this is so-called "seam bias". As a result, seam bias almost always signals measurement errors. Since SIPP respondents were surveyed retrospectively, the dataset has been well documented for its seam bias issue. To address the "seam bias" issue (Moore 2008), I follow Leininger et al. (2010) and only keep observations in the fourth reference month at the time of the interview.

Table 1.3 provides the mean of the actual fraction of state eligibility and the simulated eligibility fraction over time. The eligibility criteria for Medicaid and SCHIP are from the annual maternal and child health update from the National Governors Association. In general, it increases over time except in 1999. The reason behind this is that some states reduce the program eligibility levels in certain years due to the high take up rate in SCHIP and tight budget constraints.

1.6. Results

Before proceeding to the estimation results, I first discuss the summary statistics for the sample presented in Table 1.4. The total number of observations is 64,171, about 39 percent of which is SCHIP/Medicaid eligible. These SCHIP/Medicaid children are more disadvantaged than the full sample in general. They are more likely to be minorities and live in a family that with 4 more children; their mothers are generally less-educated and less likely to be married.

Table 1.5 shows summary statistics for vaccination status. Compared to the whole sample, SCHIP/Medicaid eligible children have lower up-to-date vaccination rates in all listed vaccines. For example, the rate of being up-to-date for the 4:3:1:3 vaccine series without lengthy delays among the full sample and SCHIP/Medicaid eligible children are 0.497 and 0.468, respectively. Furthermore, the sample mean test rejects the null hypothesis of zero difference in the up-to-rate for all vaccines between two groups. For the site of receiving vaccines, SCHIP/Medicaid eligible children also have a lower percent of children who receive vaccines from providers also offering comprehensive services compared with the full sample.

Table 1.6 reports the results from the regression described in Equation (1) to assess the effects of insurance eligibility expansions on vaccination status among children aged 19 to 23 months old. The first 4 columns in Table 1.6 show the results from linear probability model. The results in column one and two suggest that being eligible for SCHIP/Medicaid is associated with an increase in the probability of being up-to-date with

4:3:1:3 vaccine series and Hepatitis B without lengthy delays by 1.5 and 2.8 percentage points, respectively. While being eligible for SCHIP/Medicaid is associated with a significantly increase in the probability of being up-to-date for both 4:3:1:3 vaccine series and Hepatitis B vaccine series, no significant correlation is found between the insurance eligibility and the likelihood of being up-to-date for varicella vaccine. Moreover, public insurance eligibility is negatively and statistically significant related to being up-to-date for MMR vaccine. As noted above, this unexpected result is possible if there are omitted variables and measurement errors that biased the LPM estimator. The last four columns in Table 1.6 report the IV estimates. All models are estimated using standard errors that account for clustering of observations at the state level. The coefficients in the first stage are positive and the F-statistic ranges from 476.26 to 566.89. The Hausman test rejects the consistency of LPM estimates. Therefore, the IV estimates should be the preferred estimates. My IV results suggest that being eligible for SCHIP/Medicaid leads to an increase in the likelihood of being up-to-date with less than 6 months' delay for vaccine 4:3:1:3 and Hepatitis B vaccine series only. SCHIP/Medicaid eligibility is now associated with a 10.3 (13.1) percentage points increases in the probability of being up-to-date for 4:3:1:3 (Hepatitis B) vaccine series. It represents a 20 (17) percent increase of the baseline probability. The differences between the LPM and IV estimates suggest that LPM results are biased downward (underestimated), which confirms the previous conjecture that the LPM estimates without correcting the endogeneity and omitted bias issues may under-estimated the actual SCHIP/Medicaid effects on vaccination utilization. In other words, children who are likely to be eligible for SCHIP/Medicaid may also be likely to have low utilization of vaccination services in general.

Finally, the results in the last two columns in Table 1.6 imply that being eligible for SCHIP/Medicaid has moderate effects on the vaccine status for vaccine varicella and vaccine MMR. The IV estimates suggest that insurance eligibility is negatively related to vaccine outcomes for both varicella and MMR, but the correlations are not statistically significant. Since varicella vaccine was first recommended by ACIP in 1996, one possible explanation is that the information gap may lead to a low vaccination rate for varicella even with financial incentives. Hence, the IV estimates imply that public insurance expansions may have a limited impact on newly recommended vaccine such as varicella. For vaccine MMR, the rumor of possible link between MMR and autism may have deterred parents from immunizing their children. Given that being up-to-date for a vaccine series has relatively greater financial cost and a higher level of complexity compared with single-dose vaccines, an alternative explanation is that insurance eligibility expansions may have greater effects on vaccine series.

All results shown in Table 1.6 suggest that higher maternal education is associated with increased possibility of being up-to-date for vaccines with less than 6 months' delay. The immunization rate is also different for different demographic groups. White children are more likely to be up-to-date without lengthy delays for all vaccines compared with minorities. In addition, large family size, family mobility, and urban residence are all associated with a decreased up-to-date immunization rate.

Table 1.7 contains the estimates of the impact of SCHIP/Medicaid eligibility on the possibility of receiving vaccines from a provider that also provides comprehensive pediatric services. Both LPM and IV estimates suggest that public health insurance eligibility is associated with a decreased possibility of receiving vaccines from a provider with comprehensive pediatric services among children aged 19-23 months old. However, the IV estimates are not statistically significant. This is possible since low-income children are more likely to live in areas with limited access to comprehensive health care providers.

To summarize, my results suggest that being eligible for SCHIP/Medicaid is positively associated with the probability that a child is up-to-date without lengthy delays for both 4:3:1:3 and Hepatitis B vaccine series , but not for single-dosed varicella and MMR vaccines. I also find little evidence that public insurance eligibility affects the probability of receiving vaccines from a comprehensive pediatric service provider.

1.7. Robustness Checks

One concern with the analysis in the previous sections is the robustness of the results to changes in the sample size used to generate the simulated eligibility instrument. Thus, I conduct the same IV analysis in Table 1.6 using the simulated instrument with different sizes. It is clear from Table 1.8 that the results for all vaccines are quite robust. The magnitude of the effects on vaccine 4:3:1:3 series is ranged from 0.081 to 0.103, which suggests that being eligible for SCHIP/Medicaid is associated with a 8.1 to 10.3 percentage points increase in the probability of being up-to-date without lengthy delays for 4:3:1:3 vaccine series. Likewise, I find that being eligible for SCHIP/Medicaid increases a child’s probability of being up-to-date without lengthy delays for Hepatitis B vaccine series by 12.2 to 13.1 percentage points. Overall, the results are quite robust and changes in the size of the simulation do not alter the main conclusion about the effectiveness of SCHIP/Medicaid eligibility on children’s vaccination status.

To further check my results, I also conduct a few sensitivity analyses to examine the effects of public insurance eligibility on vaccination status for different groups in the NIS sample. Since SCHIP/Medicaid expansions would have had its most pronounced effect on those children who are previously uninsured or underinsured, it is reasonable to expect that the effects of insurance eligibility expansions should be greater for children from states that have high uninsured rate. I limit the sample to eleven states that have the highest rate of uninsured children before SCHIP expansions.[15] These eleven states are Arizona, California, Florida, Louisiana, Nevada, New Jersey, New Mexico, Mississippi, Oklahoma, South Carolina, and Texas. Panel A of Table 1.9 describes the IV results for this group. As expected, the coefficients are bigger than the estimates listed in Table 1.6. To address the concern that children who are always ineligible for SCHIP/Medicaid are sufficiently different from children who are sensitive to the eligibility cutoffs, I also restrict the sample to children in households with family income less than 400 percent of the Federal Poverty Level. The results are reported at the bottom panel of Table 1.9. For 4:3:1:3 vaccine series, being eligible for SCHIP/Medicaid now is associated with a 10.7 percentage points increase in the probability of being up-to-date without lengthy delay. The magnitudes, as expected, are bigger than the baseline estimates for all vaccines, which suggest that the results are mainly driven by children who are sensitive to insurance eligibility changes.

I also calculate marginal effects for the discrete change from 0 to 1 in assigned eligibility. Results are displayed in Table 1.10. Given that none of the outcomes are in the tails of the distribution, the probit estimates of SCHIP/Medicaid eligibility on the

[15] These 11 states had the highest rate of uninsured children between 1996 and 1997.

probability of being up-to-date without lengthy delays for all vaccines are similar to those results from the LPM estimates.

Finally, I follow the methodology of Altonji et al. (2005) and provide reasonable bounds of the point estimate of the impact of SCHIP/Medicaid eligibility without the use of an instrument. These bounds guide the interpretation and plausibility of the results using an instrument. The idea is that one can use the amount of observed selection as a guide for the extent of unobserved selection as the extent of selection on observables is usually smaller than the amount of selection of unobservables.[16] Based on the previous research and the discussion above, I expect that unobservable factors that determine eligibility and up-to-date vaccination rate are negatively correlated. In this case, the lower bound is from the LPM model (baseline results) which assumes that selection on the unobservables is zero. Given that the selection on the unobservables is likely to be smaller than selection on the observables, the upper bound estimate of public insurance effects can be obtained by setting the restriction that selection on unobservables and observables is equal.

Table 1.11 presents the lower bound and upper bound estimates by using the bivariate probit model. The point estimate of the impact of public insurance expansion is positive and significant for all vaccines except for the lower bound estimate on vaccine varicella. For example, the estimate of the effect of SCHIP/Medicaid expansions on children's up-to-date vaccination rate for vaccine 4:3:1:3 series increases from 0.015 to 0.195 after imposing the equal selection restriction. The lower bound and upper bound estimates are statistically significant at 5 percent level and 1 percent level, respectively. Moreover, the results also suggest that the correlation ρ between the individual eligibility

[16] Please note that this methodology does not rely on an exclusion restriction in the bivariate probit model.

and vaccination outcomes, as expected, are negative and statistically significant. This supports the hypothesis that the endogeneity bias is downward. Most importantly, since my IV estimates fall into the range of the lower bound and the upper bound estimates, it provides some further evidence that my IV estimates are plausible.

1.8. Conclusion

In this paper, I examine the impact of SCHIP/Medicaid eligibility on the probability of being up-to-date for recommended vaccines without lengthy delays among children under age 2. With both great financial incentives and aggressive outreach efforts, SCHIP/Medicaid eligibility expansions are expected to improve the immunization rate among low-income children.

To address the endogeneity issues associated with public insurance status, I construct a simulated generosity measure of state public insurance program to instrument for individual's SCHIP/Medicaid eligibility. The program generosity is an appropriate choice for an instrument because it influences a child's probability of being eligible for SCHIP/Medicaid, but is not likely to impact the probability of being up-to-date for childhood vaccines without lengthy delays. My IV estimates from the main specification suggest that being eligible for SCHIP/Medicaid increases the probability of being up to date for 4:3:1:3 vaccine series and Hepatitis B vaccine series without lengthy delays by 10.3 and 13.1 percentage points, respectively. I find little evidence that SCHIP/Medicaid eligibility influences the vaccination rate for newly recommended varicella vaccine. Additionally, no significant effects are found for vaccine MMR. One possible explanation is that being eligible for public insurance may have larger effects on vaccine series because of the greater financial cost and complexity associated with vaccine series.

I also examine the possible effects on the probability that a child obtains vaccines from a provider with comprehensive health care services. This is an important question since visiting a provider with comprehensive health care services may increase utilizations of other preventive and non-preventive care. However, my results suggest that SCHIP/Medicaid eligibility has little influence on the probability of obtaining vaccine at a comprehensive health care clinic.

Understanding the effects of public health insurance program may help to improve the future program design to combat inequalities in health care utilization among different groups of children. In light of the positive health consequences associated with vaccination, this study suggests that public insurance expansions improve social welfare and the welfare of children with low socioeconomic status.

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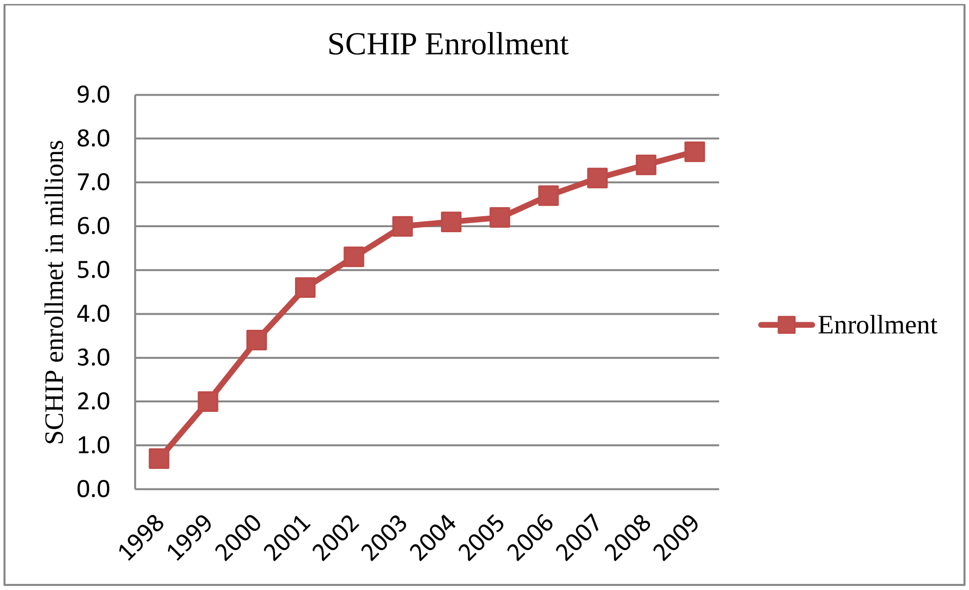
Figure 1.1. SCHIP Enrollment, 1998-2009



Source: SCHIP statistical enrollment data system (SEDS) 02/01/2011

Table 1.1. Summary of SCHIP Expansions by State and Time

State	Type	Date implemented	%FPL eligibility cutoff	
			1997	2002
Alaska	M	Mar-99	133	200
Alabama	C	Feb-98	133	200
Arkansas	M	Oct-98	140	200
Arizona	S	Oct-97	133	200
California	C	Mar-98	200	250
Colorado	S	Apr-98	133	185
Connecticut	C	Jul-98	185	300
Delaware	S	Oct-98	185	200
Florida	C	Apr-98	185	200
Georgia	S	Sep-98	185	235
Hawaii	M	Jan-00	185	200
Iowa	C	Sep-98	133	150
Idaho	M	Oct-97	133	185
Illinois	M	Jan-98	150	200
Indiana	C	Sep-98	185	200
Kansas	S	Jul-98	150	200
Kentucky	C	Jul-98	185	200
Louisiana	M	Nov-98	133	200
Massachusetts	C	Oct-97	185	200
Maryland	M	Jul-98	185	300
Maine	C	Aug-98	185	200
Michigan	C	May-98	185	200
Minnesota	M	Sep-98	275	280
Missouri	M	Oct-97	185	200
Mississippi	C	Mar-97	185	300
Montana	S	Jan-98	133	150
North Carolina	S	Oct-98	150	185
North Dakota	C	Oct-98	133	200
Nebraska	M	May-98	185	300
New Hampshire	C	May-98	185	350
New Jersey	C	Feb-98	185	235
New Mexico	M	Mar-99	185	250
Nevada	S	Oct-98	185	200
New York	C	Apr-98	133	140
Ohio	M	Jan-98	133	200
Oklahoma	M	Dec-97	150	185
Oregon	S	Sep-98	133	170

Pennsylvania	S	Jun-98	185	235
Rhode Island	M	Oct-97	250	250
South Carolina	M	Aug-97	185	185
South Dakota	M	Jul-98	133	200
Tennessee	M	Oct-97	185	200
Texas	C	Jul-98	185	200
Utah	S	Aug-98	133	200
Virginia	S	Oct-98	225	300
Vermont	S	Oct-98	133	200
Washington	S	Jan-00	185	250
Wisconsin	M	Apr-99	150	200
West Virginia	C	Jul-98	185	200
Wyoming	S	Apr-99	133	133

Notes: M indicates Medicaid, S indicates stand-alone SCHIP, and C indicates combined program. Data on the SCHIP type, implementation dates, and income eligibility limit from the Centers for Medicaid Services (CMS) available at: http://medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Childrens-Health-Insurance-Program-CHIP/CHIP-Eligibility-Standards-.html.

