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Essays on Health Care: The Impact of Insurance and Use of Medical Services on Health

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Essays on Health Care:
The Impact of Insurance and Use of Medical Services on Health

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by

Moonkyung Choi

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ABSTRACT OF THE DISSERTATION

Essays on Health Care:
The Impact of Insurance and Use of Medical Services on Health

by

Moonkyung Choi

Doctor of Philosophy, Graduate Program in Economics
University of California, Riverside, June 2012
Dr. David Farris, Co-Chairperson; Mindy Marks, Co-Chairperson

The United States per capita health care spending is the highest in the world. This dissertation addresses the impact of additional health care spending/medical service usage on health status. The first two chapters investigate the role of insurance on medical service use in understudied dental market. The third chapter examines the effectiveness of additional health care spending on infant health outcomes.

The first chapter estimates the causal relationship between adult Medicaid dental benefits and dental service usage for low-income adults by using difference-in-differences technique exploiting the state-level variation in adult Medicaid dental benefit. The results suggest that adult Medicaid dental benefit increases the possibility of dental visit by 16.4 - 22 percent. The evidence that the increased dental service use improves dental health among low-income people is also presented. The second chapter investigates the causal relationship between dental insurance and dental service use among older populations. Between ages of 61 and 68, 24 percent of Americans with at least high school diploma lose dental insurance. The decrease in dental coverage is primarily driven by the loss of employer provided dental benefit with retirement. Utilizing this rapid drop in the number of people with dental insurance at around age 65, I find that there is no evidence of a decrease in dental service usage among older populations.

The third chapter, which is co-authored with Marks, addresses the benefit of additional health care spending for newborns. We use the number of infants born on a given day in a given location as an identifying variable to generate exogenous variation in health care spending. Using detailed information on every hospital birth in California from 2002 to 2006, we find that hospital stays are less intensive when the hospitalization region is more crowded. The second stage analysis suggests that the additional health care spending on infants born on less crowded days does not improve infant health status measured by mortality rate and readmission rate.

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Introduction

Per capita health care spending in the United States is the highest in the world and is increasing rapidly. In 2007, 17.4 percent of GDP was spent on health care. This enormous spending in health care has invited many debates, specifically if the marginal dollar on health care spending is worthwhile. Increase in health care spending is primarily driven by two factors: increase in medical service usages facilitated by insurance coverage, and increase in the price of new and advanced medical technology.

According to Cutler (2007), studies of aggregate medical spending and of particular medical conditions show that at least half of cost growth is a result of increased use of new technology. Many studies on the cost-effectiveness of specific medical treatments and other interventions suggest that most medical treatments provide reasonable value while other studies argue that the increasing costs are excessive. (Lichtenberge, 2001; Cutler et. al., 2006; Cutler, 2007)

Health insurance, which shields consumers from the full costs of medical service, might leads to increase in spending. With insurance, marginal cost of health care (out-of-pocket cost) individuals face is less than total marginal cost (real cost of medical service). Since individuals make decisions based on their personal marginal costs, there is possibility of wasteful use of health care. Understanding the role of insurance on medical service usage and the effect of medical service on health is critical when allocating limited resources and making budget decision. Without efficient allocation and understanding the role of insurance and medical technology, there will be serious negative impact of employee health care costs on employers, the government budgetary problems caused by rising health care expenditures, and reduced access for individuals needing health services due to high health care costs. (Bodenheimer, 2005)

This dissertation investigates the role of insurance on medical service usage in understudied dental market and the benefits of additional health care spending for newborns. In the first two chapters, the role of insurance on dental service is examined for two different populations. The first chapter studies low-income population by exploiting state-level variation in adult Medicaid dental coverage. The second chapter studies relatively well-off older population by exploiting the loss of dental insurance upon retirement. These studies find that dental insurance has sizable impact among low-income population on both dental service usage and dental health but not among relatively well-off older population. In the third chapter, the effectiveness of additional health care spending is examined using exogenous variation in health care spending caused by the crowdedness on an infant's birth date. The results suggest that hospital stays are less intensive when the hospitalization region is more crowded and on the margin the health benefits from additional spending on infants born on slower days are negligible.

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Chapter 1
The Impact of Medicaid Insurance Coverage on Dental Service Use

Abstract

The new comprehensive health reform, beginning in 2014, will require Medicaid to expand all elements of coverage to individuals with incomes up to 133 percent of the federal poverty line. With millions more individuals gaining eligibility for adult Medicaid dental benefits, generating an unbiased estimate of the elasticity of demand for dental services is critical.

The causal relationship between access to adult Medicaid dental benefits and usage of dental services for low-income adults is estimated, using difference-in-differences estimation procedures to exploit the state-level variation in adult Medicaid dental benefits.

Results suggest that adult Medicaid dental benefits increase the probability of a dental visit within 12 months by 16.4 - 22 percent. A variety of robustness checks are invoked to confirm the finding.

Key Words: Dental market, Demand for dental services, Medicaid,
Difference-in-differences
JEL code: I11, I18, I38

I.1. Introduction

Under current Medicaid law, states have the option to include adult dental coverage. The new comprehensive health reform, beginning in 2014, will require Medicaid to expand all elements of coverage to individuals with incomes up to 133 percent of the federal poverty level. With millions more individuals gaining eligibility for adult Medicaid dental benefits, generating an unbiased estimate of the elasticity of demand for dental services is critical for making budget decisions and allocating limited resources. This paper exploits state-level variations in adult Medicaid dental benefits to estimate the elasticity of demand for dental services on low-income parents, the precise group whose eligibility is extended by the new law.

Naïve comparisons of dental service use between Medicaid-eligible and ineligible people within states may lead to biased estimates because of differences in unobservable characteristics between the two types of people. One cannot distinguish whether the differences in dental service usage are due to Medicaid benefits or to personal traits. To overcome this problem with omitted variables, studies have used exogenous variations in Medicaid coverage. While there are some reliable estimates on the causal relationship between medical insurance and use of medical services,[1] the dental market has received relatively little attention. However, the dental market is not a small market. The United

[1] Several studies attempt to identify the effects of insurance coverage on medical care use for low-income populations by exploiting state-level variation in Medicaid eligibility. Using state-level variation in Medicaid eligibility expansion for low-income children, Currie and Gruber (1996) found that being made eligible for Medicaid is associated with a 9.6 percentage point drop in the probability of going without a doctor visit in the last year. Turcotte (2005) used Medicaid eligibility expansion that covered all pregnant women and newborns with family income below 133 percent of the poverty line. They concluded that becoming eligible and enrolling in Medicaid due to pregnancy increases the likelihood of teens and adults receiving prenatal care compared to being uninsured.

States spent $101.2 billion on dental care in 2008. Dental spending is expected to be over $180 billion in the year 2019 (National Health Expenditure Projections 2009-2019).

Individual productivity is affected by oral health; the pain from dental disease can lead to greater absenteeism from work. According to the 1996 National Health Interview Survey (NHIS), 1.9 days of work were lost per 100 employed persons over age 18 because of dental symptoms or treatment (Glied and Neidell, 2010). Dental health also affects quality of life. Poor dental health not only causes pain, discomfort, and costly treatment, but also may become a serious health risk. The U.S. Surgeon General's Oral Health Report (2000) and many recent studies report the linkage between poor oral health and cardiovascular disease, respiratory infection, and adverse pregnancy outcomes such as preterm birth and low birth weight through bacteria and inflammation (Thoden, 1984; Beck et al., 1998; Genco et al., 1998; Sanchez et al., 2004; Boggess, 2008).

Studies on dental service usage focus on the number of dental visits in a given time period, as the regular use of dental services is very important to maintain oral health (Guay, 2006). Using Washington State's Access to Baby and Child Dentistry (ABCD) program, which offered extended dental benefits to participating Medicaid-enrolled children and higher fees for certified providers, Grembowski and Milgrom (2000) found that an ABCD child was 5.3 times as likely to have had at least one dental visit as a child not in the program. However, this estimate is likely to have an upward bias because the ABCD program was offered to voluntarily participating children. It is likely that parents who placed a high value on dental services enrolled their children in the ABCD program. Cohen et al. (2002) found that the use of hospital emergency departments by Medicaid patients in Maryland increased about 10 percentage points compared to that of non-Medicaid patients after the state eliminated Medicaid dentist reimbursement. However, the data were from one hospital and cannot be generalized without examining other numerous potential factors that affect dental emergency departments, such as seasonal variation, demographic changes, and any change in nearby competing hospitals.

A randomized study of the dental market was conducted by the RAND Health Insurance Experiment (HIE, 1971-1986). However, the data used for this study are more than 25 years old. Also, the RAND HIE study did not focus on low-income population, who is the group of interest for policy implications and has the worst dental health. Moreover, the RAND study estimates the impact of actual insurance co-payment on dental service use, while this study estimates the impact of Medicaid eligibility on dental service use.

To generate an unbiased estimate on the effect of Medicaid benefits on dental service use, the approach common in medical literature, exploiting state-level variation in adult Medicaid dental coverage, is used. The author has found that having adult Medicaid dental coverage increases the likelihood of a dental visit within 12 months by 7.4 - 9.9 percentage points. The estimates can be translated into increased dental visit by 1.02 - 1.37 million more people in year 2010.

The remainder of the paper is organized as follows: Section I.2 contains background information on dental health and Medicaid eligibility. Section I.3 presents the data set and presents the identification strategy. Section I.4 contains the results. Section I.5 presents and provides a discussion of results from various robustness checks.

Section I.6 discusses the various consequences of adult Medicaid dental benefit. Section I.7 concludes the paper.

I.2. Background Information[2]

Dental Health of Low-income Americans

The dental health of most Americans has improved significantly since the 1960s. However, low-income and other vulnerable populations continue to have high levels of dental disease. According to the U.S. General Accounting Office Oral Health Report (2000), about 48 percent of low-income adults with less than $10,000 in annual family income had untreated caries (cavities). In contrast, only 18 percent of adults whose incomes were $35,000 or higher had untreated caries.

Despite high levels of dental disease, the low-income group uses the lowest level of dental services. According to the Behavioral Risk Factor Surveillance System (BRFSS), in 2004, only 44 percent of the population with less than $10,000 in annual income had at least one dental visit, while 80 percent of the population with between $50,000 and $75,000 in annual household income had at least one dental visit within a year.

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[2] This section uses information from the reports below:
Centers for Medicare and Medicaid Services, Department of Health and Human Services: Profiles of Medicaid Chart Book 2000; Medicaid at a Glance 2005; 2008 Actuarial Report on the Financial Outlook for Medicaid.
United States General Accounting Office: Report to Congressional Requesters, Oral Health: "Dental Disease Is a Chronic Problem among Low-income Populations"
Manski, R. J., and Brown, E. "Dental Use, Expenses, Private Dental Coverage, and Changes, 1996 and 2004," Rockville (MD): Agency for Healthcare Research and Quality, 2007. MEPS Chartbook No. 17
www.cms.hhs.gov (Centers for Medicare & Medicaid Services)

Unlike many other diseases, dental caries or periodontal disease do not heal without professional treatment. Because oral diseases progress slowly, often without symptoms initially, "routine dental exams uncover problems that can be easily treated in the early stages, when damage is minimal[3]" (American Dental Association, www.ada.org). Delay in treatment usually results in higher costs for treatment when it is provided (Guay, 2006). For example, caries can be treated through relatively inexpensive fillings if found in the early stages. If caries are not treated and left to progress further, much more expensive[4] procedures such as root canals, crowns, dentures, or implants will be needed later; or, even worse, one might lose his or her teeth (Glied and Neidell, 2008).

Even though effective preventive and treatment measures to improve dental health are available, dental disease remains prevalent, especially among low-income populations.

Medicaid

The Medicaid program is the third-largest source of health insurance in the United States, after employer-based coverage and Medicare. Medicaid is a cooperative program between the federal and state governments to pay for health care and medical services for certain low-income persons. Each state establishes its own eligibility standards, benefits packages, payment rates, and program administration under broad federal guidelines. As a result, there are essentially 51 different Medicaid programs, one for each state and the District of Columbia.

[3] Routine dental visit (regardless of the type of visit) is preventive in nature because early detection of dental problem prevents serious diseases and costly treatment.

[4] According to the brochure of Blue Shield Dental Insurance (2010), the standard list price for one filling is $198 and one root canal is $1,178.

Medicaid eligibility is determined primarily by income, assets, and age.[5] Although states have some discretion in determining which groups their Medicaid programs will cover, to be eligible for federal funds, states are required to provide Medicaid coverage for most people who qualify for federally assisted income maintenance payments, as well as for related groups who do not receive cash payments. One of the mandatory eligibility groups is limited-income families with children (Center for Medicare & Medicaid Services). In most states, Medicaid excludes low-income childless adults unless they have a specific condition or illness.[6] In 2002, among very low-income adults with incomes less than 50 percent of the federal poverty level, 91 percent of parents were eligible for Medicaid, while only 37 percent of childless adults were eligible[7] (Davidoff et al., 2005). This difference in Medicaid eligibility regarding the presence of a dependent child in the household generates an opportunity for difference-in-differences analysis, employing parents as a treatment group and childless adults as a control group.

Adult Medicaid Dental Benefits

While every state offers comprehensive dental benefits to children, adult dental service coverage is optional under Medicaid. The level of adult dental coverage each state offers varies widely, from no coverage at all to a comprehensive package that covers

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[5] There are also different eligibility standards for pregnant women, the disabled, and the blind.

[6] Childless adults who receive Supplemental Security Income (aged, blind, and disabled individuals) are eligible for the Medicaid benefits.

[7] The following states provided Medicaid benefits to childless adults in 2002: Arizona, Delaware, Hawaii, Maine, Massachusetts, Minnesota, New Jersey, New York, Oregon, Pennsylvania, Tennessee, Utah, Vermont, and Washington. Among these states, those that offered adult Medicaid dental benefits are excluded from the sample.

every dental need, with the exception of cosmetic and orthodontic procedures. For example, in the sample years 2002 and 2004, Texas Medicaid did not offer any dental coverage to adults. Florida Medicaid offered only medically necessary emergency dental procedures to alleviate pain or infections. Connecticut Medicaid offered most dental services including annual exam and X-rays, but did not cover periodontal and fixed bridges. New York Medicaid service offered a wide range of dental services such as preventive, diagnostic, restorative, or more complex. The level of coverage can be broadly classified into two categories: coverage with at least an annual dental checkup and X-rays, and coverage without annual checkups. Most states require a very low co-payment of $1 - $3 per visit.

Figure 1.1 shows the level of adult Medicaid dental coverage in the year 2002. White states offered no adult Medicaid dental benefits, and grey states offered adult Medicaid dental benefits to low-income parents only. States in black, i.e., Massachusetts, Minnesota, New Jersey, New York, Oregon, Pennsylvania, Vermont, and Washington, offered adult Medicaid dental benefits to low-income parents and childless adults.

Because there is no difference in Medicaid coverage between parents and childless adults in these eight states, they are excluded from the main sample. In this study, the dental service use of low-income parents in grey and white states is compared.

Massachusetts, Michigan, and Oregon changed their policies from offering adult Medicaid dental benefits to offering no benefits during year 2003. However, using the usual pre/post fixed effects analysis is not feasible because of the timing of the change. The question in the BRFSS that is being used for the analysis pertains to dental service use within 12 months; therefore, if the survey were conducted in the beginning of 2004, the period in question still includes the period before the policy change. Only 2002 data from these three states are included in the sample.

I.3. Empirical Strategy

Data

The data for this paper were obtained from the Behavioral Risk Factor Surveillance System (BRFSS), a cross-sectional telephone survey conducted by state health departments, with technical and methodological assistance provided by the Centers for Disease Control (CDC) and Prevention. Using samples of telephone numbers obtained through random-digit dialing from the CDC's Behavioral Surveillance Branch, states conduct monthly telephone surveys using a standardized questionnaire to determine the distribution of risk behaviors and health practices among adults. More than 350,000 adults are interviewed each year, making the BRFSS the largest telephone health survey in the world.

The BRFSS questionnaire is comprised of core questions and optional modules. The optional modules are standardized questions, supported by the CDC, that cover additional health topics, or are more detailed questions on a health topic included in the core. Each year, states must choose which optional modules they will use based on the data needs of their state. The oral health module is one of the optional modules. The number of states that elect to include the oral health module questions varies by year. On average, only about one-third of states choose to ask oral health module questions. The sample years 2002 and 2004 are the only ones in which the oral health module was asked in all the states. The oral health module asks whether the individual saw a dental professional (for any reason) within the past 12 months,[8] whether the individual has had a teeth cleaning within the past 12 months,[9] and the number of teeth lost due to tooth decay or gum disease.[10]

The BRFSS survey contains questions regarding such health-related issues as self-assessed health status and whether the individual saw a medical doctor within the previous year. It also includes questions on detailed demographic data such as age, gender, education, race, income, marital status, whether there is child in the household, the number of adults in the household, and the state identifier. For income data, the annual household income from all sources is requested. The drawback of this dataset is that an income category is given instead of the actual income.[11]

Methodology

Using a difference-in-differences technique, the author compares the annual dental service use of low-income parents in states with and without adult Medicaid dental

[8] The question BRFSS uses is, "How long has it been since you last visited a dentist or a dental clinic for any reason?" Possible answers are (1) Within the past year (any time less than 12 months ago); (2) Within the past 2 years (1 year but less than 2 years ago); (3) Within the past 5 years (2 years but less than 5 years ago); (4) 5 or more years ago; and (8) Never

[9] The question BRFSS uses is, "How long has it been since you had your teeth cleaned by a dentist or dental hygienist?"

[10] The question BRFSS uses is, "How many of your permanent teeth have been removed because of tooth decay or gum disease? Do not include teeth lost for other reasons, such as injury or orthodontics." Possible answers are (1) 1 to 5; (2) 6 or more but not all, (3) All; and (4) None.

[11] The choices available were: less than $10K, $10K to less than $15K, $15K to less than $20K, $20K to less than $25K, $25K to less than $35K, $35K to less than $50K, $50K to less than $75K, or more than $75K.

coverage. To investigate the impact adult Medicaid dental benefits have on dental service usage, the linear probability model is estimated using Eq. (1.1) below:

$$Y_i = \beta_1 DentalBenefit_i + \beta_2 Parent_i + \beta_3 DentalBenefit_i{*}Parent_i + \beta_4 X_i + \beta_5 Year_{2004} + \varepsilon_i \quad (1.1)$$

Y_i is an indicator of whether individual i had a dental visit within the last 12 months. $DentalBenefit_i$ is an indicator that equals 1 if the person lives in a state that offers adult Medicaid dental benefits.[12] This variable controls for differences in dental service usage between states with and without adult Medicaid dental benefits. $Parent_i$ is an indicator that equals 1 if the person is a parent. This variable controls for the effect of having at least one child on dental service usage. $DentalBenefit_i{*}\ Parent_i$ is the interaction term between living in a state that offers adult Medicaid dental benefits and being a parent. The coefficient of interest, $\beta_{3,}$ is the increase in the probability of dental visits that can be attributed to the eligibility for adult Medicaid dental coverage. X_i is a vector of observable characteristics that may impact dental use. Included in X are age, age squared, gender, education, race, marital status, and dummy variables that indicate, for example, whether individual *i* is overweight or obese. In some specifications used for a robustness check, X_i also includes state-specific variables and region dummy variables. $Year_{2004}$ is the year fixed effect, and ε_i is the error term.

