Two Essays on Medicaid Dental Care Coverage

by

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Dedicated with love and gratitude to my parents.

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ABSTRACT

Two Essays on Medicaid Dental Care Coverage

by

Sasha Brodsky

Chair: Thomas Buchmueller

My dissertation investigates the role of Medicaid dental insurance for children and adults on provider participation and the use of dental care. My job market paper focuses on the effect of Medicaid dental care coverage on the demand for preventive and urgent care. I exploit changes in Medicaid dental care coverage for adults within states over the last twenty years. Using individual-level SIPP data, I find that, by lowering the effective price of care, Medicaid dental care coverage increases the probability that adults on Medicaid will go to the dentist office at least once a year. Further analysis using data on hospital emergency department (ED) discharges in California indicates no offset effect of Medicaid dental care coverage on the number of ED visits for dental disease. Returning to SIPP data, I find that Medicaid dental care coverage leads to substantial reductions in the number of days spent in bed among employed adults on Medicaid. These results point to sizable effects of insurance coverage on labor participation that have remained largely unexplored.

Dental care is not included in the Affordable Care Act as an 'essential benefit' that must be covered by health plans participating in health insurance exchanges. Increased enrollment in Medicaid will create additional fiscal pressure for those states that currently cover dental care for adults on Medicaid. My findings indicate that, on the one hand, states

can substantially reduce short-term Medicaid costs by eliminating dental care coverage, as offset effects through increased ED visits are minimal. On the other hand, based on the results on the number of days in bed, such policy could have important effects on productivity and health.

Dental care shares many features of primary care and preventive care, so the results above have implications for Medicaid expansions of coverage of preventive care and primary care. They suggest that access to preventive care due to the Affordable Care Act will not reduce the use of emergency care, so medical costs will increase. Changes in insurance coverage will have implications for businesses and local economies. For example, reduced absenteeism among working adults will raise firm productivity and increase government budgets through higher tax revenue.

The rest of my dissertation focuses on the effect of Medicaid dental care coverage on the supply of dental care. I exploit recent changes in insurance coverage due to Healthy Kids Dental (HKD), an innovative program in Michigan aimed at improving children's access to dental care by increasing the willingness of dental providers to treat children on Medicaid. The key feature of the program is that the state contracts with a private insurer, Delta Dental, to provide dental coverage to children in selected counties. Delta then reimburses providers according to the same fee schedule used for its commercially insured groups, a fee that is substantially above the normal Medicaid rate. My analysis focuses on the expansion of the program to two more counties in 2008. These make up about 6 percent of Michigan's population. I also exploit the change in fees in four additional counties that joined the program in 2012. These counties make up about 3 percent of Michigan's population. I use a difference-in-difference strategy and an event-study framework to identify the effect of increased reimbursement rates on provider participation and the use of dental care.

The results suggest that providers respond to increased reimbursement rates by seeing more patients on Medicaid: average number of participating dentists per county increases from 199 to 271. Provider response is immediate and remains constant over time. Interest-

ingly, the number of children on Medicaid per dentist remains unchanged. This observation may suggest that greater participation of dentists treating fewer children on Medicaid comes at the expense of declines in participation of dentists treating large volumes of children on Medicaid. In line with this hypothesis, increased reimbursement rates lead to very small increases in the share of children on Medicaid with any dental care of about 3 percent (mean=0.265). A similar increase is observed in the number of dental visits per child enrolled in Medicaid. I find little evidence that increased reimbursement rates affect enrollment in Medicaid, suggesting that the above effects are driven by increased use of dental care.

These results underscore the importance of increased reimbursement rates to increasing provider participation in Medicaid. As expected, higher reimbursement rates have larger effects on providers with lower volumes of Medicaid patients relative to providers with larger volumes of Medicaid patients. This finding suggests that as reimbursement rates increase, patients on Medicaid may be able to choose providers that better serve their needs (e.g. providers who are located closer to their home). Providers are likely to treat more patients as reimbursement rates increase, but increased reimbursement rates alone are unlikely to raise the level of care up to the recommended levels.

CHAPTER I

Measuring the Value of Prevention: Evidence from Medicaid Dental Care Coverage

1.1 Introduction

Prevention is commonly seen as a way to improve health and contain medical costs. With this logic in mind, the Patient Protection and Affordable Care Act significantly expands coverage of preventive care. Effective August 1, 2012, all new insurance plans must cover certain preventive services, such as mammograms and colonoscopies. Other prevention initiatives within ACA include raising reimbursement rates for primary care providers and creating incentives for employers to provide wellness programs.

The effect of preventive insurance coverage on medical costs depends on the nature of interaction among different types of covered services. Insurance coverage in general is known to lead to greater utilization of medical services (Newhouse et al., 1996; Finkelstein et al. 2012; Currie and Gruber, 1996), thereby directly increasing medical costs. However, coverage for one type of care may lead to reductions in the use of other covered services, thereby indirectly lowering total medical costs. For example, yearly visit to the dentist for check-ups may reduce the need for emergency care due to untreated dental decay. Most studies estimating these 'offset effects' focus on the effect of prescription drug coverage

on the use of hospital care.[1] Evidence so far is mixed. For the elderly in the US in the last decade, some studies report reductions in health care spending that more than offset prescription drug spending (Shang and Goldman, 2007), while others find only moderate offset effects (Hsu et al, 2006), or no offsets at all (Kaestner and Kahn 2012).

Preventive insurance coverage may improve health outcomes, thereby improving productivity, but evidence for these effects is mixed. The two large-scale experiments in health economics – the RAND Health Insurance Experiment (HIE)[2] and the Oregon Experiment[3] – have found no evidence of large effect of health insurance on health. Improvements in health may manifest themselves in increased productivity and reduced absenteeism, but empirical evidence for these effects is scarce (Buchmueller, 2000). Vistnes (1997) finds a positive association between health insurance and absenteeism, while Gilleskie (1998) reports a negative association between health insurance and absenteeism.

This study estimates the effect of preventive coverage on the use of preventive care, emergency care, and, indirectly, health in the context of dental care. Dentist office visits are part of preventive care[4], in that its goal is to minimize and prevent complications. In contrast, dental care in hospital emergency departments (ED) is considered urgent care, since hospitals are not equipped to provide dental services beyond basic alleviation of pain,

[1] One exception is Kaestner and LoSasso (2012) who use a natural experiment in which the price of outpatient care decreased, while the price of inpatient care remained constant. They find increased use of both types of care, especially for those conditions in which physicians exercise discretion. Since preventive care could take place in both inpatient and outpatient setting, distinguishing the main effect of prevention from its offset effect is difficult.