Table 1.2. Recommended Childhood Vaccine Schedule, January-June 1996

<table>
<tr><th>Vaccine</th><th>Birth</th><th>1 month</th><th>2 month</th><th>4 month</th><th>6 month</th><th>12 month</th><th>15 months</th><th>18 months</th></tr>
<tr><td>Hepatitis B</td><td colspan="3">Hep B #1</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="3">Hep B #2</td><td colspan="4">Hep B #3</td></tr>
<tr><td>Diphtheria and tetanus toxoids and pertussis</td><td></td><td></td><td>DTaP</td><td>DTaP</td><td>DTaP</td><td colspan="3">DTaP</td></tr>
<tr><td>Haemophilus influenzae type b</td><td></td><td></td><td>Hib</td><td>Hib</td><td>Hib</td><td colspan="2">Hib</td><td></td></tr>
<tr><td>Poliovirus</td><td></td><td></td><td>OPV</td><td>OPV</td><td colspan="4">OPV</td></tr>
<tr><td>MMR</td><td></td><td></td><td></td><td></td><td></td><td colspan="2">MMR #1</td><td></td></tr>
<tr><td>Varicella</td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Varicella</td></tr>
</table>

Notes: Data from the CDC Morbidity and Mortality Weekly Report, January 05, 1996.

Table 1.3. Fraction of Eligible Children under Age 2 in the SIPP

	Actual eligibility	Simulated eligibility
1996	0.485	0.475
1997	0.457	0.469
1998	0.490	0.507
1999	0.482	0.490
2000	0.517	0.516
2001	0.534	0.538
2002	0.534	0.542

Notes: Author's calculation based on the 43,189 observations from SIPP96 and SIPP01.

Table 1.4. Summary Statistics

	All		SCHIP/Medicaid eligible	
% Eligible	0.392		1	
Number of observations	64171		25144	
	Mean	Sd	Mean	Sd
Child Characteristics				
Sex	0.490	0.500	0.490	0.500
White	0.575	0.494	0.420	0.494
Black	0.175	0.380	0.246	0.431
Hispanic	0.186	0.389	0.271	0.444
Other	0.064	0.245	0.063	0.243
Marital Status				
Widowed/Divorced/Separated	0.076	0.265	0.115	0.319
Single	0.210	0.407	0.332	0.471
Married	0.714	0.452	0.553	0.497
Deceased	0.001	0.024	0.001	0.026
Number of Children				
1	0.323	0.468	0.247	0.432
2-3	0.559	0.497	0.576	0.494
4 or more	0.116	0.321	0.176	0.381
Unknown	0.002	0.042	0.000	0.015
Mother's education				
<12 years	0.138	0.345	0.225	0.417
>12 years non-college graduate	0.313	0.464	0.414	0.493
12 years education	0.201	0.401	0.200	0.400
College graduate	0.347	0.476	0.162	0.368
Other Explanatory Variables				
State unemployment rate	4.716	1.027	4.720	1.034
Children's uninsured rate	12.711	5.518	12.732	5.691
Mobility	0.086	0.280	0.084	0.277
Live in urban area	0.354	0.478	0.380	0.485
Hepatitis B law	0.452	0.498	0.442	0.497
Child population	9040999	8310041	9391639	8681145

Notes: Data from NIS 1996-2002 and the sample includes children aged 18-23 month old. Mobility means the child's state of residence at the interview is different from the child's state of birth. Living in urban area means a child lives in one of 28 Immunization Action Plan areas (IAPs) designated by the CDC. Hepatitis B law is a dummy variable and values 1 if a state has Hepatitis B vaccine requirement.

Table 1.5. Summary Statistics for Outcome Variables

	All	SCHIP/Medicaid eligible	Sample mean test
Outcome Variables:			
Panel A: Up-to-date Vaccination Rate			
4:3:1:3 series	0.497	0.468	p<0.001
Hepatitis B series	0.711	0.696	p<0.001
MMR	0.604	0.597	p<0.001
Varicella	0.882	0.868	p<0.001
Panel B: Site of Delivery			
Offering Comprehensive services	0.789	0.765	p<0.001

Notes: Data from NIS 1996-2002 and the sample includes children aged 18-23 month old.

Table 1.6. SCHIP/Medicaid Eligibility and UTD Vaccination Rate without Lengthy Delay (Linear Probability Models)

	OLS				IV			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	4:3:1:3 series	Hepatitis B	Varicella	MMR	4:3:1:3 series	Hepatitis B	Varicella	MMR
Eligibility	0.015**	0.028***	-0.028***	0.004	0.103**	0.131**	-0.073	-0.030
	(0.006)	(0.005)	(0.006)	(0.004)	(0.046)	(0.062)	(0.054)	(0.027)
Female	-0.008	-0.0002	0.003	0.003	-0.010**	-0.003	0.003	0.002
	(0.005)	(0.004)	(0.005)	(0.003)	(0.005)	(0.004)	(0.005)	(0.003)
Hispanic	0.020	0.024	0.030**	0.001	0.019	0.019	0.032***	0.002
	(0.017)	(0.016)	(0.011)	(0.007)	(0.018)	(0.016)	(0.011)	(0.007)
White	0.053***	0.033**	(0.003)	0.013*	0.058***	0.042**	-0.005	0.008
	(0.015)	(0.016)	(0.011)	(0.008)	(0.014)	(0.016)	(0.012)	(0.008)
Black	(0.006)	(0.020)	0.021*	(0.007)	-0.014	-0.023	0.023*	-0.012
	(0.020)	(0.017)	(0.012)	(0.010)	(0.019)	(0.017)	(0.012)	(0.010)
Family size	-0.012***	-0.013***	-0.024***	-0.005***	-0.012***	-0.014***	-0.022***	-0.004**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.003)	(0.004)	(0.002)
High school graduates	0.067***	0.038***	0.012	0.018**	0.070***	0.041***	0.011	0.014*
	(0.010)	(0.008)	(0.007)	(0.007)	(0.011)	(0.008)	(0.008)	(0.007)
some college	0.085***	0.052***	0.030***	0.040***	0.091***	0.063***	0.026**	0.036***
	(0.010)	(0.010)	(0.008)	(0.007)	(0.013)	(0.013)	(0.012)	(0.007)
College Graduates	0.105***	0.063***	0.057***	0.045***	0.126***	0.092***	0.047**	0.036***
	(0.011)	(0.011)	(0.009)	(0.008)	(0.017)	(0.020)	(0.019)	(0.010)
Widowed	0.194**	0.089	-0.229***	0.000	0.164*	0.07	-0.222***	0.013
	(0.074)	(0.093)	(0.075)	(0.046)	(0.083)	(0.101)	(0.076)	(0.048)
Single	0.194**	0.095	-0.233***	(0.026)	0.162**	0.071	-0.227***	-0.015
	(0.072)	(0.095)	(0.080)	(0.044)	(0.080)	(0.103)	(0.081)	(0.046)

Married	0.233***	0.138	-0.227***	0.001	0.211**	0.13	-0.224***	0.009
	(0.072)	(0.093)	(0.077)	(0.047)	(0.079)	(0.100)	(0.077)	(0.050)
Mobility	-0.022**	(0.004)	(0.011)	0.013**	-0.021*	-0.003	-0.009	0.011*
	(0.010)	(0.009)	(0.013)	(0.005)	(0.011)	(0.011)	(0.013)	(0.006)
Urban	-0.019***	-0.027**	0.022**	(0.007)	-0.019***	-0.024*	0.021**	-0.005
	(0.006)	(0.011)	(0.009)	(0.006)	(0.007)	(0.012)	(0.009)	(0.006)
VFC	0.023	0.062	0.031	0.022	-0.055	0.048	0.044	-0.028
	(0.070)	(0.079)	(0.085)	(0.039)	(0.089)	(0.079)	(0.091)	(0.048)
Hepatitis B law	(0.009)	(0.012)	(0.014)	0.003	-0.008	-0.005	-0.017	-0.008
	(0.015)	(0.018)	(0.020)	(0.008)	(0.015)	(0.019)	(0.021)	(0.010)
Unemployment rate	(0.002)	0.010	0.012	0.003	0.0002	0.017**	0.011	0.001
	(0.009)	(0.007)	(0.010)	(0.004)	(0.009)	(0.007)	(0.010)	(0.004)
Child population	0.309	(0.114)	0.094	0.101	0.045	-0.299*	0.082	-0.062
	(0.299)	(0.158)	(0.287)	(0.076)	(0.405)	(0.167)	(0.290)	(0.134)
Uninsured rate	0.002	0.001	0.002	0.000	-0.001	0.0003	0.002	0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Poverty	(0.009)	-0.013**	(0.005)	-0.015***	-0.038	-0.059*	0.013	0.001
	(0.006)	(0.006)	(0.008)	(0.005)	(0.027)	(0.033)	(0.028)	(0.013)
First-stage F					476.26	541.96	566.89	543.14
First-stage R squared					0.4797	0.479	0.480	0.479
Hausman					6.5	5.19	4.08	7.47
					(0.011)	(0.023)	(0.043)	(0.006)
Number of observations	41651	47233	42516	47348	41651	47233	42516	47348

Notes: Coefficients are from both OLS and IV estimates that also include the individual, and state level characteristics listed in Table 2. Standard errors clustered at state level are in parentheses. *, **, and ***denote statistical significance at the 10 ,5, and 1 percent level, respectively, for a two-tailed test. VFC measures the number of vaccine for children sites per child less than 35 months years old.

Table 1.7. SCHIP/Medicaid Eligibility and Site of Delivery (Linear Probability Models)

	OLS	IV
Eligibility	-0.027**	-0.015
	(0.008)	(0.020)
First stage F-statistics		299.490
Partial R-squared		0.030
Hausman Test		2.160
Mean of Dependent Variable	0.789	0.789
Number of observations	33616	33616

Notes: Coefficients are from both OLS and IV estimates that also include state and year indicators. Standard errors clustered at state level are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test.

Table 1.8. IV Estimates for the Whole Sample with Different Sizes of Simulations

	size=1000	size=3000	size=5000	N
Dependent variable				
4:3:1:3 series	0.085*	0.081*	0.103**	41651
	(0.050)	(0.049)	(0.046)	
Hepatitis B	0.122**	0.123**	0.131**	47233
	(0.054)	(0.054)	(0.062)	
Varicella	-0.066	-0.072	-0.073	42516
	(0.054)	(0.053)	(0.054)	
MMR	-0.031	-0.030	-0.030	47348
	(0.025)	(0.025)	(0.027)	

Notes: Coefficients are from IV estimates that also include both year and state fixed effects. Standard errors clustered at state level are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test. The simulation is from the national representative data SIPP 1996-2002.

Table 1.9. Subgroup Analysis Using IV

Dependent variable	4:3:1:3 series	Hepatitis B	Varicella	MMR
Panel A: States have high rate of uninsured children				
Eligibility	0.169*	0.166**	-0.043	0.029
	(0.091)	(0.080)	(0.090)	(0.056)
N	13815	15500	13892	15607
Panel B: Family Income<=400% FPL				
Eligibility	0.107*	0.138**	-0.073	-0.025
	(0.054)	(0.057)	(0.052)	(0.025)
N	29292	34874	30157	34989

Notes: Coefficients are from IV estimates that also include both year and state (or IAP) fixed effects. Standard errors clustered at state level are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test. The 28 urban Immunization metropolitan areas (IAP) are defined by the CDC as those urban areas at risk for low immunization risk.

Table 1.10. Marginal Effects of SCHIP/Medicaid Eligibility on the Probability of Being UTB for Childhood Vaccines without Lengthy Delays

Dependent variable	OLS	Probit	N
4:3:1:3 series	0.015**	0.016**	41651
	(0.006)	(0.007)	
Hepatitis B series	0.028***	0.027***	47233
	(0.006)	(0.005)	
Varicella	-0.028***	-0.029***	42516
	(0.007)	(0.007)	
MMR	0.004	0.003	47348
	(0.004)	(0.004)	

Notes: Marginal effects are reported. Standard errors clustered at state level are reported in parentheses. Models include both state indicators and year indicators. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.11. Lower Bounds and Upper Bounds of the Impact of SCHIP Expansions on the Probability of Being UTD for Childhood Vaccines without Lengthy Delays

Dependent variable	OLS	Bivariate Probit	Rho	N
4:3:1:3 series	0.015**	0.195***	-0.151**	41651
	(0.006)	(0.017)	(0.073)	
			[0.048]	
Hepatitis B series	0.028***	0.237***	-0.103*	47233
	(0.006)	(0.016)	(0.056)	
			[0.072]	
Varicella	-0.028***	0.072***	-0.004	42516
	(0.007)	(0.017)	(0.050)	
			[0.9336]	
MMR	0.004	0.169***	-0.096*	47348
	(0.004)	(0.022)	(-0.058)	
			[0.099]	

Notes: Marginal effects are reported from both OLS and bivariate probit regression. Standard errors clustered at state level are reported in parentheses. Models include both state indicators and year indicators. * Significant at 10%; ** significant at 5%; *** significant at 1%. P values for the Wald test of the hypothesis that rho=0 are reported in the brackets.