[12] All equations were also estimated using a probit model. The results from probit estimation are similar to those from the linear probability model. They are available upon request.

Table 1.1 contains a wide range of Medicaid income thresholds as the percentage of the federal poverty level (FPL) for states with adult Medicaid dental benefits.[13] The threshold for working parents ranges from 31 percent to 192 percent of the FPL. For a family of three, the income threshold can be as low as $5,217 or as high as $32,314. Because the BRFSS data do not offer an exact amount of income and asset information, it is impossible to precisely determine whether the individual is eligible for the Medicaid benefits. The lowest income group in the BRFSS data is an annual income below $10,000.

In this paper, a low-income household is defined as annual household income from all sources below $10,000. Because the income threshold is below $10,000 (59.4 percent of FPL for a family of three) in some states and the FPL varies according to the size of a family, some people in this income group in states with adult Medicaid dental benefits might not be eligible for Medicaid benefits.[14] In addition, people in the control group could be eligible for Medicaid benefits if they have a specific illness, a disability such as blindness, or are pregnant. Thus, the estimates can be interpreted as a lower bound of the impact of adult Medicaid dental eligibility on dental use. The sample has been restricted to those younger than 56 years old because, without an age restriction, childless adults are much older than parents (the treated group).[15]

Table 1.2 shows summary statistics for the sample. It includes individual demographic data such as age, gender, education, race, and marital status. Good self-reported health means self-reported good or excellent general health. Body Mass Index

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[13] The FPL for a family of three in 2001 was $16,830.
[14] A regression was run that excludes states with very low thresholds for the robustness check in Section V.
[15] Regressions were run with various age restrictions. The results do not change significantly with different age limits.

(BMI) is presented as a proxy for general health status. Percentage with medical doctor is presented to indicate whether there is difference in preference for health care in general.

The first two columns compare summary statistics of people with less than $10,000 in annual household income between two different levels of adult Medicaid dental benefit regions. States with dental benefits include all 16 states that offered adult Medicaid dental benefits only to parents in 2002.

Columns 1 and 2 show that low-income people in states with and without adult Medicaid dental benefits exhibit similar statistics regarding age, percentage of females, educational attainment, marital status, percentage of unemployment, and health indicators. The two groups have slightly different racial compositions. States that offer adult Medicaid dental benefits have six percentage points more whites and 11 percentage points fewer African Americans. Low-income people in states with and without dental benefits used approximately the same level of medical service. Nearly 70 percent of low-income people in both states with and without adult Medicaid dental benefits visited a doctor within the previous year. However, there are sizable differences in dental service use. Fifty-three percent of low-income people in states with adult Medicaid benefit visited the dentist, while only 45 percent of low-income people in states without adult Medicaid benefit had done so. A higher percentage of low-income people in states with dental benefits also had their teeth cleaned.

Columns 3 and 4 compare low-income parents with childless adults. While the two groups show similar health status and percentage of unemployed people, low-income childless adults are older, more often male, and have a different racial composition, have more education, and are less likely to be married.

The control group is used to account for the unobservable state-level differences that have an impact on dental service use. For the control group to be valid, the difference in observable characteristics of parents (treated group) across states with and without adult Medicaid dental benefits should be similar to the difference in observable characteristics of childless adults (control group) across states.

Table 1.3 presents the covariate balance test results.[16] Most of the difference-in-differences comparisons of covariates show no systematic differences between parents and childless adults across states with and without adult Medicaid dental benefits.

Four covariates, high school graduates, black, Hispanic, and BMI, show statistically significant differences. The percentage with high school diplomas and differences in BMI are statistically different at 10 percent level. However, the size of the differences is negligible. Two race variables, black and Hispanic, show statistically significant differences at one percent level. There are 4.1 percentage points fewer black parents and 3.7 percentage points more Hispanic parents in states with adult Medicaid dental benefits compared to childless adults across states. Although race variables do not have a significant impact on dental use in most regressions, the difference in race composition is accounted for by adding census region variables in the robustness check section.

[16] Covariate test results are also presented in difference-in-differences format in Appendix A.

I.4. Results

Simple Difference-in-Differences Result

Table 1.4 shows simple difference-in-differences estimates for the likelihood of a dental visit within 12 months. It reveals that adult Medicaid dental benefits increase the likelihood of a dental visit by 5.9 percentage points. In states without adult Medicaid dental benefits, low-income people with and without children show almost the same level of dental service usage, at 45 percent. This suggests that childless adults are a plausible control group for dental visits. In states with adult Medicaid dental benefits, Medicaid-eligible low-income parents used 6.3 percentage points more dental services within 12 months than did childless adults in the same states.

Regression with Control Variables Result

There are many individual characteristics that affect dental service use, such as age, gender, race, and education. Column 2 of Table 1.5 contains linear probability regression results with individual control variables using Eq. (1.1). With the inclusion of control variables, the coefficients of the interaction terms become even larger by two percentage points compared to simple difference-in-differences results.

Regression with individual control variables shows that adult Medicaid dental benefits increase the likelihood of a dental visit within 12 months by 7.9 percentage points.[17] This estimate is much lower than the RAND HIE estimate of 15.6 percentage points. The sizable gap in estimates is due primarily to the difference between eligibility

[17] Adult Medicaid dental insurance is also increase the likelihood of teeth cleaned within one year by 8.1 percentage points.

and actual insurance coverage. The relationship between Medicaid eligibility and dental service use is used in this study, while actual insurance coverage is used in the RAND study. Moreover, due to the heterogeneity in eligibility among states and different eligibility thresholds for various family sizes, some Medicaid-ineligible individuals are in the treatment group. The estimate should be interpreted as the lower bound of the true impact.

The coefficient on the dental benefits state dummy is sizable and statistically significant. This suggests that there might be state-specific characteristics such as dentist-to-patient ratio, water fluoridation rate, and industrial structure, which might generate differences in private dental insurance among low-income people that cause people in states with adult Medicaid dental benefits to visit dentists more frequently. This will be investigated further in the robustness check section. Further, females are 9 percentage points more likely to use dental services, and higher educational attainment has the biggest impact on dental service use. Compared to people with less than eight years of education, high school graduates are about 10.3 percentage points more likely to have dental visits, and college graduates are 22.7 percentage points more likely to have dental visits within a year. Coefficients on race variables are mostly statistically insignificant. Differing marital status, with the exception of cohabitation, has a relatively small impact on dental service use. Compared to people who have never been married, cohabiting people are 14.9 percentage points less likely to have a dental visit.

I.5. Robustness Checks

Placebo Difference-in-Differences

To investigate whether unobserved systematic differences between parents and childless adults cause bias on the estimation of the coefficient of interest, a placebo regression on a higher income group was run, as this group is not likely to be eligible for Medicaid benefits. A regression for Eq. (1.1) was conducted on parents with an annual household income between $35,000 and $50,000, using childless adults as a control group. Parents with an annual household income between $35,000 and $50,000 share the same state unobservables but have limited eligibility for Medicaid benefits. If adult Medicaid dental benefits are correlated with state-level factors that cause parents to visit the dentist more often, a significant effect among this slightly higher income group would also be observed.

Table 1.6 shows regression results with and without individual control variables. Regardless of specifications, the coefficients of the interaction terms are near zero and statistically insignificant. Almost zero and statistically insignificant coefficient of interaction terms in this placebo regression suggest that the possibility of state-level unobservable differences affecting all parents in states with dental benefit could be ruled out.

Alternative Control Group

For the difference-in-differences estimate to be unbiased, an ideal control group should behave in the same way, i.e., use the same level of dental services, if there were no difference in the level of Medicaid dental benefits. Although a perfect control group might not exist, low-income childless adults share the same characteristics as the general population of low-income individuals. Low-income childless adults also share the same state-specific characteristics, such as dentist-to-patient ratio, water fluoridation rate, distance to dental offices, and the industrial structure of the state that might be related to private dental insurance rates. However, childless adults might not be an ideal control group if states with adult Medicaid dental benefits have more generous social assistance programs for the low-income parents in general, hence enabling them to afford more dental services.

For a robustness check, parents with slightly higher incomes ($25,000 - $35,000 annual household income) are used as an alternative control group. Middle-income parents share similar characteristics with low-income parents but are not likely to be eligible for Medicaid benefits. The summary statistics in Table 1.2 shows that the alternative control group has a similar average age but a higher percentage of males and higher educational attainment. Middle-income parents are 14 percent less likely to have some high school education and 10 percent more likely to have a college degree. There are a greater number of whites and married couples in this group, and they are more likely to be employed. There are two additional advantages of employing middle-income parents as an alternative control group. First, the previously excluded eight states that covered childless adults are now included in the sample. Because adult Medicaid dental coverage is a state-level policy and dental service usage in the same state is likely to be correlated, failure to account for the presence of common group errors can cause downward biased standard errors (Moulton, 1990, Donald and Lang, 2007). Bertrand et al. (2004) showed that the cluster robust variance estimator works with clusters when the number of groups is more than 50. With the inclusion of the eight states, the number of groups in the analysis becomes 51. Second, comparing regression results between estimates using all 51 states and the 43 states that are used in the main analysis can determine if dropping the eight states caused any bias from the selection problem.

Table 1.7 presents regression results with and without individual control variables using the alternative control group with 51 states and the main analysis group of 43 states. Employing the alternative control group increases the coefficients on the interaction terms by 1.3 - 1.8 percentage points. The coefficient of interaction terms is still significant at one percent level. Regressions with the alternative control group of all 51 states and the main analysis group of 43 states produce similar results, suggesting that dropping states that offer Medicaid benefit to both parents and childless adults does not cause serious bias.

State-Specific Control Variables and Region Dummy Variables

Because the analysis is limited to cross-sectional variation, there is a concern that state-specific factors bias the above estimates. It is possible that several state-specific characteristics are correlated with higher dental service use in states with adult Medicaid dental benefits. Possible factors are water fluoridation rate and dentist-to-patient ratio. Many studies have found that there is a link between water fluoridation and dental health (Burt and Eklund, 1999). Water fluoridation data are available from the historical water fluoridation reports by the CDC, and the average water fluoridation rate by states since 1964 was calculated. Access to dental services might be affected by the competition among dentists. Higher dentist-to-patient ratio might increase accessibility of Medicaid patients to dental care. It also has impact on distance to dental offices from home. The dentist-to-patient ratio is the number of dentists per 10,000 people in the year 2004. The number of dentists per state is obtained from American Dental Association reports. Population estimates by state in 2004 are from the U.S. Census Bureau data.

The distribution of the states that offer adult Medicaid dental benefits does not seem to be random. The summary statistics and the covariate balance test also report systematic difference in racial distribution. To control for this regional distribution, census regional variables, i.e., Northeast, South, Midwest, and West, were added as controls.[18]

Table 1.8 contains regression results with state-specific dental use control variables and region dummy variables. With average fluoridation rate and dentist-to-patient ratio as control variables, the coefficients of the interaction terms decrease by 1.4 percentage points to 6.5 percentage points with childless adults as the control group and by 0.5 percentage point to 9.3 percentage point with middle-income parents as the control group, but still remain statistically significant.

Difference in the levels of dental use between the two regions with different adult Medicaid dental benefits is partly explained by dentist-to-patient ratio and fluoridation

[18] The author chose to use four census regions instead of nine census regions. There is not enough variation in adult Medicaid dental policy within region when nine census regions were used. For example, every state offered adult Medicaid dental benefit in Middle Atlantic Region and none of the West South Central Region states provided adult Medicaid dental benefit.

rate. Both dentist-to-patient ratio and average fluoridation rate are statistically significant only when low-income childless adults are used as a control group. This suggests there might be problem with accessibility to dental services among low-income people, possibly due to low reimbursement rate of Medicaid, as suggested in the U.S. General Accounting Office Oral Health Report (2000).

Among low-income populations, having one additional dentist in a population of 10,000 increases the probability of having a dental visit by 2.3 percentage points. Adding region dummy variables does not significantly change the coefficients of interaction terms and other estimates.

Drop States with More Restrictive Medicaid Eligibility

Medicaid eligibility income thresholds vary widely among states. For a family of three, $10,000 is 59.4 percent of the federal poverty line. Indiana, Missouri, and Nebraska are states with Medicaid dental benefits that set the eligibility threshold for working parents lower than 59.4 percent. As some of the low-income parents in the treatment group from these states are not eligible for Medicaid benefits, the estimates might have a downward bias.

Another possible source of bias is states with more restrictive Medicaid eligibility for two-parent families. Since 1998, most states offer Medicaid benefits to two-parent families. However, among states that offer adult Medicaid dental benefits, Nebraska, North Dakota, and Wisconsin offer limited Medicaid coverage for two-parent families. This might cause further bias on the estimates.

Table 1.9 presents regression results, excluding states with these possible sources of bias. Columns (1) and (4) report regression results with a full set of control variables. Columns (2) and (5) report regression results, excluding states with an eligibility threshold lower than 59.4 percent of the federal poverty line. As expected, the coefficients of the interaction terms from regressions that exclude states with a too-low threshold increase slightly, by 0.3 - 0.5 percentage points. This suggests that non-Medicaid-eligible, low-income parents in the treatment group from these states caused some downward bias on the estimate. Columns (3) and (6) report the regression results, excluding two-parent families in states with more restrictive coverage for two-parent families. Nebraska is already excluded because of its too-low Medicaid eligibility threshold. A small amount of data from North Dakota and Wisconsin are excluded. The coefficients of the interaction terms further increase by 0.3 - 0.4 percentage points, suggesting that more restrictive coverage for two-parent families caused a slight downward bias.

I.6. The Impact of Adult Medicaid Dental Benefit

In this study, the impact of adult Medicaid dental benefit on dental service use is estimated in various specifications using linear probability model. The estimates of coefficient interaction term are summarized in Table 1.10. The results are robust regardless of the specification.

Columns 4 and 8 report regression results using the richest set of control variables with minimized measurement error. They show that adult Medicaid dental benefit increases the likelihood of dental visit by 7.4 - 9.9 percentage points among low-income population. These estimates suggest, in terms of the number of people, between 1.02 and 1.37 million more people had a dental visit due to the existence of adult Medicaid dental benefits in 2010. Of the 25.26 million adults who were enrolled in Medicaid in 2010, about 13.8 million adults lived in states that offered adult Medicaid dental benefits (Kaiser Commission on Medicaid and the Uninsured, 2011). The increase of 1.02 - 1.37 million is calculated by multiplying 13.8 million and the preferred estimates of 7.4 and 9.9 percentage points. As approximately 11.46 million adults lived in states without adult Medicaid dental benefits in year 2010, if these states include at least annual dental checkup in adult Medicaid benefit, an additional 0.85 - 1.13 million people would be expected to use dental services.

The natural question that follows is whether increased dental service usage leads to better dental health. This question is not easy to answer because measuring objective dental health needs a professional's expertise. Most of the data on oral health are self-reported.[19]

RAND HIE is the only large-scale, randomized controlled study that examined the relationship between levels of insurance coverage and professionally examined oral health. Using RAND HIE data, Bailit et al. (1985) conclude that reducing cost sharing for dental services will improve oral health, with fewer decayed teeth and less periodontal disease, especially for subgroups of the population with the poorest oral health. Bailit et

[19] NHANES III data, which were collected between 1988 and 1994, contain dentist examination data and self-identified oral health status. They show a large discrepancy between self-identified oral health status and dentist exam results (http://www.cdc.gov/nchs/data/nhanes/databriefs/oralhealth.pdf).

al.'s conclusion suggests that adult Medicaid dental benefits will improve the dental health of low-income people through increased dental services.

BRFSS data provide a crude proxy for dental health. However, the number of teeth lost in categories does not provide precise information about dental health because losing teeth is an extreme case of poor dental health and the result of prolonged neglected dental care. Further, although low-income parents in states with adult Medicaid dental benefits report fewer teeth lost, difference-in-differences analysis does not produce statistically significant results, mostly because childless adults in states with dental benefit also report fewer lost teeth.

Another objective measure might be hospitalization because of dental procedures. Dental-related hospitalization can result from a severe case of poor dental health, but this happens rarely. However, it could be used as an objective proxy for dental health to investigate the levels of very bad oral health between states.

The Nationwide Inpatient Sample (NIS) is a database of hospital inpatient stays sponsored by the Agency for Healthcare Research and Quality. The NIS is the largest all-payer inpatient care database, containing data from 5 to 8 million hospital stays from about 1,000 hospitals sampled to approximate a 20-percent stratified sample of U.S. community hospitals. The NIS data used in this analysis are from 2004 and was collected from 37 states. The NIS provides demographic information such as age and median household income quartile for patients' ZIP codes, which could be used as a proxy for patients' income level. It also provides total charge and diagnosis-related group, which could be use to identify dental-related hospitalizations.

Table 1.11 compares number, hospital charge, and age of low-income patients in states with and without adult Medicaid dental benefits. Panel A in the Table 1.11 reveals that the percentage of all dental-related hospitalization is slightly higher in states with adult Medicaid dental benefits. However, the percentage of dental-related hospitalization of low-income patients (median household income for ZIP code is less than $35,999) is higher in states without adult Medicaid dental benefits.

Panel B compared total hospital charges. Low-income people in states without adult Medicaid dental benefits have more than 17 percent higher total hospital charges suggesting that there are more severe cases of dental problems in states without adult Medicaid dental benefits among low-income people. Because higher charges might reflect statewide higher medical prices, a comparison is made between total charges of all hospitalization and dental-related hospitalization of higher income people (median household income for ZIP code is $45,000 and higher). People in states with adult Medicaid dental benefits have higher charges on all hospitalization and dental-related hospitalization among a higher income population. Panel C reports the number and percentage of dental patient's median household income quartile for patient's ZIP code. About 40% of all dental-related hospitalization is offered to low-income people in states without adult Medicaid dental benefits, while only about 30% is offered to low-income people in states with adult Medicaid dental benefits. Higher hospital charges and higher percentage of hospitalization of low-income people in states with adult Medicaid dental benefits might be explained by the incidence of older low-income people in states with adult Medicaid dental benefits, because dental condition deteriorates with age. Panel D shows that the average age of individuals in states with and without adult Medicaid dental benefits is very similar. The comparison of NIS data suggests that low-income people in states with adult Medicaid dental benefits have better dental health than low-income people in states without adult Medicaid dental benefits.