[2] The HIE was designed to investigate the marginal impact of insurance cost-sharing on utilization of medical care (Newhouse et al, 1996). Non-elderly adults were randomly assigned to health insurance plans that differed in the amount of cost-sharing required of patients at the time care was received. In addition to estimating the effect of cost-sharing on medical care use, researchers examined its effect on a number of indicators of physical and mental health. The effects of cost-sharing on health outcomes were not substantial for the average person.

[3] In the Oregon Experiment, adults were assigned by lottery into Medicaid health insurance coverage. Adults who gained insurance coverage used more care, but there was no evidence of an effect of insurance coverage on self-reported physical health or mental health (Baicker, 2013).

[4] In the case of dental care, preventive care is commonly grouped into three levels. The goal of primary prevention (e.g. X-ray) is to prevent disease from occurring. Secondary prevention is used after the onset of disease, but before the development of its symptoms. An example of this type of prevention is amalgam treatment before the onset of pain. Tertiary prevention aims to minimize damage after the development of symptoms. For example, dentists may use an amalgam filling on a decayed tooth after the onset of pain.

infection, and trauma.

While the federal government requires that all states cover emergency dental care for alleviation of pain, trauma, or infection for adults on Medicaid, public coverage of preventive dental services is optional. As a result, there is considerable variation in Medicaid dental care coverage across states (Figure 1.1). Most states in the north provide dental care coverage for adults on Medicaid, while most states in the south do not. Moreover, there have been changes in dental care coverage over time (Figure 1.2). Some states, like Arkansas, added dental care coverage for adults on Medicaid in the last decade, while others, like California, eliminated it in the same time period.

My analysis exploits variation of state-level Medicaid dental care coverage over time. Using the national individual-level Survey of Income and Program Participation (SIPP) from 2001, 2004, and 2008, I compare the use of care between adults on Medicaid and other adults, controlling for observable time-varying and unobservable time-invariant state characteristics that could affect both Medicaid dental coverage and the use of care. To estimate the offset effect of Medicaid dental coverage, I focus on California, the largest state in the U.S. that has eliminated dental care coverage for adults on Medicaid. Using hospital discharge data from the Healthcare Cost and Utilization Project (HCUP) State Emergency Department Databases (SEDD) and county populations, I compare the number of ED visits for dental disease per county population between adults on Medicaid and other adults over time using event study and difference-in-difference approaches. Finally, I return to the national SIPP data to estimate the effect of Medicaid dental care coverage on the number of days spent in bed among adults on Medicaid. Evidence for this effect suggests that, by improving health, preventive care coverage may improve productivity.

I find that Medicaid dental care coverage leads to a 23 percent increase in the probability that patients will have at least one dentist office visit per year. Fewer adults on Medicaid report foregoing dental care due to costs when Medicaid dental care coverage is provided, suggesting that the reduction in the effective price of dental care drives the reduction in

the probability that adults on Medicaid have at least one dentist office visit per year. Additional analysis using data from California indicates no offset effect of Medicaid dental care coverage on the number of ED visits for dental disease per population. At the same time, I document substantial reductions in the number of bed days due to the policy: Medicaid dental care coverage leads to a reduction of 8 percent in the number of bed days among adults on Medicaid. Reduced number of bed days points to sizable effects of insurance on productivity that have remained largely unexplored.

I organize my analysis as follows. Section 2 provides background on Medicaid dental care coverage. In Section 3, I examine its effect on care use in dentist offices. Section 4 examines its offset effect on hospital ED care. I present evidence regarding the effect of Medicaid dental care coverage on the number of bed days in Section 5. I discuss the implications of my findings in Section 6, and conclude with Section 7.

1.2 Background

Dental care coverage is much less prevalent than medical care coverage in the United States. About 15 percent of adults over the age of 21 have no form of medical care coverage, but over 45 percent of adults over the age of 21 (85 million people) have no form of dental care coverage (MEPS, 2005). Private dental insurance plans, usually received through employment, are the largest providers of dental insurance. The second largest provider of dental insurance is Medicaid, a joint federal-state program for parents and caregivers in low-income families with dependent children, pregnant women, elderly[5], disabled, and other low-income adults.

The federal government requires states to provide emergency dental coverage for the relief of pain, infection, or trauma to adults on Medicaid. In addition to mandatory dental

[5]The largest public provider of insurance for the elderly, Medicare, excludes most dental services from coverage. The exclusion does not apply to inpatient dental services that are an integral part either of covered procedures (e.g., reconstruction of the jaw following accidental injury), extractions done in preparation for radiation treatment for neoplastic diseases involving the jaw, or oral examinations (but not treatment) preceding kidney transplantation or heart valve replacement.

care coverage, states have the option to cover a more comprehensive set of services. Some states cover basic dental care that includes a broader set of urgent services for the relief of pain, infection or trauma, such as smoothing of a broken tooth. Full dental care coverage includes coverage of at least some preventive services, diagnostic, and restorative services. Some states may exclude from coverage expensive treatments such as root canals, implants, precious metal crowns, may still not be covered.

The breadth of comprehensive dental care coverage varies by state and over time. Most Northeastern states, like New Jersey, covered dental care for over a decade (Figure 1.1 and Table 1.1). Some states in the South, like Texas, never provided dental care coverage in the last decade. A number of states, like California, eliminated dental care coverage. Between 2001 and 2011, the percentage of adults on Medicaid with dental care coverage dropped from 80 to about 40 percent (Figure 1.2). Though most of this reduction took place in the wake of the Great Recession, some states, like Alaska, Florida or Idaho, added coverage at different points in time; some, like Massachusetts, eliminated it well before the recession; others yet, like Washington, eliminated it after the recession.

Prior studies find that, compared to the demand for other types of care, demand for dental care is price-elastic. In the RAND Health Insurance Experiment (HIE) moving from the least comprehensive insurance plan to full coverage was associated with a 45 percent increase in yearly spending (Newhouse et al, 1996). At low levels of cost-sharing (cost-sharing of 0-25 percent), price elasticity of medical spending was 0.17, meaning that a 1 percent increase in the price of health care led to a 0.17 percent reduction in health care spending. Cost-sharing rates between 25 and 95 percent yielded elasticity estimates of 0.22. Estimated elasticities of demand were larger for preventive care (0.43) and dental care (0.46). These findings suggest that Medicaid dental care coverage may increase the demand for care.