Chapter 2

The State Children's Health Insurance Program (SCHIP) and Birth Outcomes of Teenage Mothers

Jing Xu*

Abstract

One key debate in recent U.S. health care reform is the effects of improving health insurance access to people who are previously uninsured or underinsured on their health outcomes. This paper shed lights on this issue by investigating the impact of health insurance expansions under the 1997 State Children's Health Insurance Program (SCHIP) on the health of newborns born to teenage mothers. I employ ordered probit and quantile regression to evaluate the existence of heterogeneous eligibility effects on birth outcomes among teenage mothers. To my knowledge, this is the first paper to provide a national estimate of the effects of the SCHIP expansion on birth outcomes of teenage mothers. Results show that increased public insurance eligibility is associated with significant improvements in prenatal care utilization among teenage mothers. For teenage mothers with singleton births, the expanded insurance eligibility is associated with a small but significant increase in birth weight. I also find that pregnancies with lower health endowments may benefit more from the expanded eligibility than pregnancies with great endowments.

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2.1. Introduction

Infant health is a great public concern not only because it has a long-term impact on infants' future health status, but also because poor health may impose huge medical costs to the whole U.S. health care system. Providing public health insurance to pregnant women, infants, and children with low social economic status may play an important role in promoting infant health for two reasons. First, people with health insurance coverage may have increased access to medical care services. Health insurance coverage could reduce the out-of-pocket cost from medical bills and therefore reduce financial burdens for families. These increased access and price reduction effect are expected to help vulnerable families meet their need for health care services in a timely manner. While there is extensive research studying the effects of providing health insurance to those who are previously uninsured on their health outcomes, few definitive conclusions have been reached. Furthermore, there has been concern that expanding public health insurance eligibility may increase health care utilization by those who are self-selected into public health insurance programs (Currie and Gruber 1996a; Currie and Gruber 1996b; Cutler and Gruber 1996; Cutler and Gruber 1997; Doyle 2001; Levy and Meltzer 2004; Levy and Meltzer 2008; Chou et al. 2011).

The goal of this paper is to estimate the impact of the 1997 State Health Insurance Program (SCHIP) expansions on birth outcomes among teenage mothers.[17] The target population in this paper is teenage mothers due to their high risk of having adverse birth outcomes. Most importantly, low income teenage girls are also more likely to experience teenage pregnancy as well as barriers to health care services. The passage of the 1997

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[17] The State Children's Health Insurance Program now is referred as "CHIP". In this paper, I still use "SCHIP" to follow the existing literature on this program.

SCHIP expands the income eligibility of public health insurance including reproductive services to low income children under 19. This expanded public health insurance program may improve the health outcomes of newborns by allowing the early and adequate prenatal care services for teenage mothers.

To address the endogeneity concern associated with the SCHIP state eligibility, I employ a simulated instrumental variable to control for the omitted variables such as state sentiment against teenage pregnancy and state level infant health outcomes which are correlated with both the birth outcome from teenage pregnancy and state level generosity for teenagers under SCHIP programs. My results suggest that that increased public insurance eligibility is associated with significant improvements in prenatal care utilization among teenage mothers. For teenage mothers with singleton births, the expanded insurance eligibility is associated with a small but significant increase in birth weight. I also find that pregnancies with lower health endowments may benefit more from the expanded eligibility than pregnancies with great endowments.

The rest of the paper is structured as follows. The second section provides background information for teenage pregnancy issues and institutional knowledge of the 1997 SCHIP expansions. The third section reviews the previous literature of the effects of increased access to health insurance on the health outcomes. The fourth section then focused on the data description and empirical identification strategies. The fifth section presents empirical results, and the last section concludes.

2.2. Background

2.2.1. Teenage Pregnancy

Teenage pregnancy has continued to be one of the main social and public health issues which have attracted great attention from policy makers over the years. Although there has been a decrease in both teenage pregnancy rate and birth rate over decades due to great efforts in teenage pregnancy prevention, approximately one million teenage girls become pregnant every year in the United States. Among all these U.S. teen pregnancies, 82% are unintended and two-thirds of the teen pregnancies occur among teens aged 18 to 19 years old.

Teenage pregnancy is an important public issue since it imposes great individual costs as well as social costs to both the baby and the teenage mother. In terms of the individual cost, previous studies suggest those teenage mothers are more likely to lose educational opportunities and therefore have reduced socioeconomic attainment in their adulthood (Kaestner et al., 2003). Given that teenage pregnancy is associated with high risk of adverse birth outcome such as low birth weight (<2500 grams) and infant mortality, it may also increase individual health costs. According to the medical literature, infant mortality rates vary with maternal age. Infants of teenage mothers and mothers aged 40 and above have the highest rates of adverse health outcomes. Specifically, adolescent females are two times more likely to deliver a low birth weight infant than are adult females. Those children of young mothers also suffer a disproportionately high rate of infant mortality and morbidity. Previous studies suggest that the two primary reasons for the high risk of low birth weight associated with teenage pregnancy are "Nature" and "Nurture". The term "Nature" emphasizes biological factors such as the immaturity of female reproductive system in adolescence and inadequate prenatal weight gain. Nurture points to socioeconomic attributes of teen mothers such as poverty and minority status. The socioeconomic status of teenage mothers plays an important role in the health outcomes of newborns (DiClemente et al., 1996). Children of teenage mothers tend to receive less medical attention and care than children from older mothers. Lack of medical advice about optimal weight, nutritional gain, and inadequate prenatal care also play an important role in adverse birth outcomes from teenage mothers (Roth et al. 1998). Consequently, the high incidence of adverse birth outcomes leads to a great social cost in terms of the increased use of public health services.

Low birth weight is one of the common indicators of adverse birth outcomes. It is a serious medical condition for two reasons. First, low birth weight is associated with developmental abnormalities including delayed cognitive development and other central nervous system disabilities. Second, low birth weight infant have much higher rates of mortality and morbidity. As a result, great amounts of health care resources are devoted to the treatment of low birth weight infants. In the U.S., the average hospital charges $75,000 per child for babies with a primary diagnosis of low birth weight or premature delivery (O'Connor 2004). In addition to this huge medical cost, low birth weight also imposes other difficulties such as the extra time that parents devoted to caring for their low birth weight babies.

2.2.2. SCHIP

The State Children's Health Insurance Program was prompted by the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) in 1996 and was enacted in 1997. The initial authorization of SCHIP allows the program to have more than 40 billion dollars funding, which represents one of the largest public health insurance expansions for children in the United States. In February 2009, President

Obama passed the Children's Health Insurance Program Reauthorization Act, which expands the healthcare program to an additional 4 million children and pregnant women. SCHIP covers the neonatal care, immunizations, well-baby checkup, and child care. In addition, SCHIP also allows each state to provide pre-pregnancy family planning services and supplies to eligible children. Almost every state had taken advantage of this new funding and gives the program a potential to help 2.7 million uninsured teenagers with their reproductive health care needs (Gold 1999). Furthermore, seven states even provide SCHIP-funded prenatal care to pregnant immigrant women. These changes are motivated by the fact that babies who were born to low-income families would be eligible for SCHIP/Medicaid upon birth, but their mothers might not have had adequate prenatal care due to family incomes cutoffs.

The 1997 SCHIP expansion is motivated by the high uninsured rate of children from low income families and the low take-up rate in Medicaid. There are approximately 11.5 million uninsured children in the United States after a major expansion in Medicaid in the early 1990s. Two-thirds of all uninsured children come from working poor families. For example, Guendelman et al. (2001) find that more working poor children were uninsured in insurance coverage compared with children with nonworking poor parents. This suggests that children from working poor families may experience greater barriers to heath care than other children. More importantly, children aged 14 and over have higher rates of uninsured than children aged below 6. This is possible because the age group of six years-old and below used to have more generous eligibility cutoffs than the other group has. Hence, SCHIP may have greater effects on teenagers compared with children under age six.

Similar to Medicaid, SCHIP is a joint federal-state program, which means the federal government matches state spending on eligible program beneficiaries. One concern with the public health insurance program is the challenge to retain enrollment. Monthly turnover is a considerable issue, particularly at 6- and 12-month renewal periods as income, family circumstances, and administrative activities changed. To assure stability for enrollees, SCHIP employs a variety of strategies, such as providing one year continuous eligibility, mailing preprinted renewal forms, and providing grace periods when premiums are late. However, the federal government has a cap on their SCHIP spending every year for the program through 2007. When either state or federal funding limits are reached, states may impose a waiting list.

Finally, states have a lot of flexibility to design their own SCHIP program in terms of the implementation date, income eligibility, program types, and application process. Table 2.1 shows the SCHIP income eligibility threshold, program type, and implementation date across states. SCHIP eligibility levels ranges from 133% of the Federal poverty Line in Wyoming to 350 percent of the Federal Poverty Line in New Jersey and Tennessee. However, the majority of the states expanded their income cutoff to the level of at least 200 percent of the Federal Poverty Line. States also can choose different types of SCHIP to implement. There are three different types of SCHIP across states. First, states can choose to build a separate-administrated SCHIP. They also have the option of extending their existing Medicaid programs by increasing income eligibility cutoffs. Finally, states can have a combined SCHIP program. For those states chose to have the combined program, they usually have a Medicaid expansion for one age group and a separate-administrated SCHIP for the other age group. In summary, eighteen states and D.C. chose to extend Medicaid, fifteen states created a stand-alone SCHIP, and seventeen states had the combined SCHIPs. Researchers have different opinions on the impact of different types of SCHIPs. Lo Sasso and Buchmueller (2004) suggest that the distinction among different types of SCHIP is not important with respect to its impact on the lack of insurance among children. Kronebusch and Elbel (2004) report that Medicaid expansion programs are more effective, while Wolfe and Scrivner (2005) find that stand-alone programs are associated with greater levels of public insurance.

In addition to the great flexibility in the program design, state governments also place great efforts to simplify SCHIP application process and prevent possible crowd-out effects. This allows the program to reach the real "unreached" and increase the take-up rates. To simply the application process, every state has a number of administrative reforms for SCHIP application. To further streamline the process, some separate SCHIP programs accept self-reported family income when determining financial eligibility.[18] Moreover, most states also have legislation to minimize the negative effects of crowd-out. The most common strategy was the waiting-time requirement which requires that children must be without insurance for 3-6 months prior to enroll in SCHIP.

2.2.3. Links between Eligibility Expansions and Birth Outcomes

Pregnancy insurance and the related reproductive services provided by SCHIP could potentially improve the health outcomes of newborns from teenage mothers through several ways. First, the risk of having a low birth weight baby decreases when pregnant women receive early and regular prenatal care provided by pregnancy health insurance (Fraser et al. 1995). Pregnant women without access to prenatal care are more

[18]Alabama, Arizona, Connecticut, Florida, Georgia, Maryland, Michigan, Mississippi, Vermont, Washington, and Wyoming accept self-reporting.

likely to deliver low birth weight babies and premature infants than those who receive prenatal cares. Expanding income eligibility of SCHIP/Medicaid for pregnant women will increase the probability that they have access to prenatal care, which is highly cost-effective in reducing the rate of pregnancy complications and birth defects. Prenatal care services also provide nutrition advice as well as support with quitting risk prenatal behaviors such as smoking and drinking issues. Furthermore, certain medical conditions which adversely affect the birth outcome can be timely detected and treated in the early stage.

Being eligible for public health insurance could also minimize the out-of-pocket money for medical service and increase the disposable income on other expenditures such as nutrition that may improve both mother and baby's health. Third, SCHIP may also have indirect effects on newborns health by referring the ineligible applicants to Medicaid and hence increases the take-up rates in Medicaid. For example, if applicants are eligible for Medicaid rather than SCHIP, the program will refer those applicants to the proper Medicaid application. Finally, health insurance is especially important for teenage in the post-welfare reform era. Kaestner et al. (2003) find that in the post-welfare reform era, teenage mothers are less likely to receive welfare and are more likely to live with at least one parent than in the pre-reform era. As one of the biggest health insurance expansion in the post- welfare reform, the 1997 SCHIP expansion may have particularly great impact on teenage mothers.

2.3. Literature Review

In the economics literature, research on health insurance programs and infant health is well established. Those studies are extensively focused on Medicaid reforms that took place between 1984 and 1990. Currie and Gruber (1996b) find that the increased income eligibility for pregnant women in Medicaid lowered infant mortality rate and low birth weight rate. Kaestner et al. (1999) and Dubay et al. (2001) question these findings since states have large fraction of poor and near-poor women should have large effects in improving health outcomes. They also point out that the data issue is one of the main challenges to provide a well-defined treatment and control group. Joyce (1999) find that Prenatal Care Assistance Program(a part of the Medicaid program in New York) is associated with a 20% increase in mean birth weight of 35g and a 1.3 point percentage point drop in the rate of low birth weight. His results, however, has limited ability to draw a national wide conclusion. Dubay et al. (2001) construct control and treatment groups based on race, mother's education, and marital status in a pre- and post-design. Their results suggest that health insurance expansions only reduce the low birth weight for some white women with low social economic status. However, they did not address the targeted expansions occurring between 1981 and 1984 that Currie and Gruber (1996b) find to be important. However, there is also evidence that increasing the generosity of insurance was of little benefit on health outcomes (Ray et al., 1997; Epstein and Newhouse 1998). However, those studies focused mainly on the health outcome of adults.

There are also extensive studies evaluating the effects of SCHIP on the health outcomes of infants. However, few studies have investigated the effects of SCHIP on teenagers while SCHIP has more generous expansion to children aged 15 and above. In one of the few studies focused on the effects of SCHIP on teenagers, Adams et al. (2008) analyze coverage changes for teenage mothers relative to those for mothers aged 20 to 24 years old before and after SCHIP using a difference-in-difference (DD) strategy. Their results demonstrate that SCHIP implementation is associated with an almost 10 percentage point increase in pregnancy coverage among teenage mothers under age 17. One potential criticism of DD estimates is the difficulty of identifying appropriate control group and treatment group. One can argue that the pre-trend of pregnancy may be very different for teenage mothers and mothers aged 20 to 24 years old. Additionally, their study is limited to seven states and therefore their ability to draw conclusions about the national effects of SCHIP is limited.