In addition to direct health effects, better dental care could increase wages for low-income women. Glied and Neidell's (2010) use variation in fluoridated water exposure during childhood and establish that better dental health increases wages by 4 percent among women with low socioeconomic status. If we assume low-income women work for the federal minimum wage in 2006 at $5.15 for 30 hours a week, 50 weeks a year, better dental health increases their wage by $309 a year. According to MEPS data, average Medicaid dental expenditure per capita for people with dental visit in 2006 was $264. This suggests that providing dental benefit is a cost-effective strategy, even excluding additional value for health gains.[20]

I.7. Conclusion

Using the difference-in-differences estimation method, which exploits state-level variation in adult Medicaid dental benefits, the author analyzed the effect of dental insurance on dental service use. The regression results and various robustness tests suggest that adult Medicaid dental benefits increase the likelihood of a dental visit by

[20] Given that the benefits of using dental service exceed the cost, one might wonder why the utilization of dental service is so low among low-income people. Possible explanations might be household budget constraints or differing time discount rate. Because the benefit of regular dental care is not realized immediately, people with high time discount rate might not use dental services.

16.4 percent to 22 percent (7.4 - 9.9 percentage points) among low-income people, who typically experience the worst dental health.

The only randomized study (RAND HIE) resulted in an estimate for increased usage of dental services of 31 percent (15.6 percentage points). The RAND HIE estimate is larger for two reasons. First, the RAND study compares dental service use between people with no copayment for services and those with 95 percent copayment. Medicaid dental patients are required to pay a very small copayment, between $1 and $3, in most states. However, for Medicaid patients, even a small copayment decreases the demand for medical service significantly (Helms et al., 1978). Second, the estimates in this study are based on eligibility rather than actual Medicaid coverage, making them the lower bound of the true effect. Only about a half (52 percent) of Medicaid-eligible adults were actually enrolled in the Medicaid program in 2002 (Kaiser Commission on Medicaid and the Uninsured). From a policy perspective, though, the estimate in this study is the one most likely to be realized.

Cost-benefit analysis suggests adult Medicaid dental benefit is cost effective, even without direct health gains. The new health reform extends Medicaid coverage to millions more individuals, including childless adults. Accordingly, the author suggests that such increase in benefits will result in a significant increase in preventive dental care, hence improve dental health among low-income population and decrease dental hospitalization expenditure in the long run.

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Figure 1.1. Adult Medicaid Dental Benefit in 2002

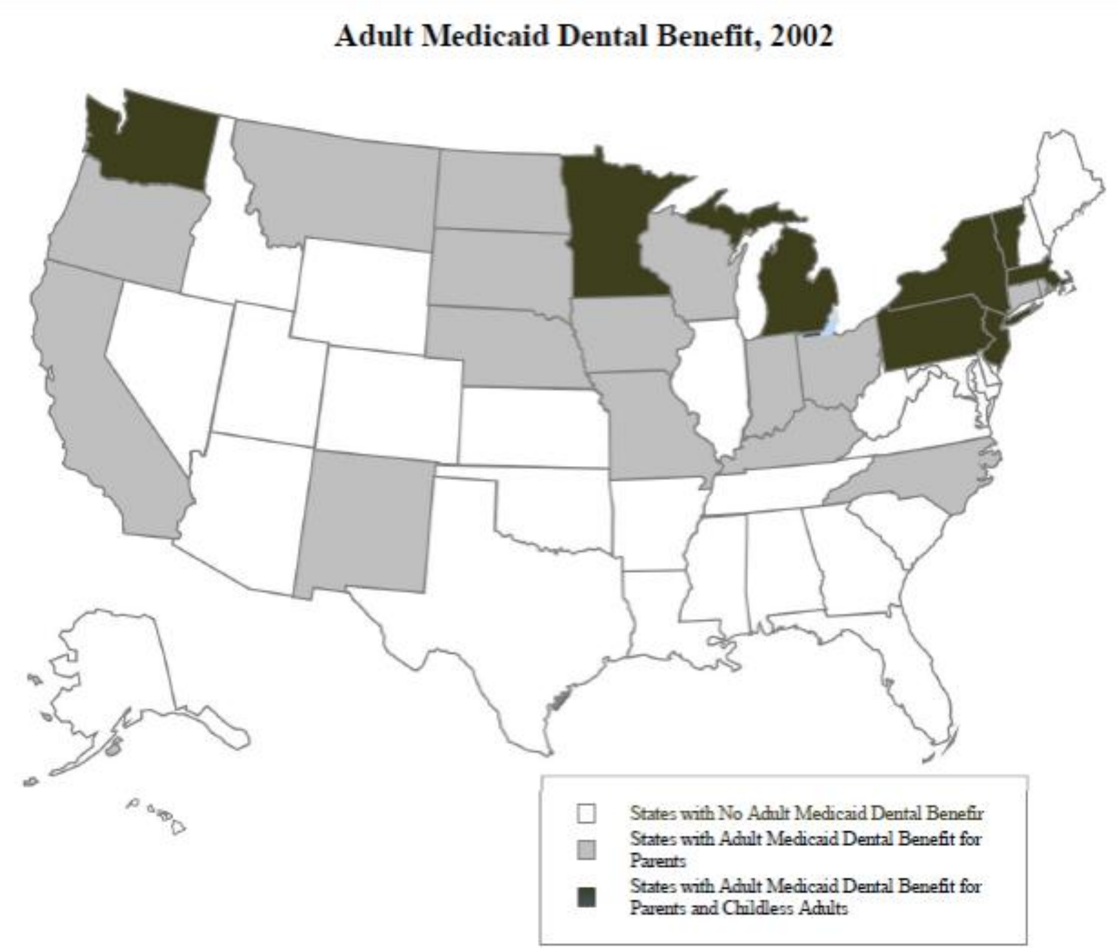

Table 1.1. Medicaid Income Threshold as % of FPL for Parents in States with Adult Medicaid Dental Benefit

States	Jobless	Working	States	Jobless	Working
California	100%	107%	Nebraska	44%	55%
Connecticut	150%	157%	New Mexico	32%	58%
Indiana	24%	31%	N. Carolina	45%	62%
Iowa	35%	87%	N. Dakota	40%	110%
Kentucky	43%	75%	Ohio	100%	100%
Massachusetts	133%	133%	Oregon	100%	100%
Michigan	38%	63%	Rhode Island	185%	192%
Missouri	30%	38%	S. Dakota	65%	65%
Montana	39%	69%	Wisconsin	185%	185%

Source: Kaiser Commission on Medicaid and the Uninsured

Table 1. 2. Summary Statistics

	Low-Income		Treated	Control 1	Control 2
	States with Dental Benefit	States w/o Dental Benefit	Low-Income Parents	Low-Income Childless Adults	Mid-Income Parents
Age	38.72	38.87	35.86	41.24	36.02
	(10.71)	(0.46)	(9.02)	(11.11)	(8.30)
Female (%)	0.68	0.70	0.83	0.58	0.66
	(0.47)	(0.39)	(0.37)	(0.49)	(0.48)
Some High School	0.17	0.18	0.21	0.15	0.07
	(0.38)	(0.48)	(0.41)	(0.36)	(0.26)
High School Graduate	0.35	0.36	0.39	0.33	0.40
	(0.48)	(0.44)	(0.49)	(0.47)	(0.49)
Beyond High School	0.40	0.38	0.31	0.44	0.51
	(0.49)	(0.48)	(0.46)	(0.50)	(0.50)
White	0.60	0.54	0.45	0.66	0.68
	(0.49)	(0.44)	(0.50)	(0.48)	(0.47)
Black	0.15	0.25	0.27	0.17	0.14
	(0.36)	(0.31)	(0.44)	(0.37)	(0.34)
Hispanic	0.15	0.11	0.18	0.08	0.11
	(0.35)	(0.38)	(0.38)	(0.27)	(0.31)
Married	0.17	0.17	0.24	0.12	0.61
	(0.38)	(0.49)	(0.43)	(0.33)	(0.49)
Divorced/Separated	0.37	0.38	0.38	0.37	0.22
	(0.48)	(0.48)	(0.49)	(0.48)	(0.42)
Never Married	0.37	0.36	0.30	0.42	0.11
	(0.48)	(0.41)	(0.46)	(0.49)	(0.32)
Unemployed	0.19	0.21	0.23	0.18	0.04
	(0.39)	(0.89)	(0.42)	(0.39)	(0.21)
# of Kids in Household	0.85	0.94	2.00	-	1.97
	(1.23)	(0.46)	(1.16)	-	(1.05)
Good Self-Reported Health	0.30	0.29	0.31	0.28	0.56
	(0.46)	(7.70)	(0.46)	(0.45)	(0.50)
BMI	28.25	28.22	28.54	27.99	27.11
	(7.66)	(0.48)	(7.46)	(7.86)	(5.85)
Dr.(MD) Visit within 1 Yr[1]	0.70	0.69	0.71	0.69	0.67
	(0.46)	(0.49)	(0.46)	(0.46)	(0.47)
Clean Teeth within 1 Yr	0.50	0.39	0.44	0.43	0.61
	(0.50)	(0.50)	(0.50)	(0.49)	(0.49)
Dental Visit within 1 Yr	0.53	0.45	0.50	0.47	0.64
	(0.50)	(0.50)	(0.50)	(0.50)	(0.48)
Observations	4543	6758	5106	6195	17150

Standard errors are in parentheses.
1.The question regarding medical doctor visit was asked in 23 states. The number of observations for a doctor visit is 2,298: 1,237 in states with, 1,061 in states without dental benefits.

Table 1.3. Covariate Balance Test

Variable	Coefficient of the Interaction Term	Standard Error	Variable	Coefficient of the Interaction Term	Standard Error
Age	-0.641	(0.395)	White	-0.010	(0.019)
Female	-0.020	(0.017)	Black	-0.042***	(0.016)
Some High School	-0.002	(0.015)	Hispanic	0.037***	(0.013)
High School Graduate	-0.031*	(0.019)	Married	0.000	(0.014)
Some College	0.007	(0.017)	Divorced	0.020	(0.017)
College Graduate	0.006	(0.013)	Separated	0.002	(0.011)
BMI	-0.520*	(0.307)	Widowed	-0.004	(0.008)
Observations	11,301				

***,*: statistically significant at 1%, 10 % level

Table 1.4. Simple Difference-in-Differences Result

	States with Dental Benefit	States w/o Dental Benefit	Difference
Parents	0.569	0.451	0.118
	(0.495)	(0.498)	
Childless Adults	0.506	0.447	0.059
	(0.500)	(0.497)	
Difference	0.063	0.004	0.059***
Observations	11,301		

Standard errors are in parentheses

***: statistically significant at 1% level

Table 1.5. Regression Result on Dental Visit within 12 Months

	(1) No Control Variables		(2) With Individual Control Variables	
Variables	Coefficient	Robust Standard Error	Coefficient	Robust Standard Error
BenefitState*Parent	0.059***	(0.019)	0.079***	(0.025)
Benefit State	0.059***	(0.013)	0.081***	(0.025)
Parent	0.004	(0.012)	-0.012	(0.019)
Age			-0.016***	(0.006)
Age^2			0.000*	(0.000)
Female			0.090***	(0.024)
High School Dropout			0.046	(0.035)
High School Graduate			0.103***	(0.034)
Some College			0.172***	(0.055)
College Graduate			0.227***	(0.060)
White			-0.017	(0.019)
Black			-0.019	(0.020)
Hispanic			-0.016	(0.024)
Married			-0.030	(0.023)
Divorced			-0.033**	(0.015)
Separated			-0.041***	(0.014)
Widowed			-0.022	(0.023)
Cohabit			-0.149***	(0.035)
Overweight			0.039	(0.032)
Obese			-0.001	(0.028)
Year 2004			-0.006	(0.015)
Number of States	43		43	
Observations	11,301		11,301	

***, **, *: statistically significant at 1%, 5%, 10% level

All the regressions are weighted.

Standard errors are in parentheses and clustered at the state level.

Omitted variables are less than 8 years of education, Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, never married, and normal weight.

Table 1.6. Placebo Regression Result

	No Control Variables	With Individual Control Variables
BenefitState*Parent	0.001	0.003
	(0.008)	(0.009)
Benefit State	0.035	0.037
	(0.026)	(0.025)
Parent	-0.002	0.010
	(0.006)	(0.006)
Individual Control Variables	No	Yes
Observation	43,174	43,174

All the regressions are weighted.
Standard errors are in parentheses and clustered at the state level.
Control variables include full set of variables found in Table 1.5.

Table 1.7. Regression Result with Alternative Control

Variables	Alternative Control Group with 51 States		Alternative Control Group with 43 States	
BenefitState*LowIncome	0.078***	0.097***	0.069***	0.092***
	(0.014)	(0.027)	(0.016)	(0.031)
Benefit State	0.045***	0.076***	0.049***	0.077***
	(0.007)	(0.016)	(0.008)	(0.017)
Low Income	-0.171***	-0.185***	-0.171***	-0.179***
	(0.010)	(0.022)	(0.010)	(0.021)
Control Variables	No	Yes	No	Yes
Number of States	51	51	43	43
Observations	26,503	26,503	22,256	22,256

***: statistically significant at 1% level
All the regressions are weighted.
Standard errors are in parentheses and clustered at the state level.
Control variables include full set of variables found in Table 1.5.

Table 1.8. Regression Result with all the Covariates and State Specific Control Variables and Region Dummy

	Control Group: Low-Income Childless Adults			Alternative Control Group: Mid-Income Parents		
BenefitState*Parent/LowIncome	0.079***	0.065***	0.065**	0.097***	0.092***	0.093***
	(0.025)	(0.024)	(0.024)	(0.027)	(0.027)	(0.026)
Dental Benefit States	0.081***	0.054***	0.058***	0.076***	0.062***	0.065**
	(0.025)	(0.013)	(0.013)	(0.016)	(0.019)	(0.025)
Parent/LowIncome	-0.012	-0.008	-0.007	-0.185***	-0.183***	-0.183***
	(0.019)	(0.018)	(0.018)	(0.022)	(0.021)	(0.020)
State Specific Control Variables:						
Average Fluoridation	No	-0.001***	-0.000	No	-0.000	-0.000
		(0.000)	(0.000)		(0.000)	(0.000)
Dentist-to-Patient Ratio	No	0.023***	0.017**	No	0.011	0.009
		(0.006)	(0.007)		(0.007)	(0.008)
Regional Dummies:						
Northeast	No	No	0.068**	No	No	0.010
			(0.030)			(0.019)
Mid West	No	No	-0.010	No	No	-0.012
			(0.022)			(0.032)
West	No	No	0.033	No	No	-0.003
			(0.026)			(0.023)
Number of States	43	43	43	51	51	51
Observations	11,301	11,301	11,301	26,503	26,503	26,503

***, **: statistically significant at 1%, 5% level

All the regressions are weighted.

Standard errors are in parentheses and clustered at the state level.

Control variables include full set of variables found in Table 1.5.

Region South is omitted.

Table 1.9. Regression Results excluding States with Too Low Thresholds and Two-Parent Households in States with Limited Coverage for Two-Parent Family

	Control: Low-Income Childless			Control: Mid-Income Parents		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
BenefitState*Parent/LowIncome	0.065**	0.070***	0.074***	0.093***	0.096***	0.099***
	(0.024)	(0.024)	(0.023)	(0.026)	(0.026)	(0.024)
Dental Benefit States	0.058***	0.057***	0.055***	0.065**	0.070***	0.067***
	(0.013)	(0.013)	(0.013)	(0.025)	(0.025)	(0.023)
Parent/LowIncome	-0.007	-0.006	-0.006	-0.183***	-0.183***	-0.183***
	(0.018)	(0.018)	(0.018)	(0.020)	(0.020)	(0.020)
Number of States	43	40	40	51	48	48
Observations	11,301	10,456	10,355	26,503	24,656	24,043

(1) All states

(2) Exclude states with Medicaid eligibility threshold below $10K (59% of FPL).

(3) Exclude states with Medicaid eligibility threshold below $10K (59% of FPL) and two-parent families in states with limited coverage for two-parent family.

***, **: statistically significant at 1%, 5% level

All regressions include full set of individual, state-specific, and region variables.

All the regressions are weighted.

Table 1.10. Summary of the Estimates in Various Specifications

	Control Group: Childless Adults				Control Group: Mid-Income Parents			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Coefficient of the Interaction Term	0.059***	0.079***	0.065**	0.074***	0.078***	0.097***	0.093***	0.099***
	(0.019)	(0.025)	(0.024)	(0.023)	(0.014)	(0.027)	(0.026)	(0.024)
Individual Control Variables	No	Yes	Yes	Yes	No	Yes	Yes	Yes
State-Specific and Region Control Variables	No	No	Yes	Yes	No	No	Yes	Yes
Number of States	43	43	43	40	51	51	51	48
Observations	11,301	11,301	11,301	10,355	26,503	26,503	26,503	24,043

***, **: statistically significant at 1%, 5% level

Standard errors are in parentheses and clustered at the state level.

Individual Control variables include full set of variables found in Table 1.5.

(1),(5) Without control variables

(2),(6) With individual control variables

(3),(7) With individual, state-specific and region control variables

(4),(8) Excluding states with Medicaid eligibility threshold below $10K (59% of FPL) and two-parent families in states with limited coverage for two-parent family

Table 1.11. Nationwide Inpatient Sample 2004: Dental Related Hospitalization

	States with Dental Benefit	States without Dental Benefit
Panel A:		
Percentage of All Dental Related Hospitalization	0.078%	0.072%
Percentage of Dental Related Hospitalization: Low Income	0.023%	0.029%
Panel B: Total Charge		
Dental Related Hospitalization: Low Income (1st quartile)	$ 11,428	$ 13,426
Dental Related Hospitalization: 3rd & 4th quartile	$ 16,818	$ 14,625
All Hospitalization	$ 23,972	$ 22,184
Panel C: Median Household Income Quartile for Dental Patient's ZIP Code		
1 ($1-$35,999)	724 (29.9%)	837 (39.8%)
2 ($36,000-$44,999)	663 (27.4%)	552 (26.3%)
3 ($45,000-$58,999)	493 (20.4%)	404 (19.2%)
4 ($59,000 or more)	541 (22.4%)	309 (14.7%)
Total	2421 (100%)	2102 (100%)
Panel D: Age		
Dental Related Hospitalization: Low Income (1st quartile)	48.1	47.8
Dental Related Hospitalization: 3rd &4th quartile	52.8	52.4
All Hospitalization	57.5	57.3
Number of All Hospitalization	3,090,127	2,908,971
Number of All Dental Related Hospitalization	2,421	2,102
Number of Dental Related Hospitalization: Low Income	724	837

Chapter 2

The Impact of Insurance Coverage on Dental Service Use Among Older Population

Abstract

There is a sudden drop in the fraction of Americans with dental insurance at around age 65. Between ages of 61 and 68, 24 percent of people with at least a high school diploma and 13 percent of people with less than a high school diploma lose dental insurance. The decrease in dental coverage seems to be driven by the loss of employer provided dental benefits with retirement.