Medicaid dental care coverage is associated with greater use of care in dentist offices. Using cross-sectional telephone survey data from years 2002 and 2004, Choi (2011) com-

pares yearly dental service use of low-income parents in states with and without dental care coverage for adults on Medicaid. Dental care coverage correlates with care use in dentist offices: the probability of at least one dentist office visit per year is 6 percentage points higher (mean of 0.50) in states that provide Medicaid dental care coverage.[6]

Case studies from several states' hospital ED are suggestive of offset effects in dental care. Wallace et al (2011) exploit the natural experiment that took place in Oregon. Their strategy is to compare the use of dental care among adults on Medicaid who lost coverage (parents and caregivers) to the analogous outcome among Medicaid beneficiaries who retained it (disabled adults). When Oregon eliminated dental care coverage for parents and caregivers of low-income children on Medicaid, the probability of dental diagnosis among ED patients on Medicaid increased from 0.032 to 0.045 in this group. Disabled adults, however, experienced a large reduction in ED use, perhaps because the program increased co-payment for care in dentist offices at the same time. Cohen et al (2002) focus on the elimination of dental care coverage for all adults on Medicaid that took place in Maryland in 1993. Using data from all Maryland Medicaid claims, the authors find that the probability of dental diagnosis among ED patients increased from 1.00 percent to 1.11 percent, when dental care coverage was eliminated.

[6]This evidence is consistent with previous estimates. Munkin and Trivedi (2009) estimate the relationship between dental coverage and utilization using data from the nationally representative MEPS data from 1996 to 2000. The authors control for selection into dental coverage by using firm size as an instrument. They find that private dental insurance coverage increases the number of general dental visits by 25 percent. Meyerhoeffer et al (2013) confirm positive correlation between dental coverage and care use among non-elderly privately insured and uninsured adults using data on individual use of dental care from the Medical Expenditures Panel Survey for 2001-2006 merged to county-level prices for representative preventive and restorative treatments from the American Dental Association survey. Private dental coverage increases the probability of preventive care use by 19 percent and the use of restorative services by 11-16 percent.

1.3 Effect of Medicaid Dental Care Coverage on the Use of Care in Dentist Offices

Coverage of preventive care may lead to an increase in its use. I estimate this effect by exploiting state-level variation in Medicaid dental care coverage over time. Any visit to the dentist office is part of preventive care in that it minimizes complications from dental disease. Since the American Dental Association recommends at least one yearly visit to the dentist office, I consider as main outcomes the probability of at least one dentist office visit in the past year and the number of dentist office visits in the past year. A measure of foregone dental care in the past year allows me to examine whether Medicaid dental care coverage affects the use of care through a reduction in its effective price.

1.3.1 Data and Descriptive Statistics

I examine the effect of Medicaid dental care coverage on the use of care in dentist offices by using the national sample of civilian non-institutionalized population in the U.S. from the Survey of Income and Program Participation (SIPP) for 2001, 2004, and 2008. Each panel is a multistage-stratified sample of the US civilian non-institutionalized population. Each individual is interviewed at most 12 times in the course of 4 years[7] about 'core' questions on family income, family composition, and program participation over the previous four months. In addition, during some interviews, individuals are asked 'topical' questions. The Medical Expenses and Utilization of Health Care Topical Module appears roughly yearly; pooling data across all years results in over 650,000 observations. The Adult Well-Being Topical Module is asked less frequently, so pooling data across all years results in roughly 330,000 observations. Appendix Table 1.1 provides more detailed information on the number of observations in each year.

Summary statistics are reported in Table 1.2. The observations are adult-years. Each

[7] Attrition rates vary between 25 percent and 35 percent across panels and waves.

adult, defined as individual above the age of 21, contributes between one and three observations to the data.[8] Overall, about 9 percent of adults in the sample are covered by Medicaid in the last four months. Due to significant heterogeneity in key covariates and outcomes, I distinguish between adults who are not covered by Medicaid, adults on Medicaid who are parents and caregivers in low-income families with dependent children, and other adults on Medicaid who are either elderly or disabled. Most non-Medicaid adults are employed. Employment rate is slightly lower for parents of dependent children on Medicaid and substantially lower for other adults on Medicaid relative to adults who are not on Medicaid. In line with this observation, very few non-elderly adults are covered by Medicare (presumably because they are disabled), but over 45 percent of other adults are eligible for both Medicaid and Medicare ('dual eligibles'). Family income is highest among non-Medicaid adults, and significantly lower for both types of adults on Medicaid.

I use different measures of utilization of care: the probability of at least one visit to the dentist office, the number of dentist office visits, the probability of foregone care due to costs, and the probability of at least one visit to the doctor's office. Adults on Medicaid use less dental care than other adults: they have a lower probability of at least one dentist office visit per year and fewer dentist office visits relative to adults who are not covered by Medicaid. This finding may suggest that adults on Medicaid residing in those states that do not cover dental care go to the dentist office less often because they cannot afford it. To test this hypothesis, I focus on a self-reported measure of foregone care. All adults in the sample are asked whether there was a time in the past year when he or she needed to see a dentist, but did not go. This variable takes on the value of 1 if the adult reports needing – but foregoing – dental care, and 0 otherwise. The probability of foregone care is higher among

[8]The data include a weight for each respondent, corresponding to an estimated number of individuals in the target population that each respondent represents. The basic components for individual weights include a base weight that reflects the probability of selection for a sample unit, an adjustment for sub-sampling within clusters, an adjustment for movers, a nonresponse adjustment to compensate for sample nonresponse, and a post-stratification adjustment to correct for departures from known population totals. Because attrition and nonresponse may be endogenous to participation in Medicaid, I do not use SIPP weights in the main specifications. Including SIPP weight does not change the magnitude or statistical significance for the main coefficients of interest. Results are available upon request.

adults on Medicaid relative to other adults, suggesting that adults on Medicaid tend to face more barriers to care than other adults. To test the plausibility of my results I focus on the effect of Medicaid dental care coverage on the probability of seeing a doctor in the past year. Large effect of Medicaid dental care coverage on this variable could suggest that the use of care among adults on Medicaid changes as state eliminate dental care coverage, thereby complicating the causal interpretation for the effect of Medicaid dental care coverage on the use of care. I do no evidence for large effects of dental care coverage on the probability of seeing a doctor in the past year.

By improving health outcomes, dental care coverage may improve productivity. One measure of productivity is the time lost due to sickness absence as a share of working time. This measure is not available in the data. Each adult in the sample, however, is asked to report the number of days, including days at a hospital, that illness or injury kept him or her in bed more than half of the day. Defined for only employed adults, this measure can be interpreted as the lower bound of absenteeism. Raw number of bed days ranges from 0 to 365. To reduce the effect of outliers, I winsorize the top 1 percent of observations. Winsorized number of bed days ranges from 0 to 150. Average number of bed days among adults in the same is 4.14.[9]

Several state-level time-varying control variables help to account for changes that may affect both Medicaid dental care coverage and the use of care among adults on Medicaid. I control for changes in recessionary pressures by using gross domestic product per capita in each state and year.[10] These data come from the Bureau of Economic Analysis (BEA). To account for changes in the supply of dental care, I control for the number of dentists per 1,000 residents in each year and state. This information is available from the American Dental Association (ADA). Individuals who cannot obtain care in dentist offices may go to

[9] In 1989, average number of bed days among individuals over the age of 15 was 2.94 days. `http://www.cdc.gov/nchs/data/series/sr_10/sr10_176.pdf` provides more statistics on the number of bed days among different populations in the US.