In this paper, I investigate the effects of public health insurance expansion through SCHIP on birth outcomes among teenage mothers. It contributes to the current literature in following ways. First, I focus on the effects of SCHIP implementation on teenagers aged 15 to 18 rather than children under age 15 since teenagers gain relatively more benefits in post-SCHIP era than those younger children. Additionally, rates of pregnancy among teenagers under age 15 are very low. Second, I employ a simulated instrumental variables estimation developed by Currie and Gruber (1996a, 1996b) to address the endogeneity issue of the enrollment measure and state choice of program eligibility. The identification is from substantial variation in SCHIP/Medicaid eligibility thresholds by state and year. I also address the measurement error in the eligibility calculation by utilizing the data from Survey of Income and Program Participation (SIPP) where the income is measured monthly to overcome the data limitation of CPS data used in Currie and Gruber's 1996 paper. While eligibility for Medicaid is determined on the basis of monthly income, the income information from CPS is measured annually. Third, I also employ ordered probit and quantile regression to evaluate the existence of heterogeneous eligibility effects on birth outcomes from teenage mothers. Finally, to my knowledge, this is the first paper to provide a national estimate of the 1997 SCHIP expansions on birth outcomes among teenage mothers. I would expect to find improved birth outcomes with the increased insurance income eligibility.

2.4. Data

I utilize two different data sources for the empirical analysis. The first data is the annual, linked birth and infant death micro data produced by the National Center for Health Statistics (NCHS). I use this data from the 1996 to 2002 period. In addition, I employ data from the 1996 and 2001 panel of Survey of Income and Program Participation (SIPP). Both datasets cover the pre- and post-SCHIP time.

The 1996-2002 linked birth/death vital statistics includes all births in a given calendar year occurring within the United States and all death for the infants born during that calendar year who died before reaching one year of age.[19] These files provide detailed information on newborns' demographic information such as date of birth, age, birth plurality, maternal educational attainments, marital status, maternal risk behavior during pregnancy, live-birth order, race, sex, and geographic area. Using a nationally representative data, Dubay et al. (2001) conclude that maternal schooling, marital status, and risk behavior can effectively sort women by social economic status and hence to identify groups that are more likely to be affected by the public insurance expansion. Most importantly, the linked vital statistics data also includes health information on birth weight, gestation, prenatal care, and infant mortality. I restrict the sample to those births

[19] I employ all states in the United States except Maine, North Dakota, South Dakota, and Wyoming because SIPP group those states together.

given by mothers aged 15 to 19 and has no previously live birth records.[20] I focus on teenage mothers who have no previously live births because of the differential effects of new participants and experienced participants. Put differently, mothers who already have live birth before are likely to obtain earlier and more prenatal care. The resulting sample includes 2,017,961 observations. Table 2.2 presents the summary statistics of the final sample. For all teenage mothers aged 15 to 18, 14.1 percent of the sample smoked during their pregnancies. Only 32.5 percent of those mothers were married at the time when they were pregnant. Table 2.2 also reports some state level characteristics. These include state level unemployment rate, state female teenage populations, and state TANF case application number.

The full set of the 1996 and 2001 panels of SIPP are employed to construct the “simulated eligibility” to measure the state generosity of SCHIP eligible income cutoffs. The SIPP data is a multi-panel, nationally representative dataset created by the U.S. Census. The first SIPP panel began interviews in 1983 with 19,878 households. Then the SIPP was redesigned in its 1996 panel with interviewing 37,000 households. The SIPP respondents are interviewed every four months with questions on their individual as well as family information over the prior four months. The SIPP content is built around a “core” questionnaire provides labor force, program participation, and income information. In addition to this core section, the SIPP also provides broader information by adding questions on variety topics such as living arrangements, child care, wealth, program eligibility, disability and taxes. I mainly use information from the household and family relation session, and the income and poverty session.

[20] I include mothers aged 19 since most of them were age 18 when they were in their first trimester.

I combined these two panels and obtain a dataset that covers the SIPP survey from 1995 to 2002. To be consistent with my target population in the linked birth/death data, I also restrict the data from the SIPP panels to female teenagers aged from 15 to 19. Moreover, to address the famous “seam bias” of SIPP data (Moore, 2008), I follow Leininger et al. (2010) and only keep observations that are in the fourth reference month at interview date. Table 2.3 provides the mean values of the endogenous actual fraction of state eligibility and the instrumental variable simulated eligibility fraction over time. In general, it increases over time.

2.5. Health outcomes

Given that increased access to health insurance could result in enhanced prenatal care which could improve birth outcomes, I first examine the effects of SCHIP expansions on the number of prenatal visits among teenage mothers. I also analyze three measures of infant birth outcomes. The first is an indicator variable of infant mortality. Infant mortality measure reflects both the health of the fetus and the effects of access to possible intervention employed during and after birth. The second measure is an indicator variable of low birth weight which means birth weight is less than 2,500 grams. The third measure is a continuous variable of the birth weight of infants. I chose birth weight rather than gestational age because birth weight has relatively few missing values. The information on gestational age in the final sample is missed for a substantial proportion of all live births. Table 2.4 reports summary statistics for the outcome variables. For infants born to teenage mothers, 8.8 percent of all births in the sample is very low birth weight or low birth weight; 0.8 percent of all live births babies died before they reach one year of age. While the average birth weight of all singleton birth is 3211.36 grams, the mean birth weight of twin births is only 2123.35 grams. In contrast to singleton birth, babies of twin births are more likely to be very low birth weight or low birth weight. The infant mortality rate before age one for twin births babies is 5.5 percent, which is also much higher than the infant mortality rate of singleton babies.

2.6. Identification Strategy

Two general approaches have been employed to evaluate the impact of health care expansions in the existing literature: difference-in-differences (DD) and instrumental variables (IV) estimations. DD estimation is appropriate when the intervention itself is randomly assigned. As Bertrand et al. (2004) pointed out one debate around the validity of a DD estimate usually revolves around the possible endogeneity of the interventions themselves. The other common problem with DD estimates is the failure of the parallel trend assumption. Put differently, it is difficult to identify an appropriate control group for the treatment group under the parallel trend assumption. In this case, the difference in difference estimator would be biased.

Instrumental variables can address the issue of endogeneity. In this paper, three potential sources of endogeneity may bias the traditional OLS estimation. First, the state eligibility is arguable endogenous to birth outcomes. The state level program eligibility cutoffs are chosen based on economic and demographic characteristics of individuals in that specific state, which may also be correlated with birth outcomes. Second, it is also possible that unobserved state sentiment toward teenage pregnancy may affect both teenage birth outcomes and state generosity for public health insurance. Third, individual who need public insurance may also choose to move to states nearby that has more generous eligibility cutoffs. Therefore, the state level income eligibility of public health insurance programs is likely to be endogenous.

To address this endogenous issue and potential measurement errors in assigning income cutoffs, I adopt the simulated instrument variables strategy pioneered by Currie and Gruber (1996a). The idea is to use one single simulated measure of the generosity of the state's public insurance programs to instrument for the state actual fraction of eligible people. The actual eligibility fraction is calculated based solely on the state eligibility rules for public insurance in a given year. I then utilize the SIPP data to implement the simulation of eligibility fraction since the SIPP is nationally representative and has detailed information on family structure and income level. The eligibility criteria for pregnancy insurance through Medicaid and SCHIP are from the annual maternal and child health update from the National Governors Association. Table 2.5 summarized the state level eligibility information for 1996 and 2002. Almost all states increase their eligibility threshold after the 1997 SCHIP expansion. To determine the eligibility, I follow the previous work (Busch and Duchovny 2005; Leininger et al. 2010), and assigned individual eligibility solely based on gross income thresholds. I do not utilize other relevant measures such as earning disregards since the various rules applied to different states and lack of information on income sources. For example, some states have the non-income rules such as "the 100 hour rule" to limit individual income eligibility. Meanwhile, individuals may be eligible for public health insurance through the Temporary Assistance for Needy Families (TANF) program, which replaced the Aid to Families with Dependent Children (AFDC) before 1996. Therefore, I also use information on income eligibility thresholds for AFDC/TANF in order to determine whether individuals are eligible for Medicaid though AFDC/TANF. The information on the state TANF information is from the Urban Institute's TRIM3 model and Welfare Rules Database.

Following the criteria described above, I employ two steps to construct the simulated instrumental variable. First, I randomly select 5000 teenage females from the SIPP sample. I then calculate the fraction of the 5000 sample that would be eligible for SCHIP/Medicaid across states. When I construct the simulated instrumental variable, I random draw the sample without replacement because when the data set is very large, the results from the random draw with and without replacement are likely to be similar. The reason is that the probability of any given observation being selected into the sample is low in a very large data set. Hence, the odds of being selected a second time is also low. As a result, observations that have already been selected into the sample have the same probability of selection has observations that have not yet been selected into the sample. The constructed "simulated instrument" varies only with a state's legislative environment rather than its economic and/or demographics characteristics. Hence, the simulated instruments shall satisfy the exogeneity and relevance assumptions for a valid instrument.

To evaluate the effects of public health insurance expansions, I first estimate the following equation:

$$Y_{ist} = \alpha + \beta \cdot ELIG_{st} + \Theta X_{ist} + \varphi \cdot Z_{st} + \gamma T_t + \delta S_s + \varepsilon_{ist} \quad (1)$$

Y_{ist} is the measure of the birth outcomes from teenage mothers for individual i in state s and year t. $ELIG_{st}$ is the fraction of children eligible for public health insurance (Medicaid or SCHIP); X is a vector of individual demographic information including gender, age, and maternal information such as ethics, education attainment, and marital status. Z is the state level controls such as state unemployment rate in year t. To control for the unobserved variables that are invariant at state and year level, I also include both state and year dummies to capture the unobservables that are constant within a state or constant across states within a year.

To the extent that some variables may not be captured by state and year dummies, the eligibility coefficient will be biased. To address this concern, I also control for the state level information including state unemployment rate, state teenage population, and state TANF caseload number in each year. Finally, I also control for the type of SCHIP in all models.

I conduct separate analysis of birth outcomes for singletons and twins from teenage mothers. Two reasons motivate the separate analysis in terms of plurality. First, multiple births accounted for almost 21 percent of all low birth weight births and 13 percent of all infant deaths, although twins only constitutes 3 percent of all births (Kogan et al., 2000). In contrast, the rate of low birth weight among smokers was 11.9%. Compared with singleton births, multiple births in the United States are much likely to be low birth weight. Moreover, the multiple births have accounted for an increasing share of all low birth weights births. Second, a large portion of twin delivers is covered by the Medicaid/SCHIP. For example, there were over 40,000 deliveries to twins in New York City between 1988 and 2001, of which approximately 11,000 were to women on Medicaid. Hence, it is plausible that public health insurance expansion may have heterogeneous effects on birth outcomes among singletons and twins.

2.7. Results

Before presenting my IV results, I first show the trend of SCHIP expansion and the birth outcome of teenage mothers in the United States from 1996 to 2002. Figure 2.1 shows the income eligibility of SCHIP/Medicaid. With the 1997 SCHIP expansion, the income eligibility of the two programs increases over time. Figure 2.2 shows the rate of LBW (low birth weight per thousand live births) over the same study period. The figure suggests that there is a drop in the number of LBW babies right after 1997. However, the rate is quite stable in general among all live births among teenage mothers.

2.7.1. Analysis of Prenatal Visits

Table 2.6 presents the results of SCHIP expansion effects on the number of prenatal care visits. Both OLS and IV estimates show that the SCHIP eligibility expansion has increased the number of prenatal care visits of teenage mothers. The results are mainly driven by those teenage mothers who carried singleton births. The IV estimates for singleton births suggest that a 1 percentage increase in eligibility fraction is associated with a 0.438 percentage points increase in prenatal visits. This also represents a 4.1% increase in the number of prenatal visits among those who had single-fetal pregnancy. The result is statistically significant at 1% level. However, the expansion effects on prenatal care visits are not significant for teenage mothers who have multi-fetal pregnancies. One possible explanation for such result is that a multi-fetal pregnancy is more risky than the single–fetal pregnancy and this may lead to a relatively more frequent prenatal care visit anyway.

2.7.2. Analysis of Birth Outcomes among Singletons

Table 2.7 shows estimated coefficients and standard errors for the impact of SCHIP expansion on singleton birth outcome of teenage mothers. The OLS and IV estimates are quite different from each other in terms of the coefficient magnitude as well as the significant level. While the OLS estimates show that the SCHIP expansion has no significant improvements in the birth weight of infant, the IV estimate suggests that 1 percentage increases in state eligibility fraction is associated with an increase in the baby's birth weight by 17.9 grams and it is statistically significant at 10% level. In column 4 of the second row, the IV estimate suggests that the effect of SCHIP expansion on the incidence of low birth weight among teenage mothers is negative and statistically significant at 1 percent level. The results suggest that 1 percent increase in eligibility fraction reduce the probability of having low birth weight singleton baby from teenage mothers by 1.6 percentage point, which represents a 17% reduction. Finally, the bottom panel of Table 2.6 describes the results for infant mortality. Both OLS and IV estimates suggest that the expansion has no effects on the incidence of infant mortality for singleton birth among teenage mothers.

2.7.3. Analysis of Birth Outcomes among Twins

Table 2.8 contains both OLS and IV estimates of SCHIP expansion on birth outcomes among twin births. Compared to the analysis of singleton birth, I find that the expansion on public health insurance has no significant impact on infants' birth weight and the incidence of low birth weight. However, the IV estimate in column 4 of the third row suggests that the expansion has negative and significant effect on the incidence of infant mortality and it is statistically significant at the 10% level. One possible explanation for this is that maternal insurance coverage provides better access to prenatal care which allows better monitoring and better treatment. The mean weight of new born from twin births is 2158 grams, which implies that twin births are the group most likely to have prenatal treatment. Moreover, due to the medical risk and maternal biological restrictions (the “nature” issue) for multi-fetal pregnancy teenage mothers, it is plausible that the expanded health insurance may not significantly influence the incidence of having low birth weight babies.