The Medical Expenditure Panel Survey which contains detailed information on insurance and demographic information as well as rich information on dental service use is analyzed to investigate the impact of loss of dental insurance on dental service use. To capture the variation in dental insurance status among different education attainment groups between the ages of 61 and 68, a series of interaction terms between age dummy variables and education dummy variables is used as an identifying variable.

The results suggest that older people who lose their dental insurance around retirement age do not change their dental service usage in any way. More specifically, the probability of a dental visit within a year, the number of dental visits per year, and dental expenditures do not change. There is also no evidence that they receive more or fewer of any particular dental procedures.

Key Words: Dental market, Demand for dental services, Older population
JEL code: I11, I13

II.1. Introduction

The elderly population is growing rapidly. People 65 years old and over are expected to grow from 12.9 percent of the U.S. population in 2009 to 19 percent (72.1 million) by 2030. (Department of Health & Human Service, Administration on Aging) The demand for health care is expected to increase since people require more health care services later in life.

Insurance is an important determinant of demand for health care. Virtually every elderly person in the U.S. has health insurance coverage because everyone becomes eligible for Medicare at the age of 65[21]. However since Medicare benefits do not include dental coverage, a significant proportion of the older population does not have dental insurance. According to National Association of Dental Plans, 97 percent of dental benefits in the United States are provided through employers and other groups. Hence many people lose their employer provided dental insurance benefit when they retire. And many dental insurance payment systems are not available to retirees. (Niessen, 1984; Jones, 2005)

Figure 2.1 compares health insurance and dental insurance status of people 40 years and older. It shows a discrete jump in health insurance status at the age of 65 reflecting universal Medicare coverage. However the fraction of people with dental insurance drops rapidly starting around age 60. About 47 percent of people hold dental insurance at the age of 60, but only 19 percent of 70 year old people hold dental insurance. The decrease in dental insurance is concentrated in people between the ages of

[21] Less than 1 percent of the people over 65 are uninsured. (Card et. al. 2008)

62 and 66. During this four year period, about 17 percent of people lose their dental insurance.

While many studies utilize the abrupt increase in health insurance at the age 65 to investigate the role of insurance on medical service usage (Brown et. al., 1998; Levy and Meltzer, 2001; Card et. al., 2008), there are limited studies on the dental market. This paper exploits the rapid decrease in dental insurance to investigate the impact of losing dental insurance on dental service use among the order population.

It is important to improve our understanding of the determinants of dental care, because regular dental visits are critical to maintain oral health (Guay 2006). The negative impact of poor oral conditions on the quality of life of older adults is an important public health issue, and it is particularly significant among edentulous (toothless) people. Severe dental carries (cavities) and periodontal diseases are the major reasons for tooth extraction. Extensive tooth loss reduces chewing performance and affects food choice; for example, edentulous people tend to avoid dietary fiber and prefer foods rich in saturated fat and cholesterol (Walls et al. 2000).

In addition to the problem with chewing, elderly people with bad oral health may have social handicaps related to communication (Smith and Sheiham, 1979). Moreover, poor oral health and poor general health are interrelated. For example, severe periodontal disease is associated with diabetes mellitus (Shlossman et al, 1990), ischemic heart disease (Joshipura et al., 1996), and chronic respiratory disease (Scannapieco, 1999). Tooth loss has also been linked with increased risk of ischemic stroke (Joshipura et al, 2003) and poor mental health (Schou, 1996).

The Dental Market

As Arrow (1963) pointed out, there are some differences between *health care* and other *goods and services* markets: The demand for health care is unpredictable and intensifies when a person is ill. Also, it is not easy for the individuals to measure the quality of services.

One explanation for the understudied *dental* market might be that dental care is considered not very different from health care in general. However, as Sintonen and Linnosmaa (2000) pointed out, many health care market features are not necessarily true for dental care. First, the number of dental diseases is relatively few and their occurrence is more predictable than is the case with many others. Second, there are extensive prevention possibilities and prevention may actually save resources, which is often not the case in other forms of medical care. Third, in most cases dental care is not emergency care in nature. These dental specific features give the individual freedom of choice in of service provider and, in theory, increase the price elasticity of the individual's demand for dental care. On the other hand, because the price of dental service cost is lower than most health services, the price elasticity of demand for dental care might be smaller than that of other medical care.

Therefore it is not clear whether the demand elasticity for dental care is bigger of smaller than elasticity for health care. It is also possible that different groups of population have different elasticity for dental care.

II.2. Empirical Strategy

Data

The data for this study comes from the Medical Expenditure Panel Survey (MEPS) pooled from the years 1999 to 2008. The MEPS is a longitudinal survey that collects data from a nationally representative subsample of households that participated in the prior year's National Health Interview Survey. Each individual remains in a sample for two years.[22] It contains detailed information on demographic characteristics such as age, gender, educational attainment, race, marital status, employment, income, region of residence, as well as health related information such as health conditions, self-assessed health status, use of medical services, charges and source of payments, and health insurance coverage. Also, the MEPS dental file collects detailed information on each dental event, including total charge and procedures provided. This rich set of information enables the analysis on levels and intensity of dental service usage to be possible.

Methodology

This study utilizes the rapid drop in dental insurance among people near retirement age between 61 and 68. I exploit the rapid drop in fraction with dental insurance to estimate the role of dental insurance on dental service use such as dental visit within a year, the number of visits, dental expenditure, and the kinds of dental service individuals receive.

[22] Exploiting the panel nature of the data is not feasible because the number of people who retired during this two year period is too small.

Table 2.1 reports summary statistics of people between 61 and 68 years of age with and without dental insurance. It shows that there are sizable differences in observable characteristics between people with and without dental insurance. Educational attainment and income level show the biggest differences between the two groups. Insured people are 31 percent more likely to be in high income group measured by family income as a percentage of poverty line.[23] Insured people are 16 percent more likely to have a college degree. People with dental insurance are 15 percent more likely to be married and 9 percent less likely to live in the South. Sixty percent of people with dental insurance are employed while only 35 percent of people without dental insurance are employed. People with dental insurance report better self-assessed health status. Sixty-two percent of people with dental insurance had a dental visit in the preceding year while only 30 percent of people without dental insurance had a dental visit.

If these observable characteristics are correlated with unobservable characteristics that influence dental service use, naïve OLS estimation will result in biased estimates. For example, people with low time discount rates, which are unobservable, are more likely to have higher education. Highly educated people are more likely to have employer provided dental insurance. If people with low time discount rate are also more likely to use preventive medical services, it is hard to distinguish whether the higher dental use by people with dental insurance is due to dental insurance or low time discount rate.

[23] "Poor" is defined as a family income below 125 percent of the federal poverty level (FPL), "low income" is defined as a family income below 200 percent of FPL, "middle income" is defined as a family income below 400 percent of FPL, and "high income" is defined as a family income at or more than 400 percent of FPL.

To solve this bias caused by unobservable characteristics, I use a series of interaction terms between age and education attainment as an identifying variable (IV) to exploit the rapid drop in dental insurance between the ages 61 and 68. The rapid decrease in dental insurance status with retirement is a good opportunity for estimating the causal impact of dental insurance because the loss of dental insurance is more likely to be associated with retirement rather than caused by unobservable characteristics or dental health. However, the expectation of losing dental insurance has impact on the timing of dental service use, there will be upward bias. For example one who plans to retire soon might use more intense dental service before the retirement because loss of dental insurance is expected with retirement. This will lead to an upward bias on estimates of the impact of dental insurance.

Figure 2.2 shows employment and dental insurance status by education attainments. It suggests that both the initial fraction of people with dental insurance and the speed of losing dental insurance are different for each education attainment groups. There is a high correlation between employment and dental insurance status among people with at least a high school diploma. People with college education are both most likely to be employed and have dental insurance. Both high school graduates and college graduates experience about 24 percentage point drop in dental insurance status from age of 61 to 68. People with less than a high school diploma show a smaller decline in dental insurance status. Only 14 percent of high school dropouts lose dental insurance.

Many people who lose their dental insurance are more likely to be better educated, higher income people because they are more likely to have had jobs that provide dental insurance to begin with. Hence, the estimate of the impact of (losing) dental insurance on dental service use is relevant to the population between ages 61 and 68 with at least a high school education who used to have employer provided dental insurance.

To capture the rapid decrease of dental insurance for each education attainment group, I use a series of interaction terms between age and education dummy variables as an IV. Both education attainment and age are independently related to dental service usage. However the interaction terms between them are capturing only the decline in the dental insurance status for each education attainment. Also the decline in the dental insurance status is not necessarily related to the demand for dental services because it is caused mostly by declining employment status among this age group. However, there are potential endogeneity problem if people choose the timing of retirement based on their dental needs. For example, people might use more intensive dental use when they expect to lose their dental insurance upon retirement, or people might delay their retirement to hold onto dental insurance longer. Then the estimate will have upward bias. However, this is unlikely because this study finds no impact of dental insurance on dental service use among older population. Hence the interaction terms are reflecting the rapid decrease in dental insurance and are not likely to be related to the preference for dental care among people in retirement age. The first-stage equation for the IV estimates is:

$$\mathrm{Dent\_Insurance}_i = \alpha_1 \sum_e \sum_a \mathrm{Edu}_{ie} \cdot \mathrm{Age}_{ia} + \alpha_2 X_i + \tau_j + \omega_i \qquad (2.1)$$

where Age_i is an indicator variable which equals 1 at the age of individual i. Indicator variable Edu_i is educational attainment of individual i. Educational attainment is categorized as less than high school diploma, high school graduate, some college education, and college graduate and more. X_i is a vector of observable characteristics that may impact dental service use such as age, education, gender, geographic region, race, marital status, income level, health insurance status, and self-reported health status. τ_i is a vector of year fixed effects and ω_i is the error term. All regressions are weighted using personal weight provided by the MEPS.

To measure the impact of losing dental health on dental service use, equation (2.2) is used for the second stage estimation in two-stage least square (2SLS) model:

$$Y_i = \beta_1 Dent\_\widehat{Insu}rance_i + \beta_2 X_i + \beta_3 \varphi_j + \varepsilon_i \quad (2.2)$$

where Y_i is a rich set of outcome variables. It includes various measures of dental service use such as whether individual i had a dental visit within a year, the number of dental visits, total dental expenditure for a year, and various kinds of dental procedures performed at the visit. When Y_i is a binary variable (whether individual *i* had a dental visit within one year or whether individual i received a specific dental procedure such as oral examination, teeth cleaning, filling, root canal, crown, denture, or tooth extraction), a probit model is employed. $Dent\_\widehat{Insu}rance_i$ reflects the rapid decrease in the fraction of people with dental insurance per each education attainment group. The coefficient of interest β_1 is the impact of (losing) dental insurance on the dental service usage. The rest of the control variables are the same as in equation (2.1).

II.3. Results

First Stage Results

Table 2.2 reports the first stage regression results. Coefficients of each interaction terms are reported. Interaction term between age68 and some college education is omitted. Interaction terms of younger age are positive, sizable, and statistically significant reflecting the rapidly decreasing dental insurance status. For example, the regression result suggests that a 61 year-old college graduate if 15.4 percentage points more likely to have dental insurance than 68 year-old with some college education. The coefficients decrease as the age increases within the same educational attainment group. The F-statistic for the first stage is also large at 160.

Second Stage Results

<u>Probability of Dental Visit</u>

Table 2.3 shows the second stage probit estimates for the dental visit within one year. The first column reports the IV estimate on the impact of losing dental insurance on dental visit. The outcome variable is equal to one if an individual had a dental visit (for any reason) within one year. For comparison, the second column reports the naïve probit regression results using the actual dental insurance status.

As expected, naïve regression result in column (2) between actual dental insurance and dental service use reports positive and statistically significant coefficient even after conditioning on a rich set of control variables. It suggests that dental insurance is associated with a 8.8 percentage point higher probability of a dental visit. However this cannot be interpreted as the causal impact of dental insurance, because there are unobserved characteristics between people with and without dental insurance such as preference for dental service, time discount rate, or underlying dental health.

Column (1) reports statistically insignificant coefficient on the predicted dental insurance suggesting that the loss of dental insurance has little impact on the probability of getting dental service. People who lose their dental insurance are still as likely to see dentists even when they do not hold dental insurance anymore.

Figure 2.3 shows dental insurance status and level of dental use. It graphically confirms the regression result that, despite rapidly decreasing dental insurance status, people still have dental visits. In every age group, from 61 to 68, the fraction of people who had a dental visit within one year is very stable at about 43 percent. This is a unique finding because most studies on the relationship between insurance and medical service use find positive and significant impact of insurance. (Bailit et al. 1985, Card et al. 2008, Currie and Gruber 1996, Hurd and McGarry 1997)

The unusual finding of this study might be explained by the source of variation in dental insurance status. People who experience a change in their dental insurance status are individuals who had employer provided dental insurance before retirement. Older people who had dental insurance for a long time before retirement might have developed a habit of regular dental checkups. If these people have received dental care regularly for a long time and understand the extensive preventive possibility in dental care, they might still go to their dentists after retirement even if they do not have dental insurance anymore. Furthermore, if they have had regular dental visits, it is highly unlikely that they need extensive dental procedures with high cost since better dental health makes dental visits more affordable. Also, because better-educated people are more likely to hold jobs that provide dental insurance, they are a relatively well off population. So, they might be less responsive to the changes in dental service price.

The rest of the regression results in Table 2.3 suggest that education has the biggest impact on the probability of dental service use. Compared to people with less than a high school diploma, college graduates are almost 32.6 percentage point more likely to have a dental visit within one year. Statistically insignificant coefficients on age dummy variables suggest that compared to 61 year olds, 62 to 68 year olds are not more or less likely to have a dental visit. Females are 8.5 percentage points more likely to have a dental visit. Race also has some impact on dental use. Compare to native Hawaiian, other Pacific Islanders, American Indian, or Alaska native, Whites are 7.6 percentage points more likely to see dentists within one year, while Black, Hispanic, and Asian are less likely to have dental visits. Marital status generally does not have much impact on dental use. Income level has big impact on dental service use. People on food stamp program are 8.7 percentage points less likely to have dental visits. Compare to poor people (with annual household income less than 125 percent of federal poverty level), high income people (with annual household income over 400 percent of FPL) are 12.6

percentage points more likely to have dental visits. Employment status is added in to control for the different time costs. Employed people are 7.8 percentage points less likely to have a dental visit, suggesting employed people have a higher time cost because they are busier than people who are not working. Compare to people in the West Region, people in Northeast Region and Mid West Region are 3.4 and 4.2 percentage points more likely to see a dentist, respectably. Healthier people are also more likely to see a dentist.

Intensity of Dental Service Use

Losing dental insurance with retirement might not have an impact on the probability of the dental visit, but it might have an impact on the intensity of the dental service use. The MEPS data provide a rich set of outcome variables on intensity of dental use such as number of dental visits a year, total dental expenditure, and detailed information on the procedure performed at each dental visit.

Table 2.4 reports second stage IV regression results on the number of dental visits and total dental expenditure for a year. The coefficients on predicted dental insurance in both columns are statistically insignificant, suggesting that losing dental insurance around retirement age not only did not decrease the probability of dental visit, but also did not change the intensity of dental visits measured by the number of dental visit and dental charges. This implies the level of dental service use does not change both on an extensive margin (probability of dental visit) and on an intensive margin (number of dental visits and dental expenditure).

The rest of the regression results reports that gender, education, race, and income level are associated with the intensity of dental service use. Age continues to have no independent impact on intensity of dental service use. This is comforting because one might suspect that the reason for not decreasing dental service usage is due to increased dental needs by the deteriorating dental health. However, statistically insignificant coefficients on age dummy variables suggest that aging is not strongly related to deteriorating dental health or increased dental service use, at least not for the age group in this study. Education variables continue to have the biggest and statistically significant coefficients. Compare to people without a high school diploma, people with college degree have 0.79 more dental visits per year and spend $191 more on dental services. People with some college education have 0.6 more dental visit and spend $172 more on dental care. Females have 0.16 more dental visits. Compare to native Hawaiian, other Pacific Islander, American Indian, or Alaska Native, White people have 0.27 more dental visits and spend $83 more on dental care. Hispanics have fewer dental visits. Income levels continue to have the second largest impact on the intensity of dental service use. Compare to poor people, high income people use 0.41 more dental visits and spend $88 more on dental care. People who live in Metropolitan area have 0.15 more dental visits. Employed people have 0.24 fewer dental visits and spend $49 less on dental care. Compare to people in West Region, People in Northeast and Mid West Regions have more dental visits and people in South Region have less dental visits. Although people in good health are more likely to have a dental visit than people with poor health, the dental expenditure are not statistically higher. Year fixed effects are included in the regression but not reported since they are mostly statistically insignificant.

Table 2.5 reports second stage probit regression results on various dental procedures. For comparison, it also reports regression results on actual dental insurance and dental procedures. Only coefficients of interest, the impact of dental insurance, are reported.

Dental treatments can be classified into three groups: diagnostic and preventive services, routine services, and major services. Diagnostic and preventive services include oral exam, X-ray, and cleaning. Oral exam and X-ray are needed to diagnose the oral health and to decide what kind of procedure is required. Routine services include filling, root canal, and extraction. Fillings are performed when the cavity is not in serious condition. Extraction is a cheap substitute for more expensive major services when serious dental problem exists. Major services include crown, bridge, and denture. They are performed when the cavity has progressed further. Dentures are evidence of bad oral health because they are needed when people lose their teeth. (Dolan 2005)

The second column reports the coefficients of actual dental insurance. Diagnostic and preventive services are sizable, positive, and statistically significant. This result was expected since people with actual dental insurance are using higher level of dental services and most dental insurance plans offer preventive services at no extra cost. Other procedures are mostly statistically insignificant and the coefficient is very small. Procedures that people with actual dental insurance do not receive more are extraction and dentures services. Since tooth extraction is a cheap substitute for major procedures, statistically insignificant coefficient on extraction implies that people with dental insurance receive major services rather than tooth extraction when they have serious cavities. Since dentures are the evidence of bad oral health (Petersen 2005, Dolan 2005), statistically insignificant coefficient on dentures suggest that there is no indication that people with dental insurance have worse dental health.

The first column reports the coefficients of second stage IV estimates. All the coefficients are statistically insignificant suggesting people who lose their dental insurance with retirement are not receiving more or fewer of any particular procedures. These results confirm that people who lose dental insurance as they retire do not change their probability of dental visit, number of dental visit, dental expenditure, or the treatment they receive. In other words, there is no evidence that people who lose their dental insurance with retirement change their dental care habit in any way.