[10] An alternative measure of local recessionary pressures is the unemployment rate. Using this measure of recession does not affect the economic or statistical significance of the main coefficients of interest. Results are available upon request.

community health centers (CHC), so I control for the number of CHC in each state and year. This information comes from the National Association of Community Health Centers.

1.3.2 Empirical Strategy

I identify the causal effect of Medicaid dental care coverage on the use of care by using a difference-in-difference (DID) approach: I compare changes in the outcome between adults on Medicaid in states that change dental care coverage and other adults in the same states, relative to the analogous changes in the outcome in states that do not change Medicaid dental care coverage:

$$Y_{ist} = \alpha_1 Full\ dental_{st} + \alpha_2 Medicaid_{ist} + \alpha_3 Full\ dental_{st} Medicaid_{ist} + \alpha_4 X_{ist} + \varepsilon_{ist}, \quad (1.1)$$

where Y_{ist} is the outcome of interest for adult i who lives in state s in year t, $Full\ dental_{st}$ takes on the value of 1 if adult i lives in a state where Medicaid provides full dental care coverage for at least six months of year t,[11] $Medicaid_{ist}$ takes on the value of 1 if adult i is covered by Medicaid in state s and year t, and X_{ist} is a set of individual characteristics (gender, race, age, marital status, insurance type, and family income), state fixed effects, state-specific yearly time trends, interview month fixed effects, and time-varying state-specific characteristics (gross state product per capita, and the number of active dentists[12]).[13]

[11] Some specifications also include an andicator variable, $Basic\ dental_{st}$, that takes on the value of 1 if adult i lives in state s where Medicaid provides basic dental care coverage for at least six months of year t and an interaction term, $Full\ dental_{st} Medicaid_{ist}$. Basic dental care coverage provides coverage only for urgent dental care (e.g. extractions). If care in dentist offices is mostly preventive, then the effect of basic dental care coverage on the probability of at least one dentist office visit should be minimal.

[12] Increases in Medicaid reimbursement to dentists may increase access to care in dentist offices. Changes in reimbursement over time may bias the estimates. Decker (2011) shows that Medicaid dental payment levels do not change significantly in inflation-adjusted terms between 2000 and 2008 for most states. The exceptions to this trend are Connecticut, Indiana, Montana, New York, and Texas, and the District of Columbia that increase fees by at least 50 percent between 2000 and 2008. As a robustness check, I exclude these states from the analysis. The estimates do not change in either economic or statistical significance. Results are available upon request.

[13] Most identifying variation comes from changes in state policy. Individuals who move across states with and without Medicaid dental care coverage could contribute to this variation. This is very rare: 14.3 percent

I estimate model (1.1) by using Ordinary Least Squares regression (OLS). In order to conduct correct inference in the presence of serial correlation in the error term across individuals within states over time, I compute standard errors clustered at the state level (Wooldridge, 2002). This approach allows for arbitrary correlation within states over time.

Year dummy variables capture differences over time that affect the Medicaid population (e.g. federal regulation). State dummy variables eliminate bias that may occur if time-invariant state characteristics both lead states to provide Medicaid dental care coverage and affect differences in the means of outcomes of interest between the Medicaid and non-Medicaid populations. The use of state dummy variables means that identification of the effect of Medicaid dental care coverage on the use of dental care comes from changes in coverage over time. Time-varying control variables help to account for state-specific time-varying unobserved heterogeneity which may be correlated with changes in coverage. State-specific yearly trends account for the possibility that trends in local economies and health care markets (e.g. Medicaid enrollment) lead states to provide Medicaid dental care coverage and affect differences in the means of outcomes of interest between the Medicaid and non-Medicaid populations.

The parameter α_1 measures the average difference in the outcome between adults in states that provide Medicaid dental care coverage and adults in the states that do not provide Medicaid dental care coverage. Medicaid dental care coverage is defined as coverage of at least some preventive, restorative, and extractive dental care. If states that do not change Medicaid dental care coverage are valid counterfactuals for states that do, then the estimated α_1 should be close to zero and not statistically significant. The coefficient α_2 controls for average differences between adults on Medicaid and the uninsured that are unrelated to Medicaid dental care coverage. α_3 measures the difference in the outcome between adults on Medicaid and other adults in the states that change Medicaid dental care coverage relative to the analogous difference in the states that do not change Medicaid

of the sample move across states, but only a few of them move between a state that provides Medicaid dental care coverage and a state that did not.

dental care coverage.

When the outcome variable is binary, I estimate model (1.1) by using linear probability model (LPM). Over 99 percent of predicted values are between 0 and 1, so LPM model with heteroskedastic standard errors generates marginal effects that are close to probit/ logit (Cameron and Trivedi, 2005; Angrist and Pischke, 2008). This specification has the advantage of not depending on the underlying data generating process (DGP)[14]. Still, as a robustness check, I re-estimate the model using probit.

1.3.3 Identification

The identification assumption of model (1.1) is that, conditional on the included right-hand side variables, there are no unobserved time-varying variables that correlate with the difference in the use of care between adults on Medicaid and other adults. The biggest threat to identification comes from changes in local economies. For instance, a weak economy with high unemployment may both increase Medicaid enrollment and strain state budgets, thereby causing states to eliminate Medicaid dental care coverage. If newly eligible adults have different dental needs than previously eligible adults on Medicaid, then the coefficient of interest may be biased. The direction of this bias is a priori unclear. Suppose that states eliminate Medicaid dental care coverage, when Medicaid enrollment increases, and this increase is correlated with young adults losing employment during the recession. If newly eligible, young adults have better health and less need for dental care, then the effect of Medicaid dental care coverage on the use of care may be underestimated. At the same time, elderly adults and adults with disabilities may be particularly affected by an economic downturn, so that Medicaid enrollment for these two eligibility categories may increase. If these adults have more dental problems compared to the existing pool of Medicaid patients and require more care, then the effect of Medicaid dental care coverage on

[14]If the DGP follows a logistic distribution, then estimators that are based on other models (e.g.probit) are inconsistent. Alternatively, if the DGP follows a normal distribution, then the logit functional form for the parameter of interest is inconsistent.

the use of care may be overestimated.