2.8. Robustness Checks

One concern about the true effects of the SCHIP expansion on birth outcomes is that the effects of eligibility expansions on birth outcomes may vary at different levels of birth weight (Almond et al. 2005). Therefore, I re-estimate equation 1 using an ordered probit model by categorizing birth weight into three different categories. The three categories of birth weight are specified as follows: 1) very low birth weight defined as<1500 grams; 2) low birth weight defined as 1500 grams to 2499 grams; and 3) normal birth weight defined as 2500 grams and up. Table 2.9 reports results from ordered probit model. The two columns report coefficients, z-scores, and changes in probability of different categories for singleton and twin births, respectively. The results suggest that increased health insurance eligibility is associated with a decrease in the probability of having a very low birth weight or low birth weight baby among teenage mothers with singleton births. However, this change in birth weight is not big enough to push an infant’s birth weight into different categories. Similar results are found for twin births.

To further evaluate the existence of the heterogeneous eligibility effects on birth weight, I then use quantile regression rather than ordered probit regression since quantile regression preserves all the within-category information that may lost through categorization. Table 2.10 shows the estimates of the effects of eligibility expansion on different quantiles of the distribution of birth weight. Coefficients and standard errors from quantile regressions at the 10th, 25th, 50th, 75th, and 90th quantiles are reported. As listed in Table 2.10, the results are only significant at the 5th quantiles but not significant at the upper quantiles. For singleton and twin births, one percent increase in SCHIP/Medicaid eligibility is associated with 12.89 grams and 162.10 grams, respectively. Infants with lower health endowments with all else equal are more likely to be at lower quantiles compared to infants with more endowments. In this case, my results imply that pregnancies with lower health endowment may benefit more from the increase health care access.

Lastly, I also conduct a few sensitivity analyses to examine whether the results were sensitive to the control variables listed in Table 2.6. The first concern is that the secular decline in smoking during pregnancy over the study period may provide a good illustration of potential confounding (Markowitz et al. 2011). To address this issue, I control for maternal risk behaviors during pregnancy such as smoking and drinking besides the infant and maternal demographic information in regression specification 1. I then also add other state level controls such as the state level TANF caseloads to capture the possible confounding trends. In general, the effects on birth weight and the incidence of low birth weight are quite robust. The results are ranged from 15.19 grams increase to 17.80 grams increase for birth weight. For the incidence of low birth weight, the estimates are from 1.7 percentage decrease to 1.8 percentage decrease. The robustness check for the analysis of twin births shows the same pattern. Adding more control variables basically does not change the results from the main regression results reported in Table 2.11.

To summarize, I find the expansions in SCHIP lead to significant improvements in prenatal care utilization and newborns' health from teenage mothers with singleton birth are quite robust. My results also indicate that pregnancies with lower health endowments may benefit more from the expanded eligibility than pregnancies with great endowments.

2.9. Conclusion

I use the linked annual vital statistical data from 1996-2002 to investigate the effects of SCHIP eligibility expansion on prenatal care utilization and birth outcomes among teenage mothers. My results suggest that the SCHIP eligibility expansion leads to an increase in both prenatal care visit and birth weight of singleton births but not for twin births of teenage mothers. However, the magnitudes of the effects on birth weights are small - a one percentage increase in eligibility is associated with a 15.19 to 17.80 gram average increase in birth weight of singleton births. Using ordered probit as a further check of the results, I find that the increases in birth weight are, however, not large enough to re-categorize a baby from very low to low birth weight, nor from low to normal weight. With the heterogeneous effects of eligibility expansion on birth weight, my results from quantile regression indicate that pregnancies with lower health endowment may benefit more from the expanded eligibility than pregnancies with great endowments. My results also confirm the previous studies that public insurance eligibility expansion may lead to some improvements in health outcomes but with smaller magnitudes (Hanratty 1996, Currie and Gruber 1996b, Chou et al. 2011). These findings provide new evidence that health insurance coverage could improve birth outcomes of those who have relatively low socioeconomic status. The enormous health costs spent on the treatment of adverse birth outcomes highlight the need for enhanced efforts to increase health insurance access to groups such as teenage mothers who are more likely to have adverse birth outcomes. In addition to the teenage pregnancy prevention programs, public policy makers should also improve health care access and provide additional support to low-income teenagers who are pregnant or have babies already.

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Table 2.1. Summary of SCHIP expansions by State and Time

State	Expansion type	Implementation time
Alaska	M	Mar-99
Alabama	C	Feb-98
Arkansas	M	Oct-98
Arizona	S	Oct-97
California	C	Mar-98
Colorado	S	Apr-98
Connecticut	C	Jul-98
District of Columbia	M	Oct-98
Delaware	S	Oct-98
Florida	C	Apr-98
Georgia	S	Sep-98
Hawaii	M	Jan-00
Iowa	C	Sep-98
Idaho	M	Oct-97
Illinois	M	Jan-98
Indiana	C	Sep-98
Kansas	S	Jul-98
Kentucky	C	Jul-98
Louisiana	M	Nov-98
Massachusetts	C	Oct-97
Maryland	M	Jul-98
Maine	C	Aug-98
Michigan	C	May-98
Minnesota	M	Sep-98
Missouri	M	Oct-97
Mississippi	C	Mar-97
Montana	S	Jan-98
North Carolina	S	Oct-98
North Dakota	C	Oct-98
Nebraska	M	May-98
New Hampshire	C	May-98
New Jersey	C	Feb-98
New Mexico	M	Mar-99
Nevada	S	Oct-98
New York	C	Apr-98
Ohio	M	Jan-98
Oklahoma	M	Dec-97
Oregon	S	Sep-98
Pennsylvania	S	Jun-98
Rhode Island	M	Oct-97
South Carolina	M	Aug-97
South Dakota	M	Jul-98
Tennessee	M	Oct-97
Texas	C	Jul-98
Utah	S	Aug-98
Virginia	S	Oct-98
Vermont	S	Oct-98
Washington	S	Jan-00

Wisconsin	M	Apr-99
West Virginia	C	Jul-98
Wyoming	S	Apr-99

Notes: M indicates Medicaid, S indicates stand-alone SCHIP, and C indicates combined program. Data on the SCHIP type and implementation dates from the Centers for Medicaid Services (CMS) available at: http://medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Childrens-Health-Insurance-Program-CHIP/CHIP-Eligibility-Standards-.html.

Table 2.2. Summary Statistics

	N=2,281,544			
	Mean	St. Dev.	Minimum	Maximum
Mother's Characteristics				
Age	17.678	1.188	15	19
White	0.790	0.407	0	1
Black	0.174	0.379	0	1
Other race	0.036	0.185	0	1
Some high school	0.488	0.500	0	1
High school graduate	0.355	0.479	0	1
Above high school	0.067	0.229	0	1
Married	0.325	0.468	0	1
Single	0.675	0.468	0	1
Smokes	0.141	0.348	0	1
Drinks	0.005	0.067	0	1
Infant's Characteristics				
Singleton	0.992	0.120	0	1
Twins	0.008	0.119	0	1
Birth weight	3203.050	576.086	227	7960
Low birth weight	0.088	0.279	0	1
Death	0.008	0.088	0	1
Female	0.486	0.500	0	1
Other explanatory variables				
State female teenage population	416,977	325,005	21,581	1,193,734
State unemployment rate	4.633	1.096	2.3	7.6
State TANF case load	60,863	101,714	1,275	895,959

Notes: Data from the linked vital statistics 1996-2002.

Table 2.3. Fraction of Female Teenage Eligible for Public Insurance in the SIPP

	Actual eligibility	Simulated eligibility
1996	0.404	0.394
1997	0.399	0.401
1998	0.445	0.458
1999	0.436	0.456
2000	0.469	0.473
2001	0.470	0.488
2002	0.474	0.489

Notes: Author's calculation based on the 43,189 observations from SIPP96 and SIPP01.

Table 2.4. Summary Statistics for Outcome Variables

	All			Singleton			Twin		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Number of prenatal visits	10.916	4.060	2,281,544	10.913	4.046	2,264,128	11.391	5.479	17,182
Birth weight in grams	3203.050	578.557	2,281,544	3211.357	569.641	2,264,128	2123.351	693.173	17,182
Very low birth weight	0.016	0.125	2,281,544	0.015	0.120	2,264,128	0.171	0.377	17,182
Low birth weight	0.072	0.258	2,281,544	0.068	0.252	2,264,128	0.519	0.500	17,182
Normal birth weight	0.913	0.283	2,281,544	0.917	0.276	2,264,128	0.309	0.462	17,182
Death	0.008	0.090	2,281,544	0.008	0.088	2,264,128	0.055	0.228	17,182

Notes: Very low birth weight, low birth weight, normal birth weight and death are binary variables.

Table 2.5. SCHIP/Medicaid Income Eligibility by State over Time for Teenagers

State	1996	2002
Alabama	133	200
Alaska	133	200
Arizona	140	200
Arkansas	133	200
California	200	300
Colorado	133	185
Connecticut	185	300
Delaware	185	200
Florida	185	200
Georgia	185	235
Hawaii	185	200
Idaho	133	150
Illinois	133	200
Indiana	150	200
Iowa	185	200
Kansas	150	200
Kentucky	185	200
Louisiana	133	200
Maine	185	200
Maryland	185	300
Massachusetts	185	200
Michigan	185	200
Minnesota	275	275
Mississippi	185	200
Missouri	185	300
Montana	133	150
Nebraska	150	185
Nevada	133	200
New Hampshire	185	300
New Jersey	185	350
New Mexico	185	235
New York	185	250
North Carolina	185	200
North Dakota	133	140
Ohio	133	200
Oklahoma	150	185
Oregon	133	170
Pennsylvania	185	235
Rhode Island	250	250
South Carolina	185	185

South Dakota	133	200
Tennessee	185	200
Texas	185	200
Utah	133	200
Vermont	200	300
Virginia	133	200
Washington	185	250
West Virginia	150	200
Wisconsin	185	200
Wyoming	133	133

Notes: The income eligibility data from the annual maternal and child health update by the National Governors Association. The income eligibility is the percent of the Federal Poverty Line.

Table 2.6. Effects of SCHIP/Medicaid Expansions on the Number of Prenatal Care Visits

	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
	Full Sample	Singleton	Twin Birth	Full Sample	Singleton	Twin Birth
Eligibility	0.070	0.065	0.320	0.435 ***	0.438***	0.455
	(0.043)	(0.043)	(0.790)	(0.064)	(0.064)	(1.021)
Female baby	0.060***	0.059***	0.104	0.061***	0.061***	0.104
	(0.006)	(0.006)	(0.087)	(0.007)	(0.007)	(0.086)
Age	0.167***	0.166***	0.245***	0.180***	0.180***	0.236***
	(0.003)	(0.003)	(0.044)	(0.003)	(0.003)	(0.042)
White	1.020***	1.019***	1.090***	1.044***	1.043***	1.070***
	(0.016)	(0.016)	(0.285)	(0.017)	(0.017)	(0.283)
Black	0.413***	0.411***	0.394	0.437***	0.436***	0.374
	(0.017)	(0.017)	(0.296)	(0.017)	(0.017)	(0.295)
Some high school	0.761***	0.758***	1.095***	0.764***	0.761***	1.099***
	(0.010)	(0.010)	(0.168)	(0.010)	(0.010)	(0.168)
High school graduate	1.088***	1.085***	1.444***	1.075***	1.072***	1.457***
	(0.011)	(0.011)	(0.182)	(0.012)	(0.012)	(0.181)
Above high school	1.127***	1.121***	1.730***	1.109***	1.104***	1.744***
	(0.016)	(0.016)	(0.245)	(0.016)	(0.016)	(0.244)
Married	0.392***	0.390***	0.596***	0.390***	0.388***	0.596***
	(0.007)	(0.007)	(0.115)	(0.007)	(0.007)	(0.115)
Smoking	0.127***	0.127***	0.247*	0.124***	0.124***	0.248*
	(0.008)	(0.008)	(0.143)	(0.009)	(0.009)	(0.143)
Drink	-0.839***	-0.831***	-2.171***	-0.836***	-0.827***	-2.162***
	(0.035)	(0.035)	(0.620)	(0.035)	(0.035)	(0.619)
State teenage population	0.0002***	0.0002***	0.0003	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0002)	(0.0001)	(0.0001)	(0.0002)

State unemployment rate	-0.027***	-0.027***	-0.04	-0.005	-0.006	-0.127
	(0.009)	(0.009)	(0.148)	(0.007)	(0.007)	(0.121)
Medical risk	2.988***	2.960***	7.100***	4.988***	4.991***	4.697***
	(0.061)	(0.061)	(0.956)	(0.103)	(0.103)	(2.214)
First stage F statistics				139691	138571	1447
Partical R-squared				0.406	0.406	0.428
Durbin-Wu-Hausman				7.70	7.86	0.21
				0.021	0.020	0.900
Number of observations	2,281,544	2,264,128	17,182	2,281,544	2,264,128	17,182

Notes: Coefficients are from both OLS and IV estimates that also include the individual, and state level characteristics listed in Table 2.2. Standard errors adjusted for heteroskedasticity of unknown form are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test. The omitted category of maternal education is high school dropout.

Table 2.7. Effects of SCHIP/Medicaid Expansions on Singleton Births

	OLS	IV
	(1)	(2)
Birth Weight	5.299	17.914**
	(5.614)	(8.469)
First stage F statistics		178502
DWH p-value		0.047
Number of observations	2,264,128	2,264,128
Low birth weight	0.003	-0.017*
	(0.004)	(0.009)
First stage F statistics		178502
DWH p-value		0.107
Number of observations	2,264,128	2,264,128
Death	-0.0005	-0.001
	(0.0009)	(0.0013)
	[-0.0006]	[-0.014]
First stage F statistics		158761
Number of observations	2,264,128	2,264,128
State indicator	Yes	Yes
Year indicator	Yes	Yes

Notes: Coefficients are from both OLS and IV regressions that also include the individual, and state level characteristics listed in Table 2.2.The regression on infant mortality also includes birth weight as a control variable. Standard errors adjusted for heteroskedasticity of unknown form are in parentheses. Marginal effects at mean are reported in the square brackets. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test. All my first stage f-statistics are greater than 10000 and results of Durbin-Wu-Hausman test cannot reject that the consistency of OLS estimates for low birth weight and death.