II.4. Conclusion

Exploiting the rapid decrease in dental insurance status among people around retirement age, I estimate the impact of losing dental insurance on various dental service uses among older population. Because dental insurance coverage is usually provided as an employment benefit, many people lose their dental insurance as they retire. (Jones 2005) The estimation comes from the people who used to have employer provided dental insurance. Since better educated people are more likely to have jobs that offer dental insurance, the majority of people who lose dental insurance are at least high school graduates. Between ages of 61 and 68, about 54 percent of people who previously had dental insurance lose their dental insurance.

To reflect this decrease in people with dental insurance for different educational attainment, a series of age and education interaction dummies is used as an IV in the two-stage lease squares model. The impact of losing dental insurance on various dental service uses is examined. The regression results suggest that people who lose their dental insurance with retirement are not any less likely to have had a dental visit in the preceding year. They do not have fewer dental visits either. Also, they do not spend any less on dental care after losing dental insurance. Even the kinds of dental procedures they receive do not change. This is a unique finding because most studies on demand for health care find positive and significant.

The possible threats to the findings in this study are endogenous retirement and the impact of aging and retirement. If people change their timing of retirement or timing and intensity of dental service usage, there is a threat of an upward bias. For example, if people expecting to lose dental insurance upon retirement use more intense dental service before retirement, the study will find a sizable and positive impact of dental insurance on dental service use. However, this is weaker threat because this study finds no impact of dental insurance. The deteriorating dental health condition with age is possible source of downward bias, because deteriorating dental health means higher demand for dental service. Statistically insignificant coefficients on age dummies in the second stage regression results offer some comfort that dental health does not deteriorate quickly in this age group. Also after retirement, the time cost of dental visit might go down causing downward bias. Employment status variable is added in all the regressions to control for the possible downward bias. However, this method is not entirely free from these possible biases. A new IV which is highly correlated with dental insurance status and has no impact on the demand for dental service, if any, might solve the problem.

The only large-scale, randomized study on health insurance and health service, the RAND Health Insurance Experiment (1971-1986), finds significant increase in dental service use when more generous dental insurance is offered. (Bailit et al. 1985) Mueller and Monheit (1988) also find dental insurance increases access to dental care and dental expenditures.

The discrepancy between this study and most other studies might be explained by the population on which this study focuses. While other studies mainly focus on low income or generally younger population, the estimates in this study come from people who used to have dental insurance and lose their dental insurance with retirement.

Card et al. (2008) study the impact of health insurance on various health service uses among older population. They estimate the impact of Medicare coverage on health care utilization and find that different socioeconomic groups respond differently when they gain Medicare coverage. While low-educated people show an increase in utilization in low-cost services such as routine doctor visits, the probability of a routine doctor visit among highly educated people does not increase much when they gain Medicare coverage, mostly because highly educated people use high level of routine doctor visit even before the 65 threshold. Dental visits and routine doctor visits are both mostly preventive in nature and relatively low cost services. Both this study and Card et al's study reveal that better-educated older population do not change their routine medical service or dental service use habit when their insurance status change.

As a policy point of view, the result of this study implies that dental insurance benefit can be dropped without causing adverse health consequence among better-educated old people. However, this result cannot be generalized to the whole population because different groups respond differently to the change in insurance status.

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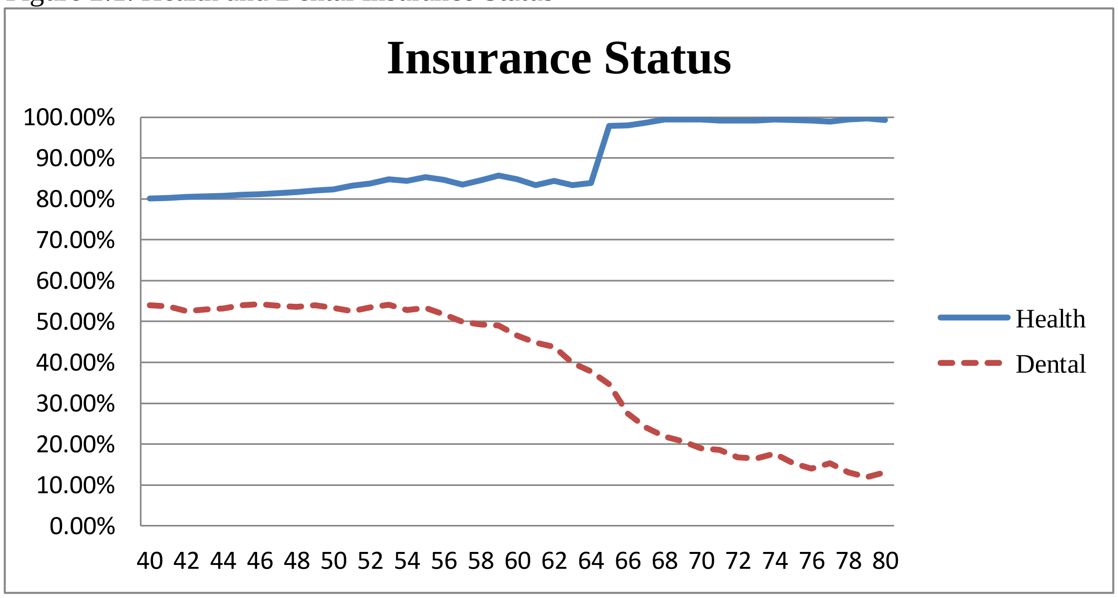
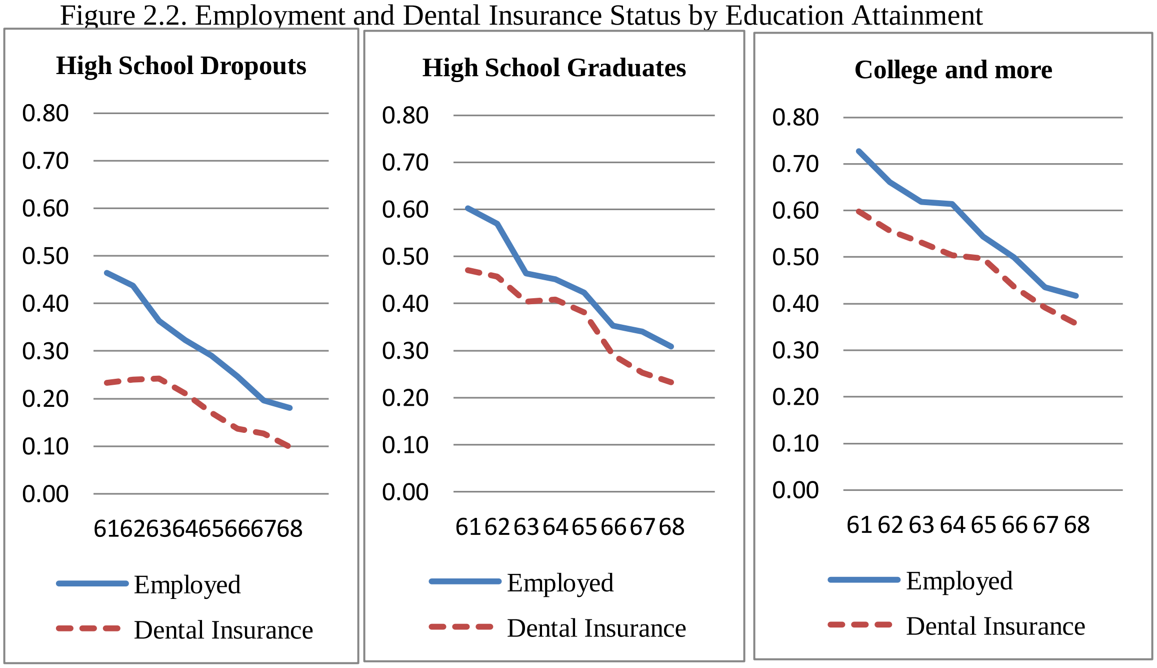
Figure 2.1. Health and Dental Insurance Status



Source: MEPS Data (1999-2008)

Figure 2.2. Employment and Dental Insurance Status by Education Attainment



Source: MEPS Data (1999-2008)

Figure 2.3. Dental Insurance and Dental Visit

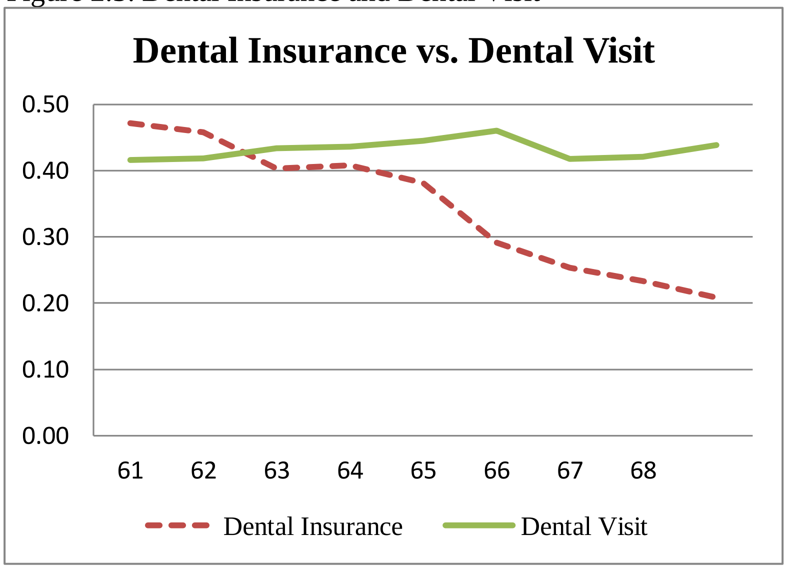


Table 2.1. Summary Statistics of People with and without Dental Insurance

	With Insurance		Without Insurance	
	Mean	S.D.	Mean	S.D.
Age	63.73	2.16	64.55	2.29
Female	0.50	0.50	0.56	0.50
High School Dropout	0.13	0.34	0.33	0.47
High School Graduate	0.50	0.50	0.46	0.50
Some College	0.07	0.25	0.05	0.22
Bachelor's and more	0.30	0.46	0.16	0.37
White	0.62	0.49	0.61	0.49
Black	0.11	0.31	0.13	0.33
Asian	0.09	0.28	0.17	0.37
Hispanic	0.06	0.24	0.06	0.23
Married	0.74	0.44	0.61	0.49
Widowed	0.09	0.28	0.14	0.35
Divorced	0.13	0.34	0.17	0.37
Separated	0.01	0.10	0.03	0.16
Never Married	0.03	0.18	0.05	0.22
West Region	0.21	0.41	0.22	0.41
Mid West Region	0.25	0.43	0.20	0.40
South Region	0.35	0.48	0.43	0.50
North East Region	0.19	0.39	0.15	0.36
Metropolitan Area	0.82	0.38	0.74	0.44
Poor[1]	0.06	0.25	0.25	0.43
Low Income	0.07	0.26	0.18	0.38
Middle Income	0.28	0.45	0.28	0.45
High Income	0.58	0.49	0.29	0.46
Employed	0.56	0.50	0.33	0.47
Poor Health[2]	0.14	0.34	0.28	0.45
Good Health	0.66	0.47	0.57	0.49
Excellent Health	0.20	0.40	0.14	0.35
Limited Physical	0.08	0.27	0.21	0.41
No Teeth	0.14	0.34	0.23	0.42

(Table 2.1 Continued)

<u>Outcome Variables</u>				
Dental Visit within 1 Year	0.56	0.50	0.35	0.48
Number of Dental Visit	1.39	1.84	0.82	1.73
Total Dental Expenditure	357	920	178	642
Examination	0.50	0.50	0.29	0.45
Clean Teeth	0.48	0.50	0.26	0.44
Filling	0.12	0.33	0.08	0.28
Root Canal	0.04	0.19	0.02	0.14
Extract	0.05	0.22	0.05	0.22
Crown	0.11	0.31	0.06	0.23
Bridge	0.02	0.13	0.01	0.10
Dentures	0.03	0.17	0.03	0.17
Observations	6124		11043	

1. Poor refers to household income below 125 percent of the FPL.
   Low income refers to household income from 125 to just below 200 percent of the FPL.
   Middle income refers to household income from 200 to just below 400 percent of the FPL.
   High income refers to household income of 400 percent or more of the FPL.
2. Health Status is self-reported.

Table 2.2. First Stage Regression Results

	Coefficient	Robust Standard Error
age61*College Graduate	0.154	(0.055)***
age62*College Graduate	0.145	(0.055)***
age63*College Graduate	0.123	(0.056)**
age64*College Graduate	0.104	(0.056)**
age65*College Graduate	0.103	(0.056)*
age66*College Graduate	0.076	(0.056)
age67*College Graduate	0.020	(0.057)
age68*College Graduate	-0.014	(0.057)
age61*Some College	0.093	(0.065)
age62*Some College	0.196	(0.063)***
age63*Some College	0.145	(0.066)**
age64*Some College	0.138	(0.067)**
age65*Some College	0.035	(0.069)
age66*Some College	0.035	(0.066)
age67*Some College	-0.002	(0.071)
age61*High School Graduate	0.173	(0.052)***
age62*High School Graduate	0.167	(0.052)***
age63*High School Graduate	0.112	(0.053)**
age64*High School Graduate	0.116	(0.053)**
age65*High School Graduate	0.088	(0.053)*
age66*High School Graduate	0.037	(0.052)
age67*High School Graduate	0.008	(0.052)
age68*High School Graduate	-0.022	(0.053)
age61*Less than High School	0.100	(0.054)**
age62*Less than High School	0.109	(0.055)**
age63*Less than High School	0.089	(0.055)**
age64*Less than High School	0.078	(0.055)*
age65*Less than High School	0.030	(0.053)
age66*Less than High School	0.028	(0.053)
age67*Less than High School	0.046	(0.053)
age68*Less than High School	0.007	(0.053)
F-Statistics	160.94	
R-squared	0.268	
Observations	17,167	

Omitted IV interaction term is age68*Some College.
Control variables are gender, race, marital status, income level, employment status, region, general health, health insurance status, and year fixed effects.

***, **, * Statistically significant at 10% , 5%, 1% level.

Table 2.3. Second Stage Probit Regression Results for Dental Visit within One Year

	(1) IV Estimation		(2) Naïve OLS	
	Coefficient	Robust S.E.	Coefficient	Robust S.E.
Dental Insurance	0.109	(0.262)	0.088	(0.011)***
Age 62	-0.010	(0.018)	-0.010	(0.018)
Age 63	0.001	(0.021)	0.001	(0.018)
Age 64	0.029	(0.022)	0.028	(0.019)
Age 65	0.006	(0.029)	0.004	(0.019)
Age 66	0.014	(0.036)	0.012	(0.019)
Age 67	0.027	(0.043)	0.025	(0.020)
Age 68	0.026	(0.051)	0.023	(0.021)
High School Graduate	0.166	(0.015)***	0.167	(0.014)***
Some College	0.249	(0.020)***	0.250	(0.019)***
College Graduate	0.326	(0.016)***	0.327	(0.015)***
Female	0.085	(0.012)***	0.085	(0.010)***
White	0.076	(0.028)***	0.076	(0.027)***
Black	-0.135	(0.042)***	-0.134	(0.030)***
Hispanic	-0.063	(0.022)***	-0.062	(0.017)***
Asian	-0.094	(0.030)***	-0.093	(0.026)***
Married	0.020	(0.026)	0.020	(0.025)
Widowed	-0.054	(0.028)*	-0.055	(0.028)*
Divorced	-0.011	(0.028)	-0.011	(0.027)
Separated	0.071	(0.046)	0.071	(0.046)
Food Stamp	-0.087	(0.027)***	-0.087	(0.026)***
Low Income	-0.001	(0.019)	0.000	(0.019)
Mid Income	0.051	(0.021)**	0.052	(0.017)***
High Income	0.126	(0.034)***	0.129	(0.017)***
Employed	-0.078	(0.017)***	-0.078	(0.011)***
Northeast Region	0.034	(0.016)**	0.034	(0.016)**
Mid West Region	0.042	(0.015)***	0.043	(0.015)***
South Region	-0.024	(0.016)	-0.024	(0.014)*
Metropolitan Area	0.042	(0.018)**	0.043	(0.012)***
Good Health	0.086	(0.014)***	0.087	(0.013)***
Excellent Health	0.117	(0.017)***	0.118	(0.017)***
Private Health Insurance	0.124	(0.131)	0.134	(0.020)***
Public Health Insurance	0.050	(0.030)*	0.051	(0.022)**
Observations	17,167			

All regressions are weighted.

Coefficients are for discrete change of dummy variable from 0 to 1.

Omitted variables are age61, less than high school education, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, never married, poor, West Region, and poor health.

Year fixed effects are included in the regressions, but they are not statistically significant and not reported.

***, **, * Statistically significant at 10%, 5%, 1% level.

Table 2.4. Second Stage Regression Results for the Number of Dental Visit and Dental Charge

	(1) Number of Dental Visit		(2) Dental Expense	
	Coefficient	Robust S.E.	Coefficient	Robust S.E.
Dental Insurance	0.129	(0.805)	229.04	(389.39)
Age 62	-0.006	(0.074)	15.26	(30.61)
Age 63	-0.012	(0.078)	19.35	(33.73)
Age 64	0.032	(0.080)	53.67	(34.91)
Age 65	-0.030	(0.103)	25.48	(46.92)
Age 66	-0.036	(0.124)	15.54	(54.82)
Age 67	-0.037	(0.140)	19.24	(62.39)
Age 68	-0.021	(0.163)	14.31	(72.19)
High School Graduate	0.344	(0.043)***	89.54	(17.20)***
Some College	0.604	(0.078)***	171.70	(37.13)***
College Graduate	0.794	(0.068)***	190.82	(25.66)***
Female	0.156	(0.041)***	25.17	(18.28)
White	0.267	(0.091)***	82.56	(34.67)**
Black	-0.203	(0.135)	-12.75	(64.77)
Hispanic	-0.198	(0.068)***	-52.56	(41.66)
Asian	-0.166	(0.105)	-35.70	(40.42)
Married	0.022	(0.085)	-5.13	(36.72)
Widowed	-0.110	(0.088)	-1.15	(39.07)
Divorced	-0.047	(0.087)	-14.59	(38.46)
Separated	0.082	(0.118)	71.16	(57.88)
Food Stamp	-0.079	(0.077)	-31.11	(21.51)
Low Income	0.094	(0.052)*	9.19	(24.81)
Mid Income	0.170	(0.061)***	-4.00	(26.75)
High Income	0.410	(0.108)***	87.66	(48.90)*
Employed	-0.237	(0.054)***	-49.14	(26.87)*
Northeast Region	0.214	(0.067)***	3.88	(26.89)
Mid West Region	0.132	(0.052)**	-10.27	(25.26)
South Region	-0.104	(0.050)**	-56.11	(23.64)**
Metropolitan Area	0.145	(0.056)**	41.68	(26.47)
Good Health	0.097	(0.059)*	1.50	(24.09)
Excellent Health	0.085	(0.069)	-4.37	(28.27)
Private Health Insurance	0.357	(0.413)	7.24	(200.38)
Public Health Insurance	0.212	(0.095)**	11.57	(39.83)
Observations	17,167		17,167	

All regressions are weighted.
Omitted variables are age61, less than high school education, Native Hawaiian or Other Pacific Islander, American Indian or Alaska Native, never married, poor, West Region, and poor health.
Year fixed effects are included in the regressions, but they are not statistically significant and
***, **, * Statistically significant at 10%, 5%, 1% level.