Time-varying control variables help to capture unobserved heterogeneity in local economies. In addition, to the extent that not all the identifying variation comes from states that eliminate Medicaid dental care coverage during the Great Recession, this problem is mitigated. Still, I test for changes in Medicaid enrollment that may coincide with changes in Medicaid dental care coverage. I exclude from the sample the states that added dental care coverage between 2001 and 2011 and use the following specification:

$$Medicaid_{ist} = \delta_1 Time_t + \delta_2 Full\ dental\ drop_{st} + \delta_3 Full\ dental\ drop_{st} Time_t + \varepsilon_{ist}, \quad (1.2)$$

where $Time_t$ is a linear time trend, and $Full\ dental\ drop_{st}$ takes on the value of 1 if state s eliminates Medicaid dental care coverage between 2001 and 2011. The coefficient δ_2 measures the average difference in the level of the outcome variable between states that eliminate Medicaid dental care coverage and states that do not change it; δ_3 measures whether the outcome variable changes at a different rate in the states that eliminate Medicaid dental care coverage as compared to states that do not change it.

The first column of Appendix Table 1.2 reports the results from model (1.2) for the entire sample of adults. Fewer adults are covered by Medicaid over time: the coefficient on *Time* is small in magnitude and statistically insignificant. There is no evidence for differences in either levels or trends in the probability of Medicaid coverage between the states that eliminate dental care coverage for adults on Medicaid and other states. In the next two columns, I report the results separately for non-elderly non-disabled parents (column 2), disabled adults (column 3), and elderly adults (column 4). Though the number of disabled adults on Medicaid declines over time, there is no evidence for a differential trend in this decline between states that eliminate Medicaid dental care coverage and those that do not change it. These findings support my empirical strategy for using states that do not change

Medicaid dental care coverage as counterfactuals for the states that do, since changes in Medicaid dental care coverage are not significantly related to changes in program participation.

1.3.4 Results

The American Dental Association recommends at least one visit to the dentist office per year, so the first question that I examine is the effect of Medicaid dental care coverage on the probability of the recommended yearly visit to the dentist office (Table 1.3). In the first column, I allow the effects of Medicaid dental care coverage to vary across basic coverage and full coverage. In the second column, I compare the effect of full coverage to basic or no coverage. In the third column, I restrict the sample to adults whose income is below 200 percent of the federal poverty line. This comparison group is more appropriate as a counterfactual for the experience of adults on Medicaid absent the policy change. I then use this sample to estimate model (1) separately for parents (column 4) and disabled adults (column 5).

The coefficient on $Full\ dental$ captures changes over time in dental care use among non-Medicaid adults, when Medicaid dental care coverage changes. The coefficient is not statistically significant in columns 1-5. This finding validates my empirical strategy, as it suggests that changes in Medicaid dental care coverage are not correlated with other changes affecting the use of dental care among adults who are not covered by Medicaid. In the first column, the coefficient on Medicaid dental care coverage is insignificant. This finding indicates that adults on Medicaid obtain similar levels of dental care as other adults, when Medicaid dental care coverage is not provided. The main coefficient of interest, the interaction of Medicaid coverage and dental care coverage, captures the effect of Medicaid dental coverage on the probability of going to the dentist office among adults on Medicaid. The coefficient is positive and statistically significant for the interaction of $Medicaid$ and $Full\ dental$ but not for the interaction of $Medicaid$ and $Basic\ dental$. In columns 2-4 I

therefore compare the effect of Medicaid full dental care coverage to basic or no coverage. In columns 2-4, the coefficient on *Medicaid* is positive and statistically significant, suggesting that even when full Medicaid dental coverage is not provided, adults on Medicaid obtain more dental care than the uninsured. The estimate of 0.091 in column 2 implies that Medicaid dental care coverage increases the probability of going to the dentist by 23 percent (=0.091/0.41). Though not large enough to raise the use of dental care up to the recommended yearly visit to the dentist, this increase implies that over half of adults on Medicaid obtain recommended treatment, when Medicaid dental care coverage is provided. The estimated effect of Medicaid dental care coverage becomes slightly larger, at 9.6 percentage points, when I exclude from the sample adults whose income is above 200 percent of FPL.[15]

The effect of Medicaid dental care coverage may vary by Medicaid eligibility category. On the one side, the effect of dental coverage may be stronger among disabled adults who face more problems with access to care, as compared to healthier non-elderly adults who are parents to children on Medicaid.[16] For example, some medication regimens reduce saliva flow, a natural defense against cavity-causing bacteria. Certain chronic conditions impair the ability to maintain proper nutrition and oral self-care, so disabled adults may have greater need for dental care relative to other adults (GAO, 2000). Alternatively, if dentist offices are not equipped to treat disabled adults, they may not be able to obtain dental care, even if dental coverage is provided. In this case, the effect of Medicaid dental coverage would be stronger among non-elderly adults who are parents to children on Medicaid relative to disabled adults on Medicaid.

[15] As a robustness check, I re-estimate the model by using the probit model. In this model the marginal effect of Medicaid dental care coverage is a function of the covariates: it is largest when the slope of the CDF is largest (predicted probability close to 0.5). The marginal effect of a change in the interaction term is not equal to the marginal effect of changing just the interaction term; the sign may be different for different observations, and statistical significance cannot be determined from the z-statistic reported in the regression output (Norton et al, 2004). I compute the true marginal effect by taking taking the cross derivative of the expected value of the dependent variable. The resulting estimates are similar in magnitude to LPM estimates (Appendix Table 1.3).

[16] About 20 percent of disabled adults on Medicaid report foregoing needed care; only 16 percent of parents to children on Medicaid report foregoing needed dental care.

I report the results separately for non-disabled non-elderly adults ('parents') (column 4 of Table 1.3), and disabled adults (column 5 of Table 1.3). Medicaid dental care coverage causes larger increase in the probability of at least one dentist office visit per year among disabled adults relative to parents in low-income families with dependent children. Though this difference is not statistically significant (p-value: 0.18), this finding is consistent with disabled adults experiencing greater need for dental care, and dental offices accommodating adults with special needs.

An alternative measure of utilization is the number of visits to the dentist per year. Basic Medicaid dental care coverage has at most small effect on the number of dentist office visits among adults on Medicaid: the coefficient on the interaction term between *Medicaid* and *Basic dental* is small in value and insignificant (column 1 of Table 1.4).[17] In contrast, full Medicaid dental care coverage increases the number of visits to the dentist by 0.22 (mean=0.90). The increase is similar in column 2, when I compare the effect of full Medicaid dental care coverage to basic or no coverage. These findings suggest that, in addition to allowing more adults on Medicaid to obtain dental care, Medicaid dental care coverage enables them to obtain care more often. The estimated effect of Medicaid dental coverage on the number of dental visits increases slightly to 23.7 percentage points, when only adults below 200 percent of FPL are included in the sample. As before, the increase in the number of visits is larger among disabled adults (column 5) relative to parents of children on Medicaid (column 4), but the difference is not statistically significant (p-value=0.51).