Table 2.8. Effects of SCHIP/Medicaid Expansions on Twin Births

	OLS	IV
	(1)	(2)
Birth weight	52.771	51.337
	(79.985)	(131.667)
First stage F statistics		3409
DWH p-value		0.990
Number of observations	17,182	17,182
Low birth weight	-0.058	-0.086
	(0.059)	(0.100)
First stage F statistics		3409
DWH p-value		0.729
Number of observations	17,182	17,182
Death	-0.023	-0.086*
	(0.029)	(0.049)
	[-0.023]	[0.088]*
First stage F statistics		1385
DWH p-value		0.111
Number of observations	17,182	17,182
State indicator	Yes	Yes
Year indicator	Yes	Yes

Notes: Coefficients are from both OLS and IV regressions that also include the individual, and state level characteristics listed in Table 2.2. Standard errors adjusted for heteroskedasticity of unknown form are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test.

Table 2.9. Ordered Probit Estimation of the Impact of Eligibility Expansions on Birth Weight

	Singleton	Twin
Coefficient	0.010	0.028
Z-statistic	(0.17)	(0.09)
Change in probability of very	-0.0001	-0.003
low birth weight	(0.001)	(-0.034)
Change in probability of low	-0.0005	-0.002
birth weight	(0.003)	(0.021)
Change in probability of normal	0.0006	0.005
birth weight	(0.004)	(0.009)
Number of observations	2,264,128	17,182

Notes: Coefficients are from ordered probit model that include all variables in Table 2.2. Marginal effects in italics. Standard errors in parentheses.

Table 2.10. Quantile Regression Results of the Impact of Eligibility Expansions on Birth Weight

	Singleton		Twin	
	Coefficient	Quantiles of birth weight	Coefficient	Quantiles of birth weight
10th Quantile	12.888**	2580	162.098*	1070
	(6.31)		(98.24)	
25th Quantile	126.205	2920	-28.927	1758
	(170.905)		(93.005)	
50th Quantile	-133.208	3250	22.455	2240
	(816.995)		(146.568)	
75th Quantile	9.908	3572	59.962	2605
	(7.917)		(122.742)	
90th Quantile	11.908	3856	27.905	2892
	(11.573)		(106.110)	
Number of observations	2,264,128		17,182	

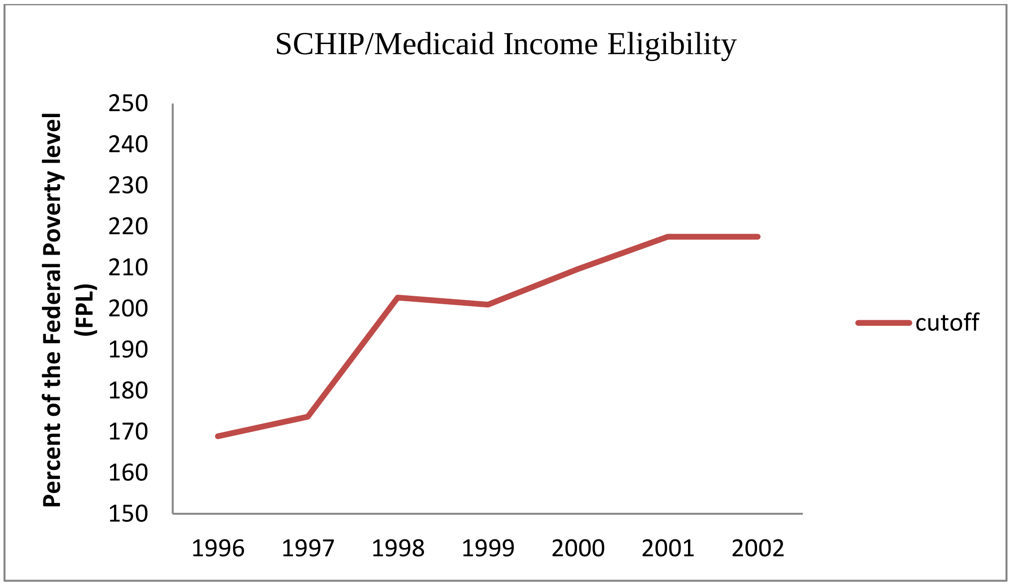
Notes: Coefficients are from quantile regressions that include all variables in Table 2.2. Standard errors in parentheses. *, **, and *** indicate significance at p<0.1, p<0.05, and p<0.01 respectively.

Table 2.11. Sensitivity Analysis of the Effects of Eligibility Expansions on Singleton Births

Specification:	(1)	(2)	(3)
Birth weight	15.191*	17.914*	17.796*
	(9.494)	(9.469)	(9.416)
Maternal Risk Behavior	no	yes	yes
State indicator	yes	yes	yes
Year indicator	yes	yes	yes
State unemployment rate	yes	yes	yes
State teenage population	yes	yes	yes
State TANF caseloads	no	no	yes
Number of observations	2,264,128	2,264,128	2,264,128

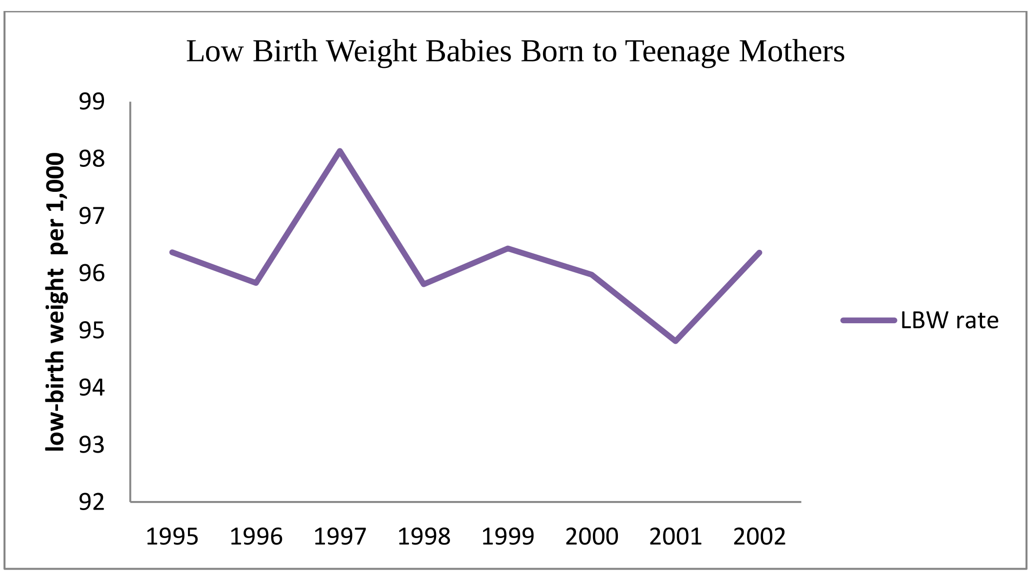
Notes: Coefficients are from the IV estimates with different model specifications. Standard errors adjusted for heteroskedasticity of unknown form are in parentheses. *, **, and *** denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test.

Figure 2.1. SCHIP/Medicaid Income Eligibility, 1996-2002



Source: The 1996-2002 annual maternal and child health update by the National Governors Association.

Figure 2.2. Low Birth Weight Babies Born to Teenage Mothers, 1995-2002



Source: Data from the linked vital statistics, 1995-2002.

Chapter 3

The Impact of SCHIP Expansions on Food Insecurity among Low-Income Families with Children

David Frisvold* and Jing Xu †

Abstract

We evaluate the impact of a large, non-cash transfer through non-food assistance program on the prevalence of food insecurity among families with children. Specifically, we examine the State Children's Health Insurance Program, which greatly expanded public health insurance to children in low-income families, and contribute to the small but growing literature documenting the reduction in economic hardship from expansions of public insurance. We exploit the state and time variation of the expansions of state public health insurance programs and implement a simulated instrumental variables strategy to address the selection issue of public health insurance eligibility. Our results suggest that the expansions of eligibility for SCHIP/Medicaid significantly reduced the probability that a family with children would be food insecure.

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3.1. Introduction

Childhood food insecurity is detrimental to children's health and human capital development. As of 2008, the prevalence of food insecurity among children is about 11 percent. There is a large literature examining the relationship between social welfare programs and household food security, which mostly focuses on the impact of food assistance program on the prevalence of food insecurity. These programs are the focus of this literature because an explicit goal of food assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP), is to improve the access to food for needy families.

In contrast, relatively few studies attempt to assess the impact of non-food assistance programs on food security status. Non-food assistance programs are a major component of the U.S. social safety net and they may alleviate food insecurity issues by providing additional support to relax the financial constraints of vulnerable families. More surprisingly, a large proportion of poor households are food secure while a non-trivial portion of households with incomes above the Federal Poverty Line are food insecure (Gunderson et al., 2011). This might be due to the fact that households with incomes under the poverty line are more likely to receive more resources to fight against food insecurity. Those families are more likely to be eligible for food assistance programs and other social safety net programs such as Medicaid and State Earned Income Tax Credits (EITC). However, low-income families who earn too much to qualify for other safety-net programs may experience the most barriers to meeting their basic needs such as food security. SCHIP is an example of such a program. In particular, health care costs have increased dramatically over the recent years. As a result, families with tight budgets or constrained resources may have great challenges to be food secure. Both the high cost of health care and generous expanding of public health insurance for children highlight the potential for SCHIP/Medicaid to reduce the probability that vulnerable families experience food insecurity because of financial constraints. In addition, some non-food assistance programs such as Medicaid and State Children's Health Insurance Programs (SCHIP) have more generous eligibility thresholds than food assistance programs.

In this paper, we examine the impact of SCHIP/Medicaid eligibility expansions for children on the prevalence of food insecurity among families with children using data from the 1996-2007 Current Population Survey Food Security Supplement (CPS-FSS) and the Survey of Income and Program Participation (SIPP) data. We chose this period of the data because it covers both pre- and post-SCHIP period and allows us to control for pre-expansion trends on food insecurity. One difficulty that arises in assessing the relationship between SCHIP/Medicaid eligibility and food insecurity is the endogeneity issue of family eligibility for public health insurance since families have some ability to influence whether they satisfy the eligibility criteria. In addition, households that are most likely to have low food security issue are also more likely to be eligible for and participate in public health insurance programs. To address this potential endogeneity concern, we utilize an instrumental variables strategy to identify the effects of SCHIP/Medicaid eligibility on the probability that a family with children has low food security. We also investigate the relationship between SCHIP/Medicaid eligibility and very low food security among children which is a measure of the most severe food-insecure condition among children used by the U.S. Department of Agriculture[21]. Our results suggest that being eligible for SCHIP/Medicaid reduces the probability that a family has low food security. Moreover, the results also suggest SCHIP/Medicaid eligibility has stronger effects on families in states that have higher uninsured rates for children before SCHIP expansion and in low income families with income less than 185 percent of the Federal Poverty Level (FPL). We also find little evidence that SCHIP/Medicaid eligibility decreases the probability that a family has childhood very low food security.

3.2. Background

Due to the high prevalence of uninsured children among the working poor families, the State Children's Health Insurance Program (SCHIP) was enacted in 1997 to provide health insurance to uninsured children in families that earn too much to qualify for Medicaid. It is a joint federal-state program, in that the federal government matches state spending on eligible program beneficiaries. However, SCHIP is not an entitlement program and has a specific annual funding limit. When either state or federal funding limits are reached, states may impose waiting lists or enrollment caps on SCHIP.

Another important feature of SCHIP is that states have flexibility in designing their own SCHIP programs in terms of the implementation date, program type, and income eligibility cutoffs. Title XXI of the Social Security Act authorized that SCHIP enrollment could begin as early as October 1, 1997. As a result, eight states started SCHIP in 1997, thirty-three states in 1998, eight states in 1999, and two states in 2000. SCHIP income eligibility level also varies across states and time. Table 3.1 presents a

[21] Low food security households include those with very low food security. Very low food security measures the most severe food insecurity condition.

detailed summary of SCHIP income eligibility thresholds, program type, and implementation date. As Table 3.1 shows, most states expanded income eligibility to at least 200 percent of the FPL after the 1997 SCHIP expansions. However, SCHIP income eligibility still varies across states and years. For example, insurance eligibility levels range from 200% of the FPL in Wyoming to 350 percent of the FPL in New Jersey. Additionally, states have more generous eligibility criteria for younger children who are under age six. Finally, states can also choose different strategies to expand their public insurance programs. They can choose to build a separately administrated SCHIP, extend their existing Medicaid programs, or have a combined SCHIP/Medicaid program. By 2002, eighteen states and D.C. chose to extend Medicaid, fifteen states created a stand-alone SCHIP, and seventeen had a combined program.[22]

SCHIP also represents one of the largest health insurance expansions for children with more than $40 billion funding in its initial 10 years' authorization (U.S. Department of Health & Human Services, 2009). As of 2010, the average SCHIP/Medicaid participation rate among eligible children without private insurance is 85.8% (Center for Children and Families, 2011). The Affordable Care Act of 2010 maintains the SCHIP eligibility standards in place until 2019 and provides an additional $40 million in federal funding to continue efforts to promote enrollment in SCHIP/Medicaid. SCHIP expansion provides an annual cash-equivalent transfer of approximately $2,500 in the form of reduced out-of-pocket medical spending (Shaefer, 2009).

[22] Some states changed their type of SCHIP program since initial implementation.

This transfer is equivalent to 40 percent of the average annual SNAP benefits for a family of four, which is the largest food assistance program in the U.S.[23] In contrast to SNAP, SCHIP has more generous eligibility thresholds. While SNAP requires that a household's gross income before taxes in the previous month cannot exceed 130% of the FPL , most states expanded the income-eligibility cutoff for public health insurance for children to at least 200% of the FPL because of the introduction of the SCHIP program. With the rising health care costs in the U.S., this great expansion in public health insurance income eligibilities allows a large, non-cash transfer to a large group of needy families that earn too much to qualify for food assistance programs. Hence, we expect that the 1997 SCHIP expansions may reduce the prevalence of childhood food insecurity, especially for children in vulnerable families. Non-food social safety net programs may help needy families to avoid or reduce food insecurity by expanding household disposable resources.