Table 2.5. Second Stage Probit Regression Results on Dental Procedures

	(1) IV Estimation		(2) Naïve OLS		
	Coefficient	Robust S.E.	Coefficient	Robust S.E.	Average
Diagnostic and Preventive Services					
Examine	0.340	(0.262)	0.090	(0.011)***	36.2%
Clean Teeth	0.153	(0.265)	0.088	(0.011)***	33.9%
Routine Services					
Filling	0.098	(0.151)	0.009	(0.006)	9.8%
Root canal	0.032	(0.077)	0.004	(0.003)	2.6%
Extraction	0.016	(0.102)	-0.003	(0.004)	5.1%
Major Services					
Crown	-0.052	(0.142)	0.015	(0.005)***	7.5%
Bridge	0.069	(0.054)	0.003	(0.002)	1.3%
Dentures	0.013	(0.068)	0.002	(0.003)	2.9%
Observations	17,167				

All regressions are weighted.
Coefficients are for discrete change of dummy variable from 0 to 1.
Control variables include full set of variables found in Table 2.3.
*** Statistically significant at 1% level.

Chapter 3
Access to Medical Resources and Infant Health

Abstract

Less healthy infants receive more intensive hospital treatment confounding estimates of the returns to health care spending. To identify the true relationship between health care spending and infant health, we introduce a new instrument: the number of infants born on a given day in a given location. During a "slow" time period a relatively healthy infant might be assigned to treatment whereas that same infant would not have been assigned to treatment if she had been born on a different day when the hospital region would have been more crowded. Using detailed information on every hospital birth in California from 2002 to 2006, we find that hospital stays are less intensive when the hospitalization region is more crowded. A one standard deviation increase in *crowdedness* translates to a reduction of spending of around $209 per infant.

We first present evidence that the level of hospital crowdedness is orthogonal to underlying infant characteristics that may impact spending and health. We then use crowdedness as an instrument for health care spending and find that on the margin the benefits from additional spending are negligible. In particular, additional spending does not reduce infant mortality rates and it has no consistent impact on rehospitalization rates in the first year of life.

Key Words: Infant Health, Health Production Function, Cost-Benefit Analysis
JEL code: I12, I18

III.1. Introduction

Health care spending and spending on infant health in particular consume an ever larger portion of US GDP.[24] This enormous spending in health care has invited many debates – specifically if the marginal dollar on health care spending is worthwhile. Existing evidence about the benefit of the marginal dollar of medical spending is mixed. The same mixed findings occur in discussions of the benefit of additional spending on infant health. Evidence from time-series study tends to suggest that additional spending on new therapeutic improvements generate declines in infant mortality. (Phibbs el. al., 2007; Richardson et. al., 2007; Almond et. al., 2010) However cross-sectional studies suggest that the new technologies have expanded to the point where additional benefits are negligible. (Goodman et. al., 2002)

A methodological challenge when identifying the causal relationship between health care spending and health is non-random selection of patients into treatment. Less healthy infants receive more intensive hospital treatment confounding estimates of the returns to such care. This endogenous health care spending would result in downward bias of the effectiveness of treatment, which can be misinterpreted that more intense hospital care decreases infant health. On the other hand, unobservable characteristics of parents might cause upward bias. If unobservable characteristics, say responsible parenting or better insurance, lead to more spending and longer stays in hospitals and

[24] In 2007, 17.4 percent of GDP was spent on health care. Childbirth is the most common medical procedure. According to Nationwide Inpatient Sample data (HCUP, 2005), almost 19 percent of all hospitalization were related to childbirth in 2005. Also, the average cost for newborn delivery has been rising. During the sample years, the average charge for delivery went up from $10,989 in 202 to $13,603 in 2006. Moreover, the second and third most expensive condition treated in US hospitals was “Mother’s pregnancy and delivery” and “newborn infants, which accounted for 5.2 percent and 43 percent of the national hospital bill in 2004, respectively. (Russo and Andrews, 2006)

these characteristics are also positively correlated with healthier babies, then naïve estimates might have upward bias. One might falsely conclude that higher health care spending improves infant health.

We propose a new approach for estimating marginal returns to medical spending and treatment. To generate exogenous health care spending, this paper introduces a new identifying variable (IV): the crowdedness on an infant's birth date in a given location. Using this IV, we investigate the true causal relationship between health care spending and infant health measured by neonatal (28 days) and one-year mortality rate and hospital readmission within one year. The thought experiment is on a "slow" day a relatively healthy infant may receive more care either because the resource constraints are temporarily weakened or because health care providers responded to the temporary income shock by performing more procedures or by having the infants stay longer at the hospital. This change in treatment decisions in the presence of income threat is well documented in the supplier induced demand literature.[25]

We compare health outcomes within the same hospitalization region using variation in spending per birth that arises from hospital crowding due to the non-uniform distribution of birth dates. One advantage of exploiting the variation in crowdedness within the hospital region is that our estimate is free of potential bias from the large regional variations in infant care resources or capacity. Using health service areas termed

[25] One of the features of medical market is agency relationship between doctors and patients. Because doctors have asymmetrically more knowledge about medical care than their patients do, doctors are expected to behave as patients' agents when making treatment decisions. However, studies find that when doctors face negative income shocks, doctors may exploit the agency relationship and provide more care in order to maintain their income. See Ch9. Physician Agency from the Handbook of Health Economics (McGuire, 2000) and Gruber and Owings (1996) for further explanation of the supplier induced demand literature.

neonatal intensive care regions (NICRs), Goodman et. al. (2001b) found a more than fourfold regional variation in clinically active neonatologists. If the infant care resources are not distributed randomly, estimates on the infant care resources and infant health might produce biased estimates. Since our only source of variation in health care spending is caused by within region variation in crowdedness, our estimate measures the effect of health care spending in a given region. We also condition on rich set of control variables such as underlying baby's health status, family background, insurance coverage, and timing of the birth such as days of the week, months, and year.

Another advantage of our analysis comes from the types of babies that our estimates come from. Because the infants receiving additional procedures or longer hospital stays on slow days are likely to be in "marginal" health condition or the additional procedures given are likely to be of "marginal value", our second stage results will identify the health consequences of the hospital care on infants who received the additional services solely because they were born on slow days. More precisely, we are comparing the health outcomes of babies born on slow days with babies born on busy days in the same region who have identical underlying health characteristics and family background. This is precisely the information from which the constant policy debates about staffing ratio and the number of new born intensive care units benefit.

Previous studies have used exogenous source of variation in hospital stay such as changes in the required length of hospital stay after birth. While some studies using legislation mandating minimum postnatal hospital stay find positive effect of the extended hospital stay for small segment of infants, many studies find extended hospital stay do not have positive impact on infant health.[26]

Existing studies utilizing the state-level mandates on the length of hospital stay measure the marginal benefit of an extra night for those infant who would have otherwise had been discharged. In other words, if the health care providers had been practicing effectively, it is not surprising that extending hospital stay for healthy infants (who would have been discharged before the mandate) does not produce any health gains. Unlike the studies that use the change in policies to generate variation in treatment intensity, our study utilizes variation comes from the decision of medical personnel. In our study, the slow day infants who received more intense care are chosen by the medical personnel; hence they are the infants with marginal health conditions who would be the first ones to get more care if additional resources were available.

Additionally, while many studies examine the relationship between the length of hospital stay and infant health, we focus on the causal relationship between health care spending and infant health. Hospital charges contain more comprehensive information on hospital care infants receive. As a summary measure of the treatment provided by the hospital, hospital charge reflects length of stay, number of procedures, and kinds of

[26] Using legislation mandating coverage of minimum postnatal hospital stays, Meara et. al. (2004) find rates of rehospitalization for jaundice within 10 days fell in the year after legislation was introduces, but rates of all-cause rehospitalization, dehydration, and infection diagnoses did not change. Madden et. al. (2002) find no health effect of extended hospital stay among infants with normal vaginal deliveries. Evans et. al. (2008) also find that additional one day hospital stay decreases readmission rate within 28 days by about one percentage point for subsamples of vaginal delivery with complications and cesarean delivery without complications. But they did not find any impact of mortality rate in any of the subsamples. Almond and Doyle (2011) find that infants born 10 minutes after midnight do not show better health status than infants born 10 minutes before midnight, despite longer hospital stay due to hospital billing practice. Moreover, using California's minimum-insurance mandate which required insurance coverage for at least two days of hospitalization after birth, they find that no health gain is realized in both 1 to 2 nights stay margin and 2 to 3 nights stay margin.

procedures performed during the hospitalization. Health care spending is also often at the center of the policy debates.

This number of infants born on a given day in a given location is an ideal IV because, according to our first stage analysis, the number of other infants born on a given day in a given region is highly correlated with health care spending of the target infant, and the number of other infants born should not have any impact on own infant health other than through additional spending. Moreover, summary statistics show that after conditioning on the days of the week, infants born on slow versus busy days have very similar pregnancy characteristics, parents' demographic characteristics, proxies for infant health, labor complications, and insurance status. There is no indication that the level of crowdedness is correlated with underlying infant characteristics that may impact spending and health.

Our first stage result reports that when the number of infants born on a given day in a given region decreases by one standard deviation (32 babies), the health care spending increases by about $209. We also discover that the infants who receive additional treatment because they were born on slow days are disproportionally low birth weight infants. The second stage results suggest that the additional health care spending on infants does not improve infant health status measured by neonatal mortality, one year mortality, or hospital readmission.

Alternative measures of crowdedness are also examined. We also measure crowdedness using (i) weighted number of infants born before an infant's birth date and (ii) weighted number of infants born before and after an infant's birth date.

When we examine the impact of hospital stay, similar null findings are obtained for length of stay. The infants who had longer hospital stay because they were born on slow days did not report any better health status. We also find similar null findings when we restrict our study on low birth weight infants for whom the marginal returns to care may be larger.

This paper is organized as follows: Section III.2 describes the dataset and presents the identification strategy. Section III.3 discusses the relationship between crowdedness and receipt of care. Section III.4 discusses our main findings. Section III.5 presents and discusses results from various robustness checks. Section III.6 concludes the paper.

III.2. Empirical Strategy

Data

The data used in this study are confidential data provided by the California Office of Statewide Health Planning and Development (OSHPD). The OSHPD data link infant hospital discharge records for the first year of life with infant vital statistics data (birth and death certificate data). The OSHPD data used in this paper include every hospital birth in California between 2002 and 2006. The OSHPD data provide date and location of the birth, which are the key sources of variation for our analysis. It also provides detailed information on prenatal care, parents' demographic information, and newborn characteristics. Health care use information including hospital spending, length of hospital stay, number of procedures, and length of wait for procedures are also available. It also provide the date and cause of death. Because the data cover all subsequent hospitalization for the first year, we are able to identify whether a newborn was transferred or readmitted into a hospital. Hospital spending is the sum of hospital charges from consecutive hospital stays after birth. If a newborn was transferred from the birth hospital, we tracked the newborn to the transferred hospitals until the newborn was discharged. Hospital stay is also the length of consecutive hospital stay after the birth including transfers. Outcome variables are neonate and one-year mortality and rehospitalization within the first year.

Initial data from OSHPD contained 2,660,679 birth records with birth date and location of the birth information, which we used to calculate the number of infants born on a given day in a given location. About 11.7 percent of observations were missing charge information. We excluded these 310,523 observations with missing charge information. Most of these observations with missing charge data are from Kaiser Foundation Hospital births. Instead of charging specifically for an inpatient stay, Kaiser Hospitals receive a constant monthly (capitated) payment from each member, whether or not that member is hospitalized.[27] Thus the amount of the charge for the birth could not be reported. Then we dropped 506 observations with birth dates on the last two days of the sample due to implausibly low number of reported births. Our final sample contains 2,349,650 infants that are born between the years 2002 and 2006 with all relevant information.

[27] Health care providers at Kaiser Hospitals do not have financial incentive to treat infants more intensely when the hospital experience low number of infants born. We examine impact of this different financial incentive on the length of stay in the robustness check section.

Table 3.1 reports the summery statistics for all infants and infants with low birth weight (less than 2000g of birth weight). Table 3.1 suggests that parity and length of gestation have big impact on birth weight. While only three percent of all births are multiple births, almost thirty percent of low birth weight births are twin or more birth. Length of gestation of low birth weight infants is also significantly shorter than that of all infants. Length of gestation of low birth weight infants is shorter by 50 days. Also, whopping 61 percent of low birth weight infants are born by caesarean section while 28% of all birth is caesarean section birth. Hospital charge for low birth weight infants is almost 20 times higher than charge for all infants. Low birth weight infants also stay almost thirty days longer at hospitals and have more procedures done[28]. While one year mortality of all infants is 0.0034 percent, that of low birth weight infants is over 10 percent. Low birth weight infants are also 4.56 percentage points more likely to be rehospitalized within one year.

Methodology

Regions

The hospital regions in this study are neonatal intensive care regions (NICRs) defined by Goodman et. al.(2001a) to specifically represent geographic markets for neonatal intensive care. This definition of regions is commonly used in studies of regional distribution of the neonatal care resources. Using traditional methods of small area analysis, Goodman et. al. divided United States into 246 health service areas. These

[28] The procedure information is available only for 30% of observations.

market-based regions are based on vital records and minimal travel of very low birth weight infants.[29] There are 18 NICRs in California. Table 3.2 reports descriptive statistics for the number of infants born per day per region.

Since we generate the variation in spending from the number of infants born on a given day in a given region, our identification requires sufficient within region variation in the number of infants born on a given day. Columns 3 and 4 in Table 3.2 show the mean and standard deviation. The fifth through ninth columns report minimum, maximum and the quartiles of the number of infants born on a given day per region. Table 3.2 reports wide range of the number of infants born a day. In many regions, maximum number of infants born a day is much bigger than three times of minimum number of infants born a day. Interquartile range (middle fifty) also report sizable within region variations in the number of infants born a day. Figure 3.1 shows the distribution of the number of infants born a day in LA County during sample years. It shows a nice bell shaped distribution around the mean with wide range.

Infants Born on Slow vs. Busy Days

The underlying assumption for our identification strategy is that crowdedness should be uncorrelated with any infant level observable and unobservable traits that may impact infant health. To investigate if there are any observable differences in the infants born on busy days and slow days, Table 3.3 compares summary statistics of infants born on *busy days* and *slow days* in each region.

[29] See Goodman et. al.(2001a) for detailed description of the method used to assign NICRs.

We classify as a busy day if any day is the top quartile busiest day for that day of the week in each region. For example, we rank all Mondays according to the number of babies born in each region. We classify 65 busiest Mondays (25% of all Mondays) in each region as busy days and 65 slowest Mondays as slow days. We repeat the procedure for Tuesdays, Wednesdays, etc. We condition on days of the week, because our data show that there are sizable differences in the number of infants born on weekends and weekdays. Table 3.3 reports the difference in the average number of infants born on busy days and slow days are about 49 births.

Generally, the observable differences between infants born on slow and busy days are very small. Slow day infants and busy day infants received similar level of prenatal care. Parents of slow day infants tend to be younger and less educated. However the size of the difference is very small. Mothers of slow day infants are younger than mothers of busy day infants by 0.09 year, which is only about one-month difference. The difference in mother's education is only 0.04 years. Differences in fathers' education and age are even smaller. The gender and racial distribution of infant born on slow and busy days are almost identical. Slightly more multiple births happen on busy days, but this is to be expected because all else equals, multiple births lead to hospital crowdedness. Thus it is important to condition on parity in our analysis. Birth weight is one of the most used indicators of newborn health. Hospital costs decrease with increasing birth weight. (Russell et. al. 2007) Infants born on slow days are slightly heavier by 10 grams, implying infants born on slow days are, if anything, slightly healthier and less in need of medical attention. Gestation of slow day infants and busy day infants are identical. There is only one percent point difference in Caesarean section rate. Insurance is another factor that may influences hospital charges and infant health outcomes. The insurance status also shows very similar coverage. On busy days, one percentage point more Medicaid infants and one percentage points fewer infants with private insurance were born.

Overall, the summary statistics show that, once we condition on the day of the week, there are no apparent differences in observable family background and health indicators. This suggests that the level of crowdedness is orthogonal to underlying infant characteristics that may impact spending and health.

Identification Strategy

To address the potential endogeneity of the health care spending, we use an IV strategy which utilizes the difference in health care spending that arises from the variation of number of infants born on a given day in a given location. The first-stage equation for the IV estimates is:

$$\mathrm{Spending}_{ijt} = \theta_1 \mathrm{Crowd}_{ijt} + \theta_2 \sum_1^7 \mathrm{T}_{1ijt} + \theta_3 \sum_1^{12} \mathrm{T}_{2ijt} + \theta_4 \mathrm{H}_{ijt} + \mathrm{X}'_{ijt}\theta_5 + \lambda_j + \varphi_i + \omega_{ijt} \quad (3.1)$$

where $\mathrm{Spending}_{ijt}$ is hospital charge for infant *i*. If infant *i* was transferred after birth, we traced all the transferred hospital stays and added all the hospital charges.

Crowd_{ijt} is the normalized number of infants born on a same day as infant *i*'s birthday in region *j* on day *t*. To account for the sizable differences in the number of infants born a day among regions, we normalize the number of infants born a day in each region. We assume the number of infants born in each region has normal z-distribution. So our first stage coefficient is interpreted as the change in healthcare spending when the number of infants born increases by one standard deviation in each region[30]. Transforming the number of infants born into normalized distribution let us have more uniformed interpretation of the coefficients. As a specification check, we will explore alternative measures of $\mathrm{Crowd}_{\mathrm{ijt}}$ by including the weighted number of infants born before and/or after the infant *i*'s birth date.

$\sum_1^7 \mathrm{T}_{1_{\mathrm{ijt}}}$ is a vector of dummy variables for the day of the week. Our data suggest that fewer infants are born on weekends. Numerous authors have shown an association between weekend births and higher infant mortality rates (MacFarlane, 1978; Mathers, 1983; Hendry, 1981; Rindfuss et. al., 1979; and Mangold, 1981). The authors speculate that low levels of staffing on the weekend (i.e. relatively busy hospital personnel) could be driving the poor outcomes. If this is the case, not controlling for the days of the week might give use biased result because fewer infants are born on weekends. However, more recent works (Dowding et. al., 1987; Gould et. al, 2003; Hamilton and Restrepo, 2003) show that difference in underlying babies' health and family background across weekend and weekday birth can account for the difference in mortality rates. To purge our result of these problems, we control for the days of the week. $\sum_1^{12} \mathrm{T}_{2_{\mathrm{ijt}}}$ is a vector of dummy variables for month of the year the infant *i* was born. Studies suggest that maternal characteristics are not uniformly distributed throughout the year. (Buckles and Hungerman, 2008; Dehejia and Muney, 2004) More specifically, Buckles and

[30] Results are robust to the raw number of infants born a day in a region.