The results presented so far indicate that Medicaid dental care coverage increases the use of care in dentist offices. One mechanism for this effect is the reduction in the effective price of care. I provide more direct evidence for this mechanism by focusing on a measure of foregone care due to financial reasons. Table 1.5 reports the results. In the preferred

[17]The outcome variable consists of a large number of zero values and non-negative integers ranging from 1 to 8. Modeling such data with a continuous distribution could lead to inconsistent parameter estimates. I therefore use negative binomial distribution that yields consistent estimates in the presence of over-dispersion (Wooldridge, 1999). Results remain unchanged, so I do not provide them here.

specification in column 3, Medicaid dental care coverage causes a statistically significant reduction in the probability of reporting unmet need for dental care of 6.3 percentage points or 35 percent relative to the mean of 0.18. This finding confirms that the reduction in the effective price of care drives the effect of Medicaid dental care coverage on the use of care.

1.3.5 Sensitivity Checks

As a robustness check, I examine the effect of Medicaid dental care coverage on the probability of at least one visit to the doctor's office. Large effects of Medicaid dental care coverage on this outcome may complicate the causal interpretation of my results in Tables 1.3- 1.5, as they suggest that changes in local economy or health care markets drive both changes in Medicaid dental care coverage and changes in utilization of dental care. Appendix Table 1.4 reports the results. The coefficient on $Full\ dental$ is small and statistically insignificant, suggesting that changes in Medicaid dental care coverage are not correlated with other changes affecting the use of dental care among non-Medicaid beneficiaries. The coefficient on $Medicaid$ is positive, indicating that Medicaid beneficiaries are more likely to go to the doctor's office at least once a year relative to uninsured adults. The coefficient of interest, the interaction between $Medicaid\ Full\ dental$ is small and statistically insignificant. It is positive, suggesting that Medicaid dental care coverage may lead to small increases in the use of medical care, perhaps because dentists remind their patients to obtain yearly medical check-ups.

Model (1.1) assumes that the effect of Medicaid dental care coverage on the use of care is constant over time. Adults may not react to changes in coverage immediately, so its effect on the use of care may not become apparent until a few years after the policy change. A number of states eliminated Medicaid dental care coverage at the time that is not covered by the SIPP data (Figure 1.2 and Table 1.2), so I am not able to obtain a precise estimate for the effect of Medicaid dental care coverage in the first years of its implementation. Still, I test for dynamic effects of Medicaid dental care coverage by eliminating from the sample

the year of implementation and re-estimating model (1.1). If Medicaid dental care coverage has larger effects in the medium run than in the short run, then the newly estimated coefficient on the interaction term between $Medicaid$ and $Full\ dental$ should be smaller in magnitude than that from Table 1.3. Consistent with this hypothesis, the estimated coefficient increases to 0.10 (column 1 of Appendix Table 1.5). I further restrict the sample to individuals in years for which their state of residence either added or did not change Medicaid dental care coverage (column 2), and allow the effect of Medicaid dental care coverage to vary in the first three years after the policy change (column 3). The estimated effect of Medicaid dental care coverage increases significantly in the third year after the introduction of Medicaid dental coverage. These findings suggest that it takes a few years for adults to learn about dental care coverage; after this adjustment period, more adults go to dentist offices on a yearly basis.

1.4 Offset Effect of Medicaid Dental Care Coverage

Results so far indicate that, by reducing the effective price of care, Medicaid dental care coverage increases the use of care in dentist offices. Adults on Medicaid always have access to basic dental care in hospital emergency departments. If preventive care and urgent care are substitutes, then greater use of care in dentist offices may lower the use of care in hospital emergency departments. I estimate this offset effect by focusing on California that eliminated dental care coverage for adults on Medicaid on July 1, 2009.

1.4.1 Data and Descriptive Statistics

I estimate the offset effect of Medicaid dental care coverage by using discharge data for all patients in hospital emergency departments in California between 2005 and 2011 from the Healthcare Cost and Utilization Project (HCUP) State Emergency Department Databases (SEDD). For each ED patient, I observe basic demographics (gender, age, race), primary diagnosis, 20 other diagnoses, and primary payer (Medicare, Medicaid, private, or

uninsured)[18]. The sample is based on over 30 million ED visits for adults above the age of 21.

Few adults go to hospital ED to treat dental disease: only 1.37 percent of ED patients have dental disease as the primary diagnosis (Table 1.6). Dental disease is any disease of oral cavity, salivary glands, and jaws, as defined by the International Classification of Diseases (ICD-9) (Appendix Table 1.6). Most adults could avoid an ED visit for dental care if they had gone to the dentist office: 1.11 percent of ED patients have preventable dental disease as the primary diagnosis. Preventable dental disease is dental disease that could have been prevented at an earlier time. Appendix Table 1.7 provides a list of preventable dental diseases. Some dental disease may not be identified correctly, since hospital emergency departments do not commonly employ dentists. I address this problem by using a broader definition of dental disease that includes dental disease, as well as cellulitis (infection) and abscess (inflammation) of the face that could originate from dental disease; 1.93 percent of ED patients have this type of disease as primary diagnosis. Appendix Table 1.8 provides detailed comparisons between HCUP SEDD and other sources.

The main outcome of interest is the number of ED visits for dental disease per population. I construct this outcome by collapsing hospital discharge data to the level of insurance type, county, and month, and dividing the number of ED visits for dental disease by county population (in 1,000's). There is no discontinuity in the outcome around the time of the policy change (Figure 1.3). This observation provides descriptive evidence that Medicaid dental care coverage is not associated with changes in the number of ED visits for dental disease per population.

County-level time-varying control variables help to account for changes that may affect both Medicaid dental care coverage and the use of care among adults on Medicaid. I control for changes in recessionary pressures by using unemployment rate in each county

[18]Medicare includes both fee-for-service and managed care Medicare patients. Medicaid includes both fee-for-service and managed care Medicaid patients. Private insurance includes Blue Cross, commercial carriers, and private HMOs and PPOs. There is no information on secondary payer.

and month, as well as employment rate in 14 largest 2-digit NAICS industries. These data come from the Bureau of Labor Statistics (BLS). Because dental health depends on the availability of dentists, I control for the number of dentists per 1,000 residents in each year and state using information from the American Dental Association (ADA). Individuals who cannot obtain care in dentist offices may go to community health centers (CHC), so I control for the number of CHC in each state and year. This information comes from the National Association of Community Health Centers. Estimates for California population by year, county, age, race, and sex come from the California Department of Finance. The number of Medicaid beneficiaries by county, year, and age comes from the California Department of Health Care Services. The number of uninsured adults in each county and year comes from the U.S. Census Small Area Health Insurance Estimates (SAHIE).