3.3. Literature Review

While extensive research focuses on the impact of SNAP on food insecurity (Alaimo et al., 1998; Gundersen and Oliveira 2001; Wilde and Nord 2005; Yen et al., 2008), little is known about the effects of non-food social safety net programs such as Medicaid and SCHIP on food insecurity. There is a small, but growing, related literature on the impact of health insurance on food insecurity and economic hardship. Finkelstein and McKnight (2008) examine the impact of the introduction of Medicare on out-of-pocket spending and find that the program substantially reduced out-of-pocket medical expenditure risk for the elderly. Finkelstein et al. (2012) use data from the Oregon health

[23] Calculation based on the data from the Food and Nutrition Service at the United States Department of Agriculture.

insurance experiment in 2008 to examine the impact of Medicaid on out-of-pocket spending. They find that expanded access to health insurance for low-income and uninsured adults in Oregon is associated with increased health care utilization, reduced out-of-pocket medical expenditures, and improved self-reported health status. Gross and Notowidigdo (2011) find that increased Medicaid and SCHIP eligibility, primarily throughout the 1990s, reduced personal bankruptcies. Leininger et al. (2010) examine how SCHIP-eligible families change their spending in response to the introduction of the SCHIP program. The authors find that SCHIP-eligible families increased their overall expenditures, particularly by increasing spending on transportation and saving for retirement. These studies suggest that expansions of public health insurance are successful in reducing economic hardship. Therefore, expansions of public health insurance could reduce food insecurity because households may have additional resources to spend on food.

The most closely related paper to this project is Schmidt et al. (2012), which examines the impact of the level of overall benefit of five major safety net programs on food insecurity with a focus on non-immigrant, single-parent families with incomes below 300 percent of the poverty line. They imputed both eligibility and benefit levels for five major safety net programs including both cash and non-cash transfer. Their results suggest that providing a generous cash or food safety net to needy families could improve food security.

Our paper compliments Schmidt et al. (2012) by focusing the impact of the largest non-food and non-cash transfer safety net programs- the 1997 SCHIP/Medicaid expansions on the prevalence of food insecurity among non-immigrant families with children. Instead of using the imputed benefit level, we use the imputed family income eligibility for SCHIP/Medicaid due to the data limitation that we discuss in below. Our study is useful for understanding the upcoming expansions to Medicaid through the Affordable Care Act because of the size of the expansion. We also explore how the effects of SCHIP expansion on food insecurity vary across states with different uninsured rate and families that are more vulnerable to eligibility cutoffs.

3.4. Identification Strategy

The empirical difficulties of estimating the relationship between food insecurity and SCHIP/Medicaid eligibility are self-selection, unobserved heterogeneity, and measurement error. Families may self-select into public health insurance programs since they have some ability to influence whether they satisfy the eligibility criteria. Public health insurance eligibility is also likely to be endogenous because unobserved heterogeneity; a common set of unobserved factors could affect both household SCHIP/Medicaid eligibility criteria and food security status. SCHIP/Medicaid eligible families are also most likely to qualify for other social safety net programs. Another concern is the possibility of reverse causality; while the non-food social safety net programs affect the prevalence of food insecurity, the prevalence of food insecurity may also influence the income eligibility criteria of state welfare programs[24]. To remedy this issue, our measure of public health insurance eligibility is lagged by one year. Moreover, measurement errors in the calculation of imputed income eligibility due to data limitations could also bias the estimates of SCHIP/Medicaid eligibility on family food insecurity status.

[24] States with severe food insecurity problems may choose to adopt more generous income eligibility cutoffs to improve the welfare of children in low-income families.

To address these concerns, we implement a simulated instrumental variables strategy developed by Currie and Gruber (1996a, 1996b) to address the endogeneity issue of a family's SCHIP/Medicaid eligibility status. We use a measure of the generosity of state's SCHIP/Medicaid eligibility thresholds, the simulated eligibility fraction, to instrument for a family's imputed SCHIP/Medicaid eligibility. This simulated eligibility fraction is constructed by applying the state and year level SCHIP/Medicaid income cutoff to a constant national sample of children under age 18 from a nationally representative SIPP dataset. We then calculate the number of children who would be eligible for SCHIP/Medicaid in each state-year stratum. The generosity of a state's public insurance program can influence the probability of a family's SCHIP/Medicaid eligibility status. With all else being equal, children live in a state has more generous eligibility cutoffs are more likely to be eligible for SCHIP/Medicaid. Therefore, our instrument is correlated with the endogenous variable. The other concern on the validity of an instrument is that the instrument should be uncorrelated with the error term. Rather than use the actual eligibility fraction, we use simulated fraction because actual eligibility fraction is likely to be correlate with a state's socioeconomic characteristics. For example, if a state had a bad economy in a specific year, then the actual SCHIP/Medicaid eligible children would be high even with a relatively low income threshold. In this case, the variation in the eligibility fraction is not driven by the exogenous change in the eligibility cutoffs. In contrast, simulated eligibility fraction only varies with a state's SCHIP/Medicaid income cutoffs but not with its economic or demographic characteristics. Hence, we prefer to use simulated eligibility fraction as our instrument.

To examine the potential influence of endogeneity, we first estimate the following specification using OLS:

$$FI_{hst}=\alpha + \beta * SCHIP_{hst} + \varphi * X_{hst} + \gamma_s + \delta_t + \varepsilon_{st,} \quad (1)$$

where FI is our outcome variable to measure a family's food security status. It is an indicator for low food security or very low food security among children in household i in state *s* in year *t*; SCHIP denotes household's eligibility for SCHIP or Medicaid; X is a vector of both state and household level controls. We use the information of the reference person to proxy household characteristics. Specifically, characteristics of reference person included in X are age, gender, race/ethnicity (white, black, Hispanic, and other race), marital status, and education attainment. In addition, we also control for family size, state level unemployment rate, state children's uninsured rate, and state fraction of college graduates among people aged above 25. α is a constant term, γ represents state fixed effects, δ represents a vector of year fixed effects, and ε represents a stochastic error term. β, which is the coefficient of interest, represents the relationship between family income eligibility for SCHIP/Medicaid and food insecurity. We then modify this specification to instrument for family income eligibility for SCHIP/ Medicaid with the simulated state SCHIP/Medicaid eligible fraction as described above. All standard errors throughout the analysis are clustered to allow for arbitrary correlation within states.

3.5. Data

The impact of SCHIP/Medicaid eligibility on food security is evaluated using data from the 1996-2007 Current Population Survey Food Security Supplement and the Survey of Income and Program Participation data. The CPS-FSS data collects food security measures at the household level since 1995. It provides information on food spending, security, sufficiency, program participation information, and other household characteristics. The CPS-FSS is also the data source of national and state-level statistics on food insecurity and hunger reported by the United States Department of Agriculture (USDA) in its series of annual reports on the U.S. food security. The food insecurity measures in the CPS-FSS are summarized from the households' response to 18 questions on food security status (See Appendix 1 for the full list of questions). However, one potential problem with the CPS-FSS data is that it has no detailed information on family income. The income variable in the CPS-FSS does not distinguish earned and unearned income. Additionally, it only provides the total income information in a categorized variable. Given that we need to impute a family's SCHIP/Medicaid eligibility based on family earned income and family structure, we follow Schmidt et al. (2012) and match the earning data that are collected when a household is in the CPS outgoing rotation groups[25].

In addition to the CPS-FSS data, we also use data from the 1996, 2001, and 2004 SIPP panels to construct an instrumental variable measuring the generosity of state public health insurance eligibility rules for children in each year. The SIPP data is a multi-panel, nationally representative dataset with a target of interviewing 37,000 households. It is a good source for our instrumental variable since it has full information on family income, family structure, and detailed demographic information on family members. Given that public insurance eligibility is determined on the basis of monthly income, we use the SIPP data rather than the CPS data to avoid potential bias caused by measurement errors in the calculation of income eligibilities. In this paper, we define a household with

[25] CPS Outgoing Rotation Groups are extracts of the Basic Monthly Data during the household's fourth and eighth month in the survey, when usual weekly hours/earnings are asked. More information is available at http://www.nber.org/cps/.

children as SCHIP/Medicaid eligible if its household income is in the eligibility range for Medicaid/SCHIP.

As discussed above, one issue with the 1996-2007 CPS-FSS data is that it has no detailed information on the age of a child. The data only asked if the household has any children under age 18. Given that SCHIP/Medicaid has different income eligibility rules for different age groups of children, we choose to apply the less generous income eligibility threshold for children aged above 6 to have a conservative estimate.

Our income eligibility criteria for SCHIP/Medicaid are based on the annual maternal and child health update from the National Governors Association. Table 3.2 shows both the mean of the actual fraction and simulated fraction of children who are eligible for SCHIP/Medicaid at state level from 1996 to 2007. Both actual and simulated fractions suggest that more children under age 18 are eligible for SCHIP or Medicaid after the 1997 SCHIP expansions. Additionally, more than 50% of all the children under age 18 are eligible for SCHIP/Medicaid after 1999.

As noted above, families who are eligible for SCHIP/Medicaid are also likely to qualify for other social safety nets that could reduce food insecurity or economic hardships. To better assess the role played by public health insurance expansions for children on food insecurity, we also control for household's eligibility for other non-food or food social safety net programs. Specifically, we control for a household's imputed income eligibility for SNAP. In addition, we also use the State Temporary Assistance for Needy Families (TANF) case application number from the Urban Institute's TRIM3 model and Welfare Rules Database to proxy the generosity of other state specific social welfare programs.

Throughout the paper, the household is the unit of analysis. We also restrict the study to non-immigrant households that have at least one child under age of 18, and whose family reference person are parents aged from 18 to 65.[26] Families include in this sample have complete information on variables listed in Table 3.3. As a result, our final sample has 100,568 families with children, of which 39.8% are SCHIP/Medicaid eligible. Table 3.3 describes the characteristics of the sample and shows the differences between SCHIP/Medicaid eligible and SCHIP/Medicaid ineligible households. In general, families with SCHIP/Medicaid eligible children are more disadvantaged than those SCHIP/Medicaid ineligible families. Parents of SCHIP/Medicaid eligible children are more likely to be minorities, single, less-educated, and have a family that with 4 more children. For example, 53.0% of the reference parents of SCHIP/Medicaid eligible families are not high school graduates, while 31.8% of the reference parents of SCHIP/Medicaid ineligible families are not high school graduates. Furthermore, most SCHIP/Medicaid eligible families are also eligible for SNAP, which highlights the importance of controlling households' eligibility for other social welfare programs that help alleviating food insecurity issue.

Table 3.4 shows summary statistics for food security status among families. We look at both the prevalence of family low food security and very low food security among children. Low food security households are defined as those households reduced the quality, variety, and desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially disrupted. Very low food security is defined as eating patterns of one or more household members were disrupted and food intake

[26] The CPS-FSS has information if a household has children under age 18, but no detailed information on the age of a child. Therefore, we limit our sample to households with at least one child is under age 18.

reduced because the household lacked money and other resources for food[27]. Compared to the whole sample, SCHIP/Medicaid eligible families are more likely to be food insecure. For instance, the prevalence of low food security among SCHIP/Medicaid ineligible families and SCHIP/Medicaid eligible families are 0.06 and 0.23, respectively. The sample mean test also rejects the null hypothesis of zero difference in food insecurity status among SCHIP/Medicaid eligible and ineligible families. In addition, the prevalence of having very low food security among children in SCHIP/Medicaid eligible families is almost twice that of SCHIP/Medicaid ineligible families. As described above, our estimation strategy is appropriate in this setting because families that are likely to be eligible for SCHIP/Medicaid are also families that are likely to be food insecure. The reverse causality highlights the need to address selection on unobservables to assess the impact of the expanded income eligibility for SCHIP/Medicaid on food security status among families with children.

3.6. Results

Table 3.5 reports the results from the regression described in equation (1) to assess the effects of SCHIP/Medicaid eligibility expansions on food security among families with children. We show the results from both OLS model and IV models. The OLS results in column one and three suggest that being eligible for SCHIP/Medicaid is associated with an increase in the probability of having food insecurity and childhood food insecurity by 7.6 and 0.3 percentage points, respectively.[28] These results seem counterintuitive, however, it is possible that the OLS estimates are biased without

[27] These measures of food insecurity were introduced by USDA in 2006. For further information, please see Food Security in the U.S.: Definitions of Food Security. These definition is available at : http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx#.Ud3hhZNON1I

[28] Appendix 3.B. show full results from the OLS and IV regressions in Table 3.5.

addressing the endogeneity issue of public health insurance eligibility. Therefore, we re-estimate equation 1 using an IV strategy. Our first stage F-statistics are all greater than 1000, which suggests that the simulated eligibility fraction is strongly correlated to family imputed eligibility for SCHIP/Medicaid. Our IV results suggest that being eligible for SCHIP/Medicaid reduces the probability that a family with children has low food insecure. A family's income eligibility for SCHIP/Medicaid is now associated with a 2.7 percentage point decrease in the probability of having low food security and it is statistically significant at 10 percent level. We also find being eligible for SCHIP/Medicaid reduce the probability that a family has very low child food insecurity, however, the effect is not statistically significant.

To further check our results, we also conduct a few sensitivity analyses to explore the impact of public insurance eligibility on food security status for different groups in the sample. Since SCHIP/Medicaid expansions would have had the most pronounced effect on those children who are previously uninsured or underinsured, it is reasonable to expect that the effects of insurance eligibility expansions should be greater for children from states with relatively high uninsured rate among children. Hence, we limit the sample to seventeen states that had higher rate of uninsured children before the 1997 SCHIP expansion. The seventeen states are Arizona, Arkansas, California, Colorado, Connecticut, Florida, Kansas, Louisiana, Nevada, New Mexico, New York, Mississippi, Oklahoma, Oregon, Tennessee, Texas, and Washington. Panel A of Table 3.6 displays the IV results for this group. As expected, the magnitude of the coefficients is bigger than our main results listed in Table 3.5. SCHIP/Medicaid eligibility now is associated with a 6.3 percentage point reduction in the probability that a family has low food security and it is statistically at 5 percent level. Our point estimate also suggests that being eligible for SCHIP/Medicaid is associated with a reduction in the probability of having very low food security among children. However, it is not statistically significant. As Schmidt et al. (2012) point out, very low food security among children is a rare event, which limits the statistical power here.