Hungerman (2008) argue that mothers giving birth in the winter are more likely to be teenagers, less educated and less likely to be married. We use month of the year variables as control variables, to account for possible systematic seasonal differences in infant health outcomes due to the nonrandom distribution of maternal characteristics and family background across seasons. $\mathrm{H_{ijt}}$ is an indicator which equals 1 if infant *i* was born on any of four major holidays (new year's day, Independence Day, Thanksgiving Day, or Christmas) when we observe significant drop in the number of infants born. We suspect the level and quality of hospital staffs and hospital care might be different on Holidays. $\mathrm{X'_{ijt}}$ is a vector of individual characteristics that include a rich set of information of infant *i* born in region *j* on day *t*. It includes pregnancy characteristics such as number of prenatal care visit, trimester the prenatal care began, and an indicator whether there were any pregnancy complications. Parental characteristics such as age and education of mother and father, and an indicator if the mother had previously failed delivery are included. To account for the nonlinear impact of age and education of parents on infant health, categorical dummy variables are used. Newborn characteristics such as gender, race, parity, and an indicator if the infant was the first born are also included. Birth characteristics such as birth weight, length of gestation in days and whether caesarean section[31] was performed are also included. Because of the nonlinear impact on infant health, birth weight is categorized at 500g intervals and length of gestation is categorized at two week intervals. This model also includes insurance status information. λ_j and φ_i

[31] We recognize caesarean section surgery is potentially endogenous to the number of infants born on a given day in a given location, and may be especially responsive to SID (see Baicker et. al. 2006). We run regression excluding caesarean section from the set of control variables. We also restricted our sample to vaginal delivery infants. In any cases, the results are very similar to our main finding.

are region and year fixed effects. They control for the possible differences in health care price and resource capacity among regions and over time. Robust standard errors are clustered at the region and month of the year level.

III.3. Impacts of Crowdedness on Hospital Spending

So far, crowdedness is measured by the number of infants born on a given day in a given region. However, average length of hospital stay in our sample is 3.35 days, thus a newborn might also compete with infants born few days before and/or after its birth date for medical resources such as hospital beds, medical procedures, and hospital staffs. So we created two alternative measures of crowdedness - weighted lagged number of infants born before and weighted lagged number of infants before and after. Equation (3.2) and (3.3) show how we constructed these measures.

$$\text{Crowdedness\_Before}_{\text{ij}} = \sum_{s=0}^{7} \omega_s \text{Number of infants born}_{\text{ijs}} \qquad (3.2)$$

$$\text{Crowdedness\_BeforeAndAfter}_{\text{ij}} = \sum_{r=-7}^{7} \omega_r \text{Number of infants born}_{\text{ijr}} \qquad (3.3)$$

$\text{Crowdedness\_Before}_{\text{ij}}$ is the crowdedness on an infant *i*'s birth date. ω_s is the weight. It is the average percentage of *s* day old infants still in hospitals. For example, on the infant's birthday, s is 0 and the weight (ω_0) is 1. When s is 1, ω_s is 0.72, because our data show that, on average, 72 percent of infants remain at hospitals one day after they are born. We account for the births that happened up to seven days before. By the seventh day, more than 96 percent of infants are discharged from hospitals and the weight of the number of infants born seven days before (ω_0) is 0.04. $\text{Number of infants born}_{ijs}$ is the number of infants born on s days before the infant *i*'s birth date in region *j*. In this specification, we dropped the first week of the first sample year 2002 because the data on the number of infants for the last week of year 2001 is not available.

$\text{Crowdedness\_BeforeAndAfter}_{ij}$ is constructed in a similar manner. It account for the number of infants born before and after infant *i*'s birth date. The weights of *r* days before (ω_{-r}) and *r* days after (ω_r) are the same. In this specification, we excluded the first and last week of the sample due to lack of available data on before and after our sample years. [32]

Table 3.4 reports the first stage regression results of equation (3.1) using three different alternative measures of crowdedness. Column (1) reports regression result using normalized number of infants born. We calculate normalized number of infants born by subtracting the region average number of infants born from the number of infants born and then dividing by the region standard deviation of the number of infants born. The regression result suggests that when the number of infants born on a given day in a given region increases by one region standard deviation (ranges from 1 to 67, region weighted average 32), the health care spending per birth decreases by $209. This result is statistically significant at 1% level and the F-Statistic is also large at 270. Normalized weighted number of infants born before is constructed in the same way. We demean the weighted number of infants born before and divide by standard deviation in each region. Column (2) shows that when the normalized weighted lagged number of infants born

[32] We ran regressions on main specification excluding the first and the last weeks of the sample years to investigate if dropping these weeks from the sample caused any bias. The results report similar pattern.

before infant *i*'s birth date increases by one region standard deviation (49 births), hospital charge decreases by $141. Column (3) shows that when the normalized weighted lagged number of infants born before and after infant *i*'s birth date increases by one region standard deviation (57 births), hospital charge decreases by $174. The first stage results reinforce that there is evidence that the health care providers change the intensity of treatment based on the crowdedness in the hospital. The F-Statistic is the biggest when the number of infants born is used as a crowdedness measure suggesting this is the best measure of crowdedness.

To further investigate who are more likely to receive more intensive treatment because they were born on slow days, Figure 3.2.a graphically compares the health care spending of infants born top 25 percent busiest days and slowest days with the same birth weights. For ease of comparison, Figure 3.2.b reports the differences in health care spending between busy and slow day infants per birth weight. It reveals that the slow day infants who incur more health care spending are disproportionately low birth weight infants. The difference in hospital charge between infants born on slow and busy days is the biggest among very low birth weight babies with less than 1000g of birth weight. There is almost no visible difference in health care spending among infants with health birth weight of over 2500g. Figure 3.2 suggests that the infants who received more intense hospital treatment because they were born on slower days are mostly low birth weight infants. Difference in hospital charge among low birth weight infants is sizable. The average hospital charge among slow day infants with birth weight between 500 and 800 grams is $43,405 higher than the average hospital charge of their counterparts who were born on busy days. The huge difference in hospital charge among low birth weight infants and almost no difference among healthy birth weight infants suggest that the first stage estimate of increase in $209 per birth as the number of infants decrease by one region standard deviation is primarily driven by increase in spending on low birth weight infants born on slow days.[33]

III.4. Estimating the Effectiveness of the Health Care Spending on Newborn Health

To measure the causal effect of health care spending on infant health, we use equation (3.4) for our second stage estimation in our two-stage least square (2SLS) model:

$$y_{ijt} = \beta_1 \widehat{Spending}_{ijt} + \beta_2 \sum_{1}^{7} T_{1_{ijt}} + \beta_3 \sum_{1}^{12} T_{2_{ijt}} + \beta_4 H_{ijt} + X'_{ijt}\beta_5 + \mu_j + \tau_i + \varepsilon_{ijt} \quad (3.4)$$

where the dependent variable, y_{ijt} is an indicator of the health of infant *i* who was born in region *j* on day *t*. We employ the following measure of infant health: whether infant *i* is alive in 28 days or one year, or hospitalized within one year.[34] $\widehat{Spending}_{ijt}$ is predicted hospital charge for infant *i* from equation (3.1). The rest of the control variables are the same as in equation (3.1).

Table 3.5 reports 2SLS regression results. The second stage results are multiplied by $10,000 for ease of interpretation[35]. Column (1) presents the results with normalized number of infants born that day as a measure of crowdedness. The second stage results suggest that the higher spending on the infants who were born on slower days does not

[33] Further analysis on low birth weight infants is reported in robustness check section.
[34] We tried restricting the outcome variable as mortality rate with non-accidental death only (excluding ICD-10 code 295-350). The results are similar to those when mortality with all causes is outcome variable.
[35] The average hospital charge is $12,967.

improve infant health measured by neonatal and one-year mortality and readmission with one year. These results are confirmed with other measures of crowdedness that are reported in columns (2) and (3). For instance, the second stage results in column (3) suggest that an additional $10,000 in spending have no impact on both neonatal and one-year mortality rate. Moreover, positive and statistically significant coefficients on readmission in columns (2) and (3) imply that, if anything, the additional health care spending harms the infants: a phenomenon known as iatrogenic harm. Numerous studies (Black, 1998; Ashton et. al., 2003; Fisher et. al., 2003; Jha et. al., 2003) find evidence consistent with iatrogenic harm.[36] These studies suspect that additional medical care might be harmful to patients because all treatments entail some risk. Other possible explanations are that greater use of diagnostic tests may find abnormality which would not have caused harm and that longer hospital stays increase the risk of infections.

III.5. Robustness Tests

The Impact of Length of Hospital Stay

Length of hospital stay is another objective proxy for the intensity of treatment. Using the crowdedness as an IV, we examine if the hospital stay has any impact on infant health.

Table 3.6 reports regression results on the impact of hospital stay on neonatal and one-year mortality and rehospitalization. Panel A presents first stage results using three

[36] Using a major reform of the Department of Veterans Affairs health care system, Ashton et. al. (2003) and Jha et. al. (2003) find that the major reduction in hospital utilization does not cause any adverse health consequences. Utilizing wide regional variations in per capita Medicare spending and practice, Fisher et. al. (2003) find that higher spending is associated with lower quality of care. Black (1998) warns the possibility of pseudo disease caused by overuse of diagnostic tests.

different measures of crowdedness. Although the magnitude is very small, the first stage result is both negative and statistically significant. This confirms the main finding the infants born on slower days receive more intense hospital treatment. Panel B reports the second stage results. They are also consistent with our main finding. Increased hospital stay does not improve any of the mortality measure. It also reports no impact on readmission rate either.

Low Birth Weight Infants

Figure 3.2 shows that differences in hospital charge between infants born on busy days and slow days are especially large among low birth weight infants, suggesting low birth weight infants receive more intense hospital treatment when hospitals are less crowded. We run regressions on low birth weight infants (less than 2000g) to examine the impact of hospital spending on low birth weight infants' health status.

Panel A in Table 3.7 reports much larger first stage estimates than our main estimates of $209 from all infants. When the number of infants born decreases by one region standard deviation, hospital spending per low birth weight infant increases by $5,485. Column (3) reports when the number of infants born before and after decrease by one region standard deviation, hospital charge per low birth weight infant increases by $6,582. The first stage results in Table 3.7 confirm that the low birth weight infants receive more intense treatment when the hospital region is less crowded and the impact of crowdedness on health care spending is huge.

The second stage results report that the additional health care spending did not improve any mortality measures. Moreover, regression on readmission reports statistically significant positive coefficients suggesting the additional care is associated higher probability of rehospitalization within one year. Table 3.7 suggests that the additional hospital cares, or expensive additional health care spending, provided to low birth weight infants do not produce any measurable improvement in mortality rate or rehospitalization rate.

Kaiser Births

About 11.6 percent of all births occur in Kaiser hospitals during our sample years. Births in Kaiser hospitals are missing charge data because Kaiser members pay under a capitated scheme. They make monthly payment regardless of their use of medical services. Since Kaiser hospitals do not charge separately for each hospitalization, health care provides at Kaiser hospitals have little financial incentive to provide extended care when the hospital is less crowded. We investigate if crowdedness has any impact on the length of stay for infants born at Kaiser hospitals.[37] Crowdedness for Kaiser hospitals is measured at the hospital level.

The first stage results in Table 3.8 reports impact of crowdedness on the length of hospital stay. It reports that the crowdedness has no impact on the length of hospitalization when (1) number of infants born and (2) weighted number of infants born before are used as measures of crowdedness. However, column (3) reports that weighted

[37] We thank Thomas Rice for Suggesting this idea.

number of infants born before and after has, although small in magnitude, significant impact on the length of hospitalization. This suggests that it is at least partly resource constraints coupled with the desire to do everything possible which is driving our estimate of crowdedness on health care spending. However, it is interesting to note that when we examine Kaiser births, the first stage results report weaker relationship between crowdedness and the length of stay. The second stage results report suggests that the additional hospital stay does not produce any of measured health gain for Kaiser births either.

Analysis at the Hospital Level

The smallest units where infants compete for health care resources are their birth hospitals. While measuring crowdedness at the region level could capture the impact of hospital transfers and possible triage of mothers in labor, crowdedness at the hospital level might have more direct impact on treatment decision by health care providers because they observe within hospital crowdedness rather than regional crowdedness. Moreover, only 1.4 percent of newborns transferred from their birth hospitals within two days after birth.

For this analysis, we exclude observations with missing birth hospital information. Hospitals where less than two infants are born on average are also excluded because there was not enough variation in crowdedness. The number of hospitals for this analysis is 299. The average number of birth per day per hospital is 9.8 and average standard deviation is 3.1.

Table 3.9 presents regression results using crowdedness measured at the hospital level. The first stage results report that the crowdedness has a sizable impact on health care spending at hospital level when number of babies born before and before/after are used to measure the crowdedness. The second stage results suggest that the higher health care spending on infants born on slow days did not improve any mortality rates. If anything, higher spending increased the probability of rehospitalization within one year. Overall, regression results using crowdedness at hospital level report similar pattern as in our main analysis.

III.6. Conclusion

Using the crowdedness on an infant's birth date as an IV, we estimate the impact of additional health care measured by hospital spending and length of hospital stay on infant health. Our study finds that the intensity of hospital treatment is closely related to the crowdedness of hospital regions. Infants born on slow days receive more care than infants born on busy days with identical underlying health status. We also identify that the infants who receive more intense hospital care are disproportionally low-birth weight infants. The second stage results suggest that the additional hospital care performed on infants born on slower days does not translate to better infant health outcomes measured by neonatal, one-year mortality rates, and rehospitalization rate within one year. If anything, we find that the additional hospital spending increases the probability of rehospitalization.

Our study suggests that we are at the flat curve of production function where additional health care spending does not improve health status. However, our result should be interpreted cautiously because resources and commitment to perinatal health may differ across states and countries. Our results might not be generalized beyond California.

We measure infant health outcome using mortality and rehospitalization rates. While these are the best available proxy for infant health, they are not the perfect measures of health status.

Lastly, the new IV we introduce in this paper, the crowdedness, could be applied other settings where there is little possibility of controlling the timing of illness. For example, the impact of emergency room care for health attack patients could benefit from employing the crowdedness measure as an IV.

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Figure 3.1. Number of Births a Day in LA County