1.4.2 Empirical Strategy

Ideally, I would observe whether each adult in California goes to the ED for dental disease. These data are not available, so my strategy is to compare the number of ED visits for dental disease per county population between adults on Medicaid and other adults. Simple comparisons of the change in the outcome between adults on Medicaid and other adults may mask differential trends in the use of care across the two populations. I therefore adopt an event-study model:

$$Y_{hct} = \gamma_1 \sum_{j=1}^{84} M_j + \gamma_2 \sum_{j=1}^{84} Medicaid_{hct} M_j + \gamma_3 X_{hct} + \varepsilon_{hct}, \tag{1.3}$$

where each M_j=1 in the j^{th} month to/from eliminating Medicaid dental care coverage (the omitted month is the month of implementation, $j = 55$), and $Medicaid_{hct}$=1 for adults who are covered by Medicaid. X_{hct} includes county fixed effects, and time-varying county characteristics: number of dentists per 1,000 county resident, number of community health clinics per 1,000 county resident, fraction of population by race (black, American Indian, Asian, Pacific Indian, Hispanic, multi-race), fraction of female population, and fraction of

employment in 14 major 2-digit NAICS industries, and unemployment rate.

Time-varying control variables help to account for county-specific shocks that may drive ED use for dental care. For example, greater number of dentists per capita may allow adults to obtain dental care outside of the ED; job loss may cause individuals to lose their dental insurance, thereby increasing their reliance on ED care for dental disease. The coefficients γ_1's represent the time path for dental care use relative to the month of the policy change, and γ_2's capture the difference in the outcome between adults on Medicaid and other adults in each month relative to the month of the policy change. If eliminating Medicaid dental care coverage induces greater reliance on dental care in the ED, then γ_2 should become positive and statistically after June 2009.

In an alternative specification, I re-estimate the effect of Medicaid dental care coverage in California on the outcome of interest by using a DID model. I regress the outcome on the indicator for Medicaid coverage, $Medicaid$, indicator for the period when no Medicaid dental care coverage is provided, $PostJune'09$, the interaction between the $PostJune'09$ and $Medicaid$, and a full set of control variables (county fixed effects, indicator variables for each month, and time-varying county characteristics: number of dentists per 1,000 county resident, number of community health clinics per 1,000 county resident, fraction of population by race (black, American Indian, Asian, Pacific Indian, Hispanic, multi-race), fraction of female population, and fraction of employment in 14 major 2-digit NAICS industries, and unemployment rate).

The standard DID framework assumes no differential trend between adults on Medicaid and other adults in the pre-event period. I test this parallel trend assumption by restricting the sample to the period before July 2009 and regressing the outcome on the indicator for Medicaid coverage, month-year time trend, Medicaid-specific month-year time trend, and a full set of control variables. The coefficient on Medicaid-specific time trend is positive in magnitude and weakly statistically significant (p-value=0.057), suggesting that adults on Medicaid use more dental care in ED over time relative to other adults. In the preferred

specification that restricts the sample to 2008-2011, however, there is no evidence that the outcome grows at a different rate between adults on Medicaid and other adults (p-value=0.639). This observation validates my empirical strategy of measuring the impact of Medicaid dental care coverage by comparing the difference in the use of care among adults on Medicaid before and after the policy change to the analogous difference in the outcome among non-Medicaid adults.

1.4.3 Results

Figure 1.4 plots the estimated γ_2 coefficients from model (1.3) that capture the difference in the outcome between adults on Medicaid and other adults relative to the month of the policy change. Dashed lined represent 95 percent confidence intervals for each coefficient. The outcome is the number of ED visits for preventable dental disease per 1,000 county residents. There is no evidence for differential trends in the outcome between adults on Medicaid and other adults (p-value: 0.80). This finding validates my use of non-Medicaid adults as a control group for adults on Medicaid, as it suggests that both groups experienced similar trends in the use of ED care prior to the policy change. I fail to reject that adults on Medicaid used similar levels of ED care for dental disease before and after the policy change (p-value: 0.87). This finding suggests that Medicaid dental care coverage does not increase the probability of going to the ED for dental care.

The event-study framework measures the effect of Medicaid dental care coverage relative to the period of the policy change. As an alternative, I estimate its effect by using a DID model. Column 1 of Table 1.8 reports the estimates without controlling for time-varying and time-invariant county characteristics, column 2 restricts the sample to 2008-2011, and column 3 adds full control variables to the restricted sample. After controlling for time-invariant differences across counties and time-varying changes in local economies and health care markets, the coefficient on *PostJune'*09 is not significant. Consistent with the causal interpretation of the results, this finding suggests that Medicaid dental care cov-

erage has no effect on the outcome for adults who are not covered by Medicaid. Even when Medicaid does not cover dental care, adults on Medicaid go to the ED for dental care more often than other adults: the coefficient on *Medicaid* is positive and statistically significant, perhaps because Medicaid beneficiaries always have access to basic dental care for the relief of pain, infection or trauma. The coefficient on the interaction of *PostJune'09* and *Medicaid* is small in value and statistically insignificant, indicating that Medicaid dental care coverage does not a have large effect on the use of dental care in hospital ED. The largest offset effect that I cannot reject with 95 percent confidence is a 0.16 percentage point increase in the number of ED visits for dental disease per 1,000 county residents.

Comparing the use of care between adults on Medicaid and other adults could be problematic, if people lose private insurance coverage over time. Elderly adults on Medicaid are similar to Medicare beneficiaries, while parents of children on Medicaid are similar to non-elderly uninsured adults. To establish more adequate comparisons, I estimate the offset effects of Medicaid dental care coverage separately for each category of adults. Column 1 of Appendix Table 1.9 restricts the sample to adults above 65 years of age who are covered either by Medicaid or Medicare. In this specification, elderly adults on Medicaid are compared to elderly adults on Medicare who are not dual eligibles. In column 2, I restrict the sample to non-elderly adults who are either uninsured or covered by Medicaid. In column 3, I compare non-elderly adults on Medicaid to children on Medicaid who are unaffected by the policy change. Across the three specifications, there is no evidence that Medicaid dental care coverage affects the number of ED visits for dental disease among the control groups: the estimated coefficients on *PostJune'09* are small in magnitude and statistically insignificant. Similar to the results from Table 1.8, the coefficient of interest, the interaction between *PostJune'09* and *Medicaid*, is small and statistically insignificant. These findings provide additional evidence that offset effects of Medicaid dental care coverage are at most small.

Prior studies estimate offset effects of Medicaid dental care coverage by comparing

the probability of dental disease among hospital ED patients before and after the policy change. This approach does not account for changes in the composition of the Medicaid program that could lead to spurious relationship between Medicaid dental care coverage and the probability of dental disease among ED patients on Medicaid. For example, states may eliminate Medicaid dental care coverage during periods of recession. If healthier adults become eligible for Medicaid during economic downturns, then average probability of ED visit could decrease for adults on Medicaid relative to non-Medicaid adults. The same change in the composition of the Medicaid program could lead to an increase in the probability of dental disease among ED patients on Medicaid relative to non-Medicaid ED patients. As a result of these two offsetting effects, the probability of ED dental disease could remain unchanged.