Another concern about the validity of these estimates is that families who are always ineligible for SCHIP/Medicaid are sufficiently different from vulnerable families who are sensitive to the eligibility cutoffs. To check whether the inclusion of families that are always SCHIP/Medicaid ineligible may affect our results, we re-estimate the regression with families have income less than 185 percent of the FPL. This group is not only sensitive to public insurance eligibility cutoffs but also has the higher prevalence of food insecurity.[29] Of all people with incomes equal to or above the poverty threshold but below 130% of poverty 30.3% were food insecure, while 21.3% of all people with incomes equal to or above 130% but below 185% of poverty were food insecure (Cook and Jeng, 2009). If the relationship between SCHIP/Medicaid eligibility and families' food security status is not spurious, we would expect the magnitude of our point estimate should be bigger. The bottom panel of Table 3.6 shows the results from these regressions. For low-income families with income less than 185 percent of the FPL, SCHIP/Medicaid eligible families are 5.9 percentage points less likely to have low food security. Likewise, there is little evidence that SCHIP/Medicaid eligibility is associated with a reduced probability of having childhood very low food security. Overall, the effects of

[29] According to the USDA report 2011, low-income households with income below 185 percent of the FPL have higher rates of food insecurity than the national average.

SCHIP/Medicaid eligibility on low food security among families with children seem to be quite robust with different group specifications.

3.7. Conclusion

This paper estimates the impact of income eligibility for SCHIP/Medicaid on food security status among families with children. Given that public health insurances for children provide and release additional financial resources for families with children, the 1997 SCHIP/Medicaid expansion is predicted to alleviate food insecurity issue among families, especially among vulnerable families. However, the link between SCHIP/Medicaid income eligibility and food security status is difficult to measure due to the potential endogeneity issue. With the exogenous variation in the SCHIP/Medicaid thresholds through the 1997 SCHIP expansions, we employ an instrumental variables strategy to identify the effects of family eligibility for SCHIP/Medicaid on both low food security and childhood very low food security. The results show that being eligible for SCHIP/Medicaid significantly reduces the probability that a family would have low food security. The findings of this study have important policy implications and it also sheds light on the relationship between non-food safety net programs and food insecurity. However, our paper's reach is limited because we have no information about the exact age of a child in the family to construct a more accurate imputed eligibility for SCHIP/Medicaid. Further exploration and utilization of new data that have complete demographic and income information on all family members could provide better understanding of how non-food social safety-net programs improve food security.

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Table 3.1. Summary of SCHIP expansions by State and Time

State	Type	Date implemented	% FPL eligibility cutoff 1997	2007
Alaska	M	Mar-99	133	175
Alabama	C	Feb-98	133	200
Arkansas	M	Oct-98	133	200
Arizona	S	Oct-97	133	200
California	C	Mar-98	133	250
Colorado	S	Apr-98	133	200
Connecticut	C	Jul-98	185	300
District of Columbia	M	Oct-98	133	300
Delaware	S	Oct-98	133	200
Florida	C	Apr-98	133	200
Georgia	S	Sep-98	133	235
Hawaii	M	Jan-00	133	300
Iowa	C	Sep-98	133	200
Idaho	M	Oct-97	133	185
Illinois	M	Jan-98	133	200
Indiana	C	Sep-98	133	200
Kansas	S	Jul-98	133	200
Kentucky	C	Jul-98	133	200
Louisiana	M	Nov-98	133	200
Massachusetts	C	Oct-97	133	300
Maryland	M	Jul-98	185	300
Maine	C	Aug-98	133	200
Michigan	C	May-98	150	200
Minnesota	M	Sep-98	275	280
Missouri	M	Oct-97	133	300
Mississippi	C	Mar-97	133	200
Montana	S	Jan-98	133	150
North Carolina	S	Oct-98	133	200
North Dakota	C	Oct-98	133	140
Nebraska	M	May-98	133	185
New Hampshire	C	May-98	185	300
New Jersey	C	Feb-98	133	350
New Mexico	M	Mar-99	185	235
Nevada	S	Oct-98	133	200
New York	C	Apr-98	133	250
Ohio	M	Jan-98	133	200
Oklahoma	M	Dec-97	133	200

Oregon	S	Sep-98	133	185
Pennsylvania	S	Jun-98	133	300
Rhode Island	M	Oct-97	250	250
South Carolina	M	Aug-97	133	150
South Dakota	M	Jul-98	133	200
Tennessee	M	Oct-97	400	250
Texas	C	Jul-98	133	200
Utah	S	Aug-98	133	200
Virginia	S	Oct-98	133	200
Vermont	S	Oct-98	225	300
Washington	S	Jan-00	200	250
Wisconsin	M	Apr-99	185	185
West Virginia	C	Jul-98	133	220
Wyoming	S	Apr-99	133	200

Notes: M indicates Medicaid, S indicates stand-alone SCHIP, and C indicates combined program. Data on the SCHIP type, implementation dates, and income eligibility limit come from the Centers for Medicaid Services (CMS) available at: http://medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Childrens-Health-Insurance-Program-CHIP/CHIP-Eligibility-Standards-.html.

Table 3.2. Fraction of Children under Age 18 Eligible for SCHIP/Medicaid in the SIPP

Year	Actual eligibility fraction	Simulated eligibility fraction
1996	0.460	0.462
1997	0.459	0.452
1998	0.497	0.508
1999	0.471	0.483
2000	0.521	0.524
2001	0.529	0.530
2002	0.538	0.541
2003	0.509	0.509
2004	0.510	0.525
2005	0.516	0.542
2006	0.517	0.539
2007	0.517	0.542

Sources: Survey of Income and Program Participation (SIPP).

Notes: Actual eligibility fraction is constructed by applying the state and year level SCHIP/Medicaid income cutoff to the actual data and counts how many children are eligible for SCHIP/Medicaid at state-year stratum. Simulated eligibility fraction is constructed by applying the state and year level SCHIP/Medicaid income cutoff to a constant national sample of children randomly draw from the SIPP data and count how many children are eligible for SCHIP/Medicaid at state-year stratum. Authors' calculation based on the 257,460 observations from SIPP96, 167,539 observations from SIPP01, and 238,851 observations from SIPP03.

Table 3.3. Summary Statistics

% Eligible	All		SCHIP/Medicaid ineligible		SCHIP/Medicaid eligible	
Number of observations	100,568		60,622		39,946	
	Mean	Sd	Mean	Sd	Mean	Sd
Reference Person Characteristics						
Age	39.080	8.566	39.923	8.020	37.801	9.187
Female	0.436	0.496	0.363	0.481	0.546	0.498
Black	0.109	0.311	0.076	0.265	0.158	0.365
White	0.845	0.362	0.881	0.323	0.789	0.408
Hispanic	0.086	0.281	0.059	0.236	0.128	0.334
Other(Non-Hispanic, non-white, and non-black)	0.042	0.200	0.038	0.192	0.047	0.212
Single	0.087	0.282	0.045	0.207	0.151	0.358
Married	0.739	0.439	0.831	0.375	0.601	0.490
Other (Windowed, Divorced, Separated, and Deceased)	0.173	0.379	0.124	0.330	0.248	0.432
Below Highschool	0.402	0.490	0.318	0.466	0.530	0.499
Highschool	0.304	0.460	0.305	0.460	0.304	0.460
Some College	0.195	0.396	0.247	0.431	0.116	0.320
College Grad or More	0.099	0.298	0.130	0.336	0.051	0.220
Under 133% Poverty	0.268	0.443	0.000	0.019	0.674	0.469
Number of Children						
1	0.425	0.494	0.462	0.499	0.368	0.482
2-3	0.524	0.499	0.508	0.500	0.548	0.498
4 or more	0.051	0.221	0.030	0.170	0.084	0.277
Other Explanatory variable						
State unemployment rate	4.890	1.103	4.848	1.107	4.953	1.093
Children's uninsured rate	12.089	5.103	11.992	5.061	12.235	5.162
Percent state pop. 25+ college graduate	25.4	4.4	25.4	4.5	25.3	4.4

State TANF Case application	106804	157248	101174	149860	115349	167481

Notes: Data from the CPS-FSS 1996-2007. The unit of observations is family. Our sample includes non-immigrant families with at least one child under age 18 in which the reference person ages 18 to 65 and is the parent of children in the household. The regressions also include state and year dummies.

Table 3.4. Summary Statistics for Outcome Variables

	All		SCHIP/Medicaid ineligible		SCHIP/Medicaid eligible		Sample mean test
	N	Mean	N	Mean	N	Mean	p
Outcome Variables							
Low Food Security	100568	0.126591	60622	0.0583617	39946	0.2301357	p<0.001
Child Very Low Food Security	58440	0.003936	37215	0.0011286	21225	0.0088575	p<0.001

Notes: Data from the CPS-FSS 1996-2007. Sample includes non-immigrant families with at least one child 18 or younger in which the reference person ages 18 to 65 and is the parent of children in the household. We have fewer observations on child very low food security since this measure is only available after 2000 in the CPS-FSS data. The sample mean test rejects the null hypothesis of zero difference in food insecurity status among SCHIP/Medicaid eligible and ineligible families.

Table 3.5. SCHIP/Medicaid Eligibility and Family Food Insecurity Status

	Low FS		Very Low FS	
	(1)	(2)	(3)	(4)
	OLS	IV	OLS	IV
SCHIP/Medicaid Eligibility	0.076***	-0.027*	0.003***	-0.007
	(0.005)	(0.015)	(0.001)	(0.007)
F-statistics on Instrument		2011.73		1055.57
Number of Observations	100568	100568	58440	58440

Notes: Coefficients are from both OLS and IV estimates that also include the individual, and state level characteristics listed in Table 3.3. Explanatory variables are not shown include state and year dummies. Standard errors clustered at state level are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test.

Table 3.6. Subgroup Analysis Using IV

Dependent variable	Low FS	Child Very Low FS
Panel A:states have high rate of uninsured children		
Eligibility	-0.063**	-0.017
	(0.019)	(0.011)
F-Statistics on Instrument	1344.81	732.75
N	36949	18172
Panel B: Families with income<185% FPL		
Eligibility	-0.059*	-0.014
	(0.035)	(0.018)
F-Statistics on Instrument	163.12	87.48
N	42467	24336

Notes: Coefficients are from IV estimates that also include both year and state fixed effects. Standard errors clustered at state level are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test.

Appendix 3.A.: Food Insecurity Measures in the United States

Measuring Food Insecurity in the United States

1. "We worried whether our food would run out before we got money to buy more." Was that often, sometimes, or never true for you in the last 12 months?

2. "The food that we bought just didn't last and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?

3. "We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?

4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes/No)

5. (If yes to Question 4) How often did this happen – almost every month, some months but not every month, or in only 1 or 2 months?

6. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? (Yes/No)

7. In the last 12 months, were you ever hungry, but didn't eat, because there wasn't enough money for food? (Yes/No)

8. In the last 12 months, did you lose weight because there wasn't enough money for food? (Yes/No)

9. In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (Yes/No)

10. (If yes to Question 9) How often did this happen – almost every month, some months but not every month, or in only 1 or 2 months?

11. "We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last12 months?

12. “We couldn’t feed our children a balanced meal, because we couldn’t afford that.” Was that often, sometimes, or never true for you in the last 12 months?

13. “The children were not eating enough because we just couldn’t afford enough food.” Was that often, sometimes, ornever true for you in the last 12 months?

14. In the last 12 months, did you ever cut the size of any of the children’s meals because there wasn’t enough money for food? (Yes/No)

15. In the last 12 months, were the children ever hungry but you just couldn’t afford more food? (Yes/No)

16. In the last 12 months, did any of the children ever skip a meal because there wasn’t enough money for food? (Yes/No)

17. (If yes to Question 16) How often did this happen – almost every month, some months but not every month, or in only 1 or 2 months?

18. In the last 12 months did any of the children ever not eat for a whole day because there wasn’t enough money for food? (Yes/No)

Appendix 3.B. Complete Results for OLS and IV Estimation on the Impact of SCHIP/Medicaid Eligibility on Food Security

	OLS		IV	
	(1)	(2)	(1)	(2)
	LFS	Child Very LFS	LFS	Child Very LFS
Eligibility	0.076***	0.003***	-0.027*	-0.007
	(0.005)	(0.001)	(0.015)	(0.007)
Age	0.0011***	0.0001***	0.0011***	0.0001***
	(0.0002)	(0.00003)	(0.0002)	(0.0005)
Female	0.03046***	0.00208***	0.034***	0.002***
	(0.0026)	(0.0005)	(0.003)	(0.001)
Black	0.035***	0.002	0.045***	0.003
	(0.010)	(0.003)	(0.009)	(0.002)
White	-0.029***	-0.004**	-0.022***	-0.003**
	(0.007)	(0.002)	(0.006)	(0.001)
Hispanic	0.0430***	0.0006	0.047***	0.001
	(0.007)	(0.001)	(0.008)	(0.002)
Single	-0.002	-0.003	-0.004	-0.004*
	(0.008)	(0.002)	(0.009)	(0.002)
Married	-0.116***	-0.008***	-0.120***	-0.008***
	(0.004)	(0.001)	(0.005)	(0.001)
Highschool	0.093***	0.003***	0.106***	0.004***
	(0.004)	(0.001)	(0.005)	(0.001)
Some College	0.050***	0.002***	0.061***	0.003***
	(0.002)	(0.001)	(0.004)	(0.001)
College Grad or above	0.004**	0.0008***	0.0049**	0.0009***
	(0.002)	(0.0003)	(0.0019)	(0.0003)
Under 133% Poverty	0.043***	0.003***	0.127***	0.010*
	(0.006)	(0.001)	(0.013)	(0.005)
Number of Children	0.0176***	0.0003	0.0219***	0.0005
	(0.001)	(0.0003)	(0.0017)	(0.0005)
State unemployment	0.0105***	0.00007	0.0101***	-0.00001
rate	(0.002)	-(0.0004)	(0.0023)	(0.0004)
Children's uninsured	-0.0014	-0.0002	-0.0017	-0.0004
rate	(0.0010)	(0.0002)	(0.0011)	(0.0003)
State pop. 25+	-0.00009	0.00003	-0.00004	-0.00003
college graduate	(0.0006)	(0.0002)	(0.0007)	(0.0002)
State TANF case	0.0033	-0.0003	-0.0003	0.00013
number	(0.006)	(0.001)	(0.006)	(0.001)

Number of observations	100568	58440	100568	58440

Notes: Coefficients are from both OLS and IV estimates that also include the individual, and state level characteristics listed in Table 3.3. Explanatory variables are not shown include state and year dummies. Standard errors clustered at state level are in parentheses. *, **, and ***denote statistical significance at the 10, 5, and 1 percent level, respectively, for a two-tailed test.