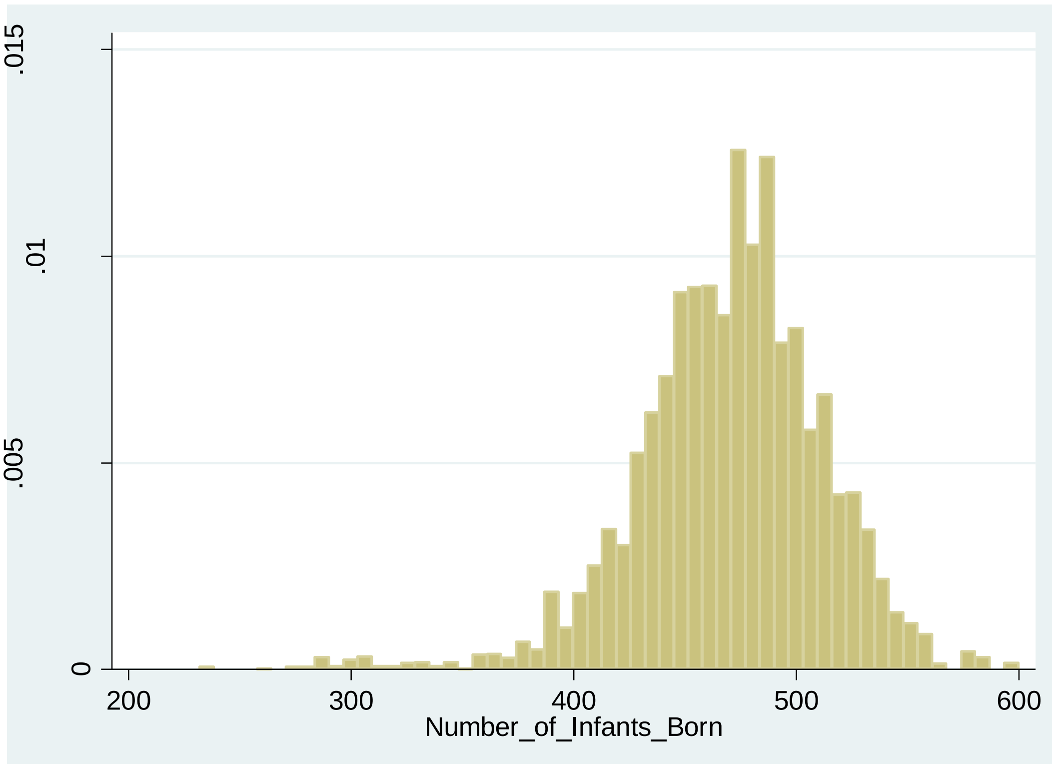

Figure 3.2. Hospital Charges on Infants Born on Slow vs. Busy Days

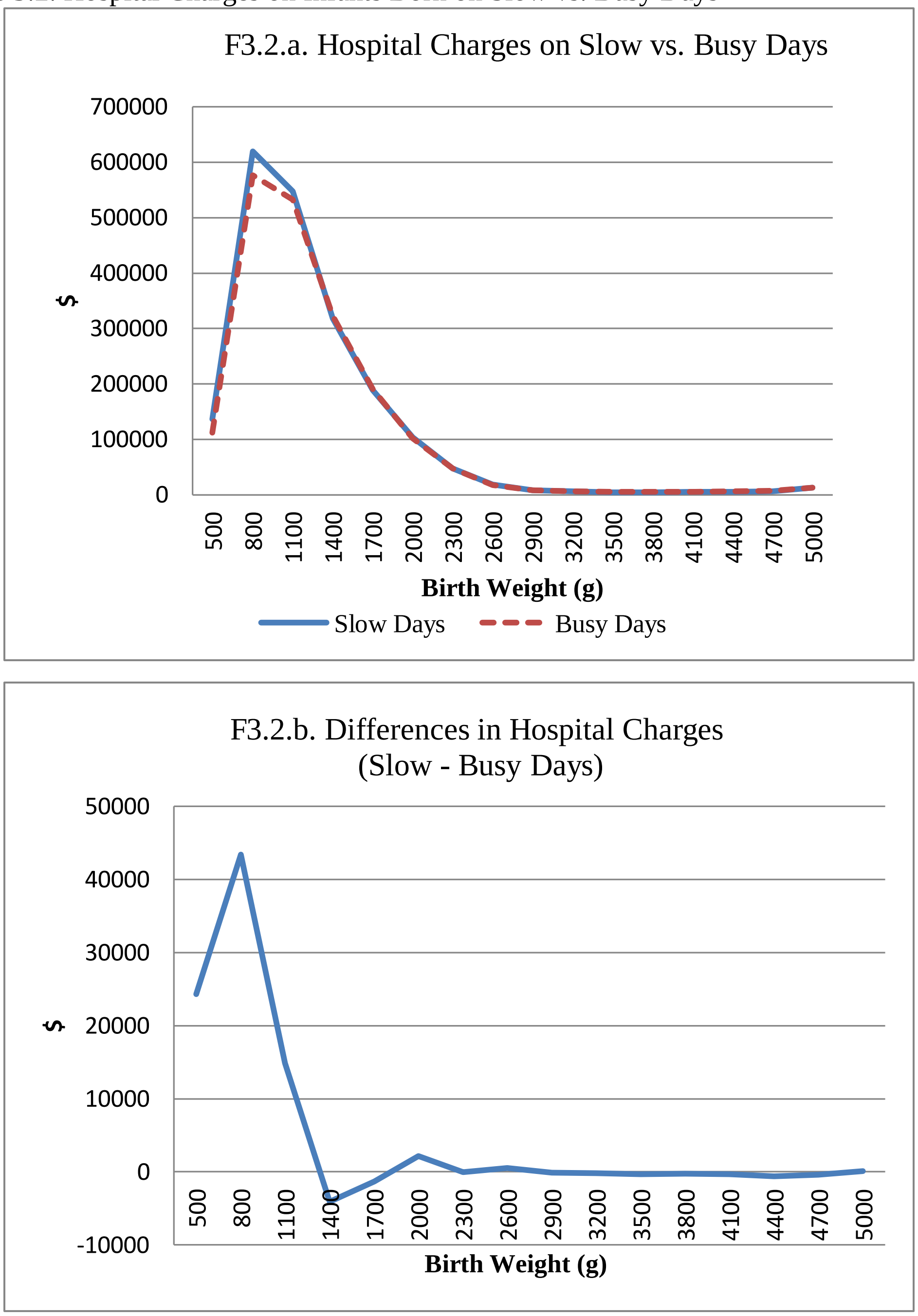

Table 3.1. Summary Statistics

Variable	All Births Mean	All Births S.D.	Low Birth Weight (<2000g) Mean	Low Birth Weight (<2000g) S.D.
Pregnancy Characteristics				
Trimester prenatal care began	2.25	1.40	2.09	1.35
Number of prenatal visits	12.37	4.05	11.02	6.27
No pregnancy complication	0.34	0.47	0.23	0.42
Parents' Characteristics				
Previously dead baby	0.01	0.11	0.03	0.17
Mother's age	27.90	6.37	28.79	7.05
Mother's education (years)	12.22	3.42	12.36	3.30
Father's age	30.84	7.21	31.49	7.90
Father's education (years)	12.18	3.58	12.24	3.53
Newborn Characteristics				
Boy	0.51	0.50	0.51	0.50
White	0.72	0.45	0.65	0.48
Black	0.07	0.26	0.13	0.34
Asian	0.09	0.28	0.08	0.27
Hispanic	0.52	0.50	0.46	0.50
First born	0.38	0.49	0.40	0.49
Single birth	0.97	0.17	0.71	0.46
Multiple birth (twin or more)	0.03	0.17	0.29	0.46
Birth Characteristics				
Birth weight (g)	3319	574	1424	467
Gestation (days)	275	24	225	45
C-section	0.28	0.45	0.61	0.49
Primary Payer				
Medicaid	0.52	0.50	0.46	0.50
Private	0.44	0.50	0.43	0.49
Self pay	0.02	0.15	0.02	0.14
Variables of Interest				
Hospital Charges	12967	78217	252634	366930
Hospital Stay (days)	3.35	8.05	33.34	33.74
Number of procedures[1]	1.55	1.54	4.58	3.62
Outcome Variables				
Neonatal Mortality	0.003	0.058	0.101	0.301
One-year Mortality	0.005	0.071	0.118	0.323
Readmit	0.090	0.286	0.135	0.342
Observations	2,349,650		57,148	

1. Data on procedures done are available for only 31 percent of the observations.

Table 3.2. Descriptive Statistics by Region

Region	% of All Births	Mean	S.D.	Min	25th Percentile	50th Percentile	75th Percentile	Max	# of Counties
1	0.15%	2.93	1.40	1	2	3	4	8	3
2	0.07%	1.88	0.89	1	1	2	2	5	2
3	1.17%	21.17	5.14	1	18	21	24	38	3
4	2.52%	40.87	7.51	16	36	41	46	63	2
5	8.48%	133.39	20.54	71	120	137	148	185	5
6	0.27%	4.52	1.88	1	3	4	6	12	1
7	5.81%	106.94	15.56	56	97	108	118	148	3
8	9.20%	143.18	22.75	74	128	145	159	212	18
9	2.67%	36.29	7.72	14	31	36	41	59	3
10	4.67%	74.99	14.59	22	65	77	85	110	3
11	5.61%	79.59	15.97	28	68	81	91	126	4
12	1.83%	25.19	5.90	5	21	25	29	42	2
13	2.73%	37.06	8.13	12	31	37	43	67	1
14	29.69%	438.90	67.27	231	399	455	485	595	1
15	2.34%	32.08	7.44	9	27	32	37	56	1
16	9.38%	134.89	23.31	62	123	139	151	185	1
17	4.81%	74.88	15.14	30	65	76	85	112	1
18	8.62%	126.50	20.66	67	112	129	141	188	2

List of Counties:

Region 1: Del Norte, Modoc, Siskiyou

Region 2: Lassen, Plumas

Region 3: Lake, Mendocino, Sonoma

Region 4: Marin, San Francisco

Region 5: Monterey, San Benito, San Mateo, Santa Clara, Santa Cruz

Region 6: Napa

Region 7: Alameda, Contra Costa, Solano

Region 8: Amador, Butte, Calaveras, Colusa, El Dorado, Glenn, Humboldt, Nevada, Placer, Sacramento, San Joaquin, Shasta, Sutter, Tehama, Trinity, Tuolumne, Yolo, Yuba

Region 9: Mariposa, Merced, Stanislaus

Region 10: Inyo, Mono, San Bernardino

Region 11: Fresno, Kings, Madera, Tulare

Region 12: San Luis Obispo, Santa Barbara

Region 13: Kern

Region 14: Los Angeles

Region 15: Ventura

Region 16: Orange

Region 17: Riverside

Region 18: Imperial, San Diego

Alpine and Sierra counties didn't report any birth during the sample years.

Table 3.3. Summary Statistics of Infants Born on Top 25% Slowest and Busiest Days

	Slow Days		Busy Days		
Variable	Mean	S.D.	Mean	S.D.	Difference
Number of infants born	179.79	(148.58)	228.65	(175.51)	-48.86
Pregnancy Characteristics					
Trimester prenatal care began	2.25	(1.39)	2.24	(1.36)	0.01
Number of prenatal visits	12.20	(4.03)	12.28	(4.09)	-0.08
No pregnancy complication	0.33	(0.47)	0.35	(0.48)	-0.02
Parents' Characteristics					
Previously dead baby	0.01	(0.11)	0.01	(0.11)	0.00
Mother's age	28.01	(6.35)	28.09	(6.35)	-0.09
Mother's education (years)	12.35	(3.36)	12.39	(3.38)	-0.04
Father's age	30.95	(7.19)	31.00	(7.20)	-0.05
Father's education (years)	12.32	(3.50)	12.33	(3.53)	-0.01
Newborn Characteristics					
Boy	0.51	(0.50)	0.51	(0.50)	0.00
White	0.71	(0.45)	0.72	(0.45)	0.00
Black	0.08	(0.27)	0.08	(0.27)	0.00
Asian	0.09	(0.29)	0.09	(0.29)	0.00
Hispanic	0.50	(0.50)	0.51	(0.50)	-0.01
First born	0.39	(0.49)	0.39	(0.49)	0.01
Single birth	0.973	(0.162)	0.966	(0.180)	0.007
Multiple birth (twin or more)	0.027	(0.162)	0.034	(0.180)	-0.007
Birth Characteristics					
Birth weight (g)	3,327	(578)	3,317	(577)	10
Gestation (days)	275	(24)	275	(24)	0
Caesarian section	0.27	(0.45)	0.28	(0.45)	-0.01
Primary Payer					
Medicaid	0.46	(0.50)	0.47	(0.50)	-0.01
Private	0.50	(0.50)	0.49	(0.50)	0.01
Self pay	0.02	(0.15)	0.02	(0.15)	0.00
Observations	627,849		625,038		

Table 3.4. First Stage Regression Results

	(1)	(2)	(3)
1st Stage Results			
Coefficient	-208.89	-141.29	-174.24
Robust Standard Error	(72.84)***	(85.40)*	(93.75)*
F-Statistics	270.30	265.82	269.59
R-squared	0.3421	0.3424	0.3429
Observations	2,349,650	2,341,790	2,334,249

(1) Normalized number of infants born

(2) Normalized weighted number of infants born before

(3) Normalized weighted number of infants born before and after

Standard errors are in parentheses and clustered at the region and month level.
Control variables are days of the week, months, and year indicators, birth weight categorized 500g interval (less than 500g, 501-1000g,… 4001-4500g, over 4500g), gestation in two weeks interval (less than 32 weeks, 33-34 weeks, …, over 43 weeks), infant's gender, parity, trimester prenatal care began, number of prenatal visits, caesarean section, insurance status indicators, mother and father's age and education.

***,* Statistically significant at 10%, 1% level.

Table 3.5. Regression Results

	(1)	(2)	(3)
1st Stage Results			
Coefficient	-208.89	-141.29	-174.24
Robust Standard Error	(72.84)***	(85.40)*	(93.75)*
2nd Stage Results			
		Neonatal Mortality	
Health Care Spending	-0.0005	-0.0002	-0.0014
(X10,000)	(0.0010)	(0.0013)	(0.0011)
		One-year Mortality	
Health Care Spending	-0.0001	0.0020	0.013
(X10,000)	(0.0018)	(0.0026)	(0.0019)
		Readmission	
Health Care Spending	0.0210	0.0971	0.1240
(X10,000)	(0.0166)	(0.0308)***	(0.0278)***
Observations	2,349,650	2,341,790	2,334,249

(1) Normalized number of infants born

(2) Normalized weighted number of infants born before

(3) Normalized weighted number of infants born before and after

Standard errors are in parentheses and clustered at the region and month level.

All second stage coefficients are multiplied by $10,000.

Control variables include the variables listed in Table 3.4.

***,* Statistically significant at 10%, 1% level.

Table 3.6. Regression Result: Impact of Hospital Stay

	(1)	(2)	(3)
Panel A: 1st Stage Results			
Coefficient	-0.0183	-0.0073	-0.0075
Robust S.E.	(0.0067)***	(0.0082)	(0.0086)
F-Statistics	1586.92	1601.81	1596.51
R-squared	0.4559	0.4560	0.4568
Panel B: 2nd Stage Results			
		Neonatal Mortality	
Hospital Stay (1Day)	-0.0006	-	-
	(0.0012)	-	-
		One-year Mortality	
Hospital Stay (1Day)	-0.0001	-	-
	(0.0020)	-	-
		Readmission	
Hospital Stay (1Day)	0.0267	-	-
	(0.0200)	-	-
Observations	2,349,650	2,341,790	2,334,249

(1) Normalized number of infants born

(2) Normalized weighted number of infants born before

(3) Normalized weighted number of infants born before and after

Standard errors are in parentheses and clustered at the region and month level.

Control variables are listed in Table 3.4.

*** Statistically significant at 1% level.

Table 3.7. Impact of Healthcare Spending for Low Birth Weight Infants (2000g<)

	(1)	(2)	(3)
Panel A: 1st Stage Results			
Coefficient	-5,485	-6,211	-6,582
Robust S.E.	(2577)**	(2560)**	(2675)**
F-Statistics	1961.70	1996.58	1972.51
R-squared	0.2439	0.2442	0.2447
Panel B: 2nd Stage Results			
		Neonatal Mortality	
Health Care Spending	-0.0005	-0.0002	-0.0009
(X10,000)	(0.0027)	(0.0022)	(0.0019)
		One-year Mortality	
Health Care Spending	-0.0022	-0.0008	-0.0012
(X10,000)	(0.0033)	(0.0026)	(0.0023)
		Readmission	
Health Care Spending	0.0048	0.0094	0.0095
(X10,000)	(0.0046)	(0.0039)**	(0.0039)**
Observations	57,148	56,930	56,846

(1) Normalized number of infants born

(2) Normalized weighted number of infants born before

(3) Normalized weighted number of infants born before and after

Standard errors are in parentheses and clustered at the region and month level.

All second stage coefficients are multiplied by 10,000.

Control variables included the variables listed in Table 3.4.

** Statistically significant at 5% level.

Table 3.8. Impact of Hospital Stay for Kaiser Births

	(1)	(2)	(3)
Panel A: 1st Stage Results			
Coefficient	-0.0124	-0.0163	-0.0307
Robust S.E.	(0.0163)	(0.0165)	(0.0148)**
F-Statistics	205.22	204.07	207.87
R-squared	0.4716	0.4711	0.4719
Panel B: 2nd Stage Results			
		Neonatal Mortality	
Hospital Stay (1Day)	-	-	-0.0005
	-	-	(0.0011)
		One-year Mortality	
Hospital Stay (1Day)	-	-	0.0021
	-	-	(0.0022)
		Readmission	
Hospital Stay (1Day)	-	-	0.0369
	-	-	(0.0398)
Observations	307,152	306,099	305,042

(1) Normalized number of infants born

(2) Normalized weighted number of infants born before

(3) Normalized weighted number of infants born before and after

Standard errors are in parentheses and clustered at the hospital and month level.

Control variables included the variables listed in Table 3.4.

** Statistically significant at 5% level.

Table 3.9. Regression Results using Hospital Level Crowdedness

	(1)	(2)	(3)
1st Stage Results			
Coefficient	-61.34	-103.56	-131.89
Robust Standard Error	(47.68)	(48.62)**	(51.78)**
F-Statistics	300.84	760.59	918.37
R-squared	0.3497	0.3500	0.3506
2nd Stage Results			
		Neonatal Mortality	
Health Care Spending	-	0.0008	-0.0002
(X10,000)	-	(0.0012)	(0.0009)
		One-year Mortality	
Health Care Spending	-	0.0024	0.0019
(X10,000)	-	(0.0022)	(0.0017)
		Readmission	
Health Care Spending	-	0.1330	0.1180
(X10,000)	-	(0.0248)***	(0.0227)***
Observations	2,314,273	2,306,581	2,299,146

(1) Normalized number of infants born

(2) Normalized weighted number of infants born before

(3) Normalized weighted number of infants born before and after

Standard errors are in parentheses and clustered at the region and month level.

All second stage coefficients are multiplied by $10,000.

Control variables include the variables listed in Table 3.4.

***,** Statistically significant at 10%, 5% level

Conclusion

This dissertation addresses the impact of insurance on medical service use in dental market and the effectiveness of health care spending. The results from chapter 1 and chapter 2 suggest that the elasticity of dental service is different among different populations. Chapter 1, which exploits the state-level variation in adult Medicaid dental benefit finds sizable impact of Medicaid benefit on dental service use among low-income population who report the worst oral health. Chapter 1 also finds evidence that adult Medicaid dental benefit improves dental health status among low-income population suggesting that offering adult Medicaid dental is cost effective. However chapter 2 finds that older population who lose their dental insurance upon retirement does not change their dental care habit in any way suggesting dental benefit could be dropped without causing adverse health impact for this population. Studies in chapter 1 and chapter 2 warn that policy makers should be aware of difference in demand elasticity among different populations when making policy decisions.

Chapter 3 uses the number of infants born on a given day on a given location as an identifying variable to generate exogenous variation in health care spending. The first stage results report that there is a high correlation between the crowdedness and health care spending. It also identifies that the infants who receive more intense hospital care are low-birth weight infants. The second stage results suggests that the additional health care spending generated by the difference in crowdedness does not translate to better infant health measured by neonatal and one-year mortality and one-year rehospitalization rate. This result suggests that California is at the flat part of infant health production function where additional health care spending does not improve infant health status. Policy implication would be that health care spending could be reduced without causing adverse health consequences.

Appendix A. Covariate Balance Test in Difference-in-Differences Table

Age

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	35.4 (9.1)	36.1 (9.0)	-0.73
Childless	41.2 (11.1)	41.3 (11.1)	-0.11
Diff	-5.8	-5.1	-0.63

Female

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.816 (0.388)	0.839 (0.368)	-0.023
Childless	0.578 (0.494)	0.581 (0.493)	-0.003
Diff	0.237	0.258	-0.021

Some High School

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.201 (0.401)	0.212 (0.409)	-0.011
Childless	0.147 (0.354)	0.155 (0.362)	-0.008
Diff	0.054	0.057	-0.003

High School Graduate

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.375 (0.484)	0.404 (0.491)	-0.029
Childless	0.333 (0.471)	0.330 (0.470)	0.003
Diff	0.042	0.074	-0.032*

College Graduate

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.074 (0.262)	0.070 (0.255)	0.004
Childless	0.162 (0.368)	0.164 (0.370)	-0.002
Diff	-0.088	-0.094	0.006

White

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.480 (0.500)	0.432 (0.495)	0.048
Childless	0.689 (0.463)	0.630 (0.483)	0.058
Diff	-0.209	-0.199	-0.010

Black

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.189 (0.392)	0.313 (0.464)	-0.124
Childless	0.119 (0.323)	0.201 (0.401)	-0.083
Diff	0.071	0.112	-0.041***

Hispanic

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.217 (0.413)	0.154 (0.361)	0.063
Childless	0.093 (0.290)	0.066 (0.248)	0.027
Diff	0.125	0.088	0.037***

(Appendix A Continued)

Unemployed

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.224 (0.417)	0.239 (0.426)	-0.014
Childless	0.164 (0.371)	0.193 (0.395)	-0.029
Diff	0.060	0.045	0.015

Good Self-Reported Health

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	0.316 (0.465)	0.307 (0.461)	0.009
Childless	0.286 (0.452)	0.281 (0.449)	0.005
Diff	0.030	0.026	0.004

BMI

	States with Dental Benefit	States w/o Dental Benefit	Diff
Parents	28.40 (7.24)	28.63 (7.59)	-0.24
Childless	28.15 (7.95)	27.87 (7.78)	0.28
Diff	0.25	0.76	-0.51*

Number of Observations: 11,301
Standard errors are in parentheses
***, *: statistically significant at 1%, 10% level