To investigate whether differences in data or methodology drive differences between my results and Wallace et al (2011) and Cohen et al (2002), I estimate a DID model for the probability of dental disease among ED patients (Table 1.9).[19] To make the results comparable to prior studies, I use as the unit of observation individual and month. The coefficient on $Full\ dental$ is not significant, suggesting that Medicaid dental care coverage does not affect the probability of dental disease among non-Medicaid ED patients. The coefficient on $Medicaid$ is positive and statistically significant, indicating that ED patients on Medicaid are more likely to be diagnosed with dental disease than other patients. The main coefficient of interest of -0.3 percentage points implies that Medicaid dental care coverage lowers the probability of dental disease in ED among adults on Medicaid from 0.020 to 0.017. This small reduction in the outcome is similar to estimates from Oregon (Wallace et al, 2012) and Maryland (Cohen et al, 2002). In summary, my results are similar to the previous studies, when I use the same methodology, suggesting that changes in program participation, local economy, or health care markets may lead to a spurious association

[19]The outcome variable is binary with large number of zero values, so linear probability model may not be appropriate. Re-estimating it with probit and computing marginal effect of the interaction terms using the the approach from Norton et al (2004) yields similar results (Appendix Table 1.10).

between Medicaid dental care coverage and ED use for dental disease.

1.5 Effect of Medicaid Dental Care Coverage on the Number of Bed Days

Prior studies suggest that adults in the US missed more than 20 million workhours due to dental disease (GAO, 2000). This estimate is based on data from the National Health Interview Survey (1989) that includes questions about the number of bed days[20] and the number of work-loss days[21] for specific diseases among adults in the US. Average number of bed days in 1989 was 3.44 (UDHHS, 1990). This is significantly lower than the average number of bed days in the 2001-2013 SIPP data of 13.86. Average number of work-loss days of 3.37 per person in the NHIS data in 1989, however, is comparable to the average number of bed days of 3.26 among adults in the SIPP data. The number of bed days for dental disease is low in the NHIS data, at 0.018 days per employed adult. Unmet need for dental care grew from 11 percent to 17 percent between 1997 and 2009 (NCHS, 2011). Assuming that the number of work loss due to dental problems reflects unmet need for dental care, an average adult in the US in 2009 loses about 0.044 days due to dental disease.

I cannot measure work-loss days directly, but I can observe the number of bed days among employed adults in the sample. Table 1.10 reports the results. Column 1 reports the results for the full sample of adults, column 2 restricts the sample to only adults with income below 200 percent of the FPL. Column 3 further restricts the sample to employed adults for whom the number of bed days may provide a lower bound for the number of sick days at work. Across all three columns, the coefficient on $Full\ dental$ is insignificant, suggesting that changes in Medicaid dental care coverage are not correlated with other changes affecting the number of bed days taken by adults who are not covered by Medicaid.

[20] Both NHIS and SIPP define a bed day as a day during which a person stayed in bed more than half a day because of illness or injury.

[21] A work-loss days is one on which a currently employed person 18 years of age and over missed more than half a day from a job or business.

The coefficient on *Medicaid* is positive and statistically significant, indicating that adults on Medicaid take more bed days relative to adults who are not covered by Medicaid. Medicaid dental care coverage reduces the number of bed days by 1.751, when all adults are used for comparison.[22] Poor adults who are not on Medicaid provide a better counterfactual for the experience of adults on Medicaid than other adults in the US. When the sample is restricted to poor adults, the estimate declines to 1.406 days or 9.7 percent relative to the mean of 14.44 (column 2). It further declines to 0.281, when I create an even more homogenous sample of only parents to children on Medicaid and parents to children who are not on Medicaid (column 3).

One aspect of the value of better health is improved productivity and earnings through reductions in absenteeism. A reduction in the number of bed days among employed adults is one measure of absenteeism. In the preferred specification in column 6, Medicaid dental care coverage reduces the number of bed days among employed adults on Medicaid by 0.131 or 4 percent relative to the mean of 3.24. Large confidence interval around this estimate, however, implies that the effect of Medicaid dental care coverage on the number of bed days among employed adults on Medicaid may vary between a reduction of 0.566(=-0.131-(1.96*0.222)) and an increase of 0.304(=-0.131+(1.96*0.222)).

Any effect on bed days comes from adults whose use of dental care is reduced when Medicaid dental care coverage is eliminated. A 9 percentage point increase in the probability of at least one dentist visit in a year due to Medicaid dental care coverage (Table 1.3)[23] implies that the average reduction in bed days of 0.131 is equivalent to a reduction of 1.42 bed days among employed adults on Medicaid who increased their use of dental care.

[22]The outcome variable consists of a large number of zero values and non-negative integers ranging from 1 to 30. Modeling such data with a continuous distribution could lead to inconsistent parameter estimates. I therefore use negative binomial distribution that yields consistent estimates in the presence of over-dispersion (Wooldridge, 1999). Results remain unchanged, so I do not provide them here.

[23]Medicaid dental care coverage increases the probability of at least one dental visit by 9.22 percentage points points among employed adults on Medicaid relative to poor adults who are not on Medicaid. Results are not reported here.

1.6 Conclusion

This paper examines the effect of Medicaid dental care coverage on the use of care and costs. By reducing the effective price of care, Medicaid dental care coverage leads to a substantial increase in the probability of a recommended yearly visit to dentist offices. I find no offset effect of Medicaid dental care coverage related to ED visits. Differences in methodology – rather than data – drive observed differences between my results and previous estimates of offset effect of Medicaid dental care coverage. I document substantial changes in the number of bed days in response to changes in Medicaid dental care coverage. This finding suggests the need to account for changes in health and productivity in order to estimate broader impacts of insurance.

Dental care is not included in the Affordable Care Act as an 'essential benefit' that must be covered by health plans participating in health insurance exchanges. Increased enrollment in Medicaid will create additional fiscal pressure for those states that currently cover dental care for adults on Medicaid. My findings indicate that, on the one hand, states can substantially reduce short-term Medicaid costs by eliminating dental care coverage, as offset effects through increased ED visits are minimal. On the other hand, based on the results on the number of bed days, this elimination would be expected to have important effects on productivity and health.

Estimating the value of prevention has broader implications for the health care reform. The results of this paper suggest that access to preventive care due to the Affordable Care Act will not reduce the use of emergency care. As a result, medical costs will increase. Changes in insurance coverage will have implications for businesses and local economies. For example, reduced absenteeism among working adults will raise firm productivity and increase government budgets through higher tax revenue.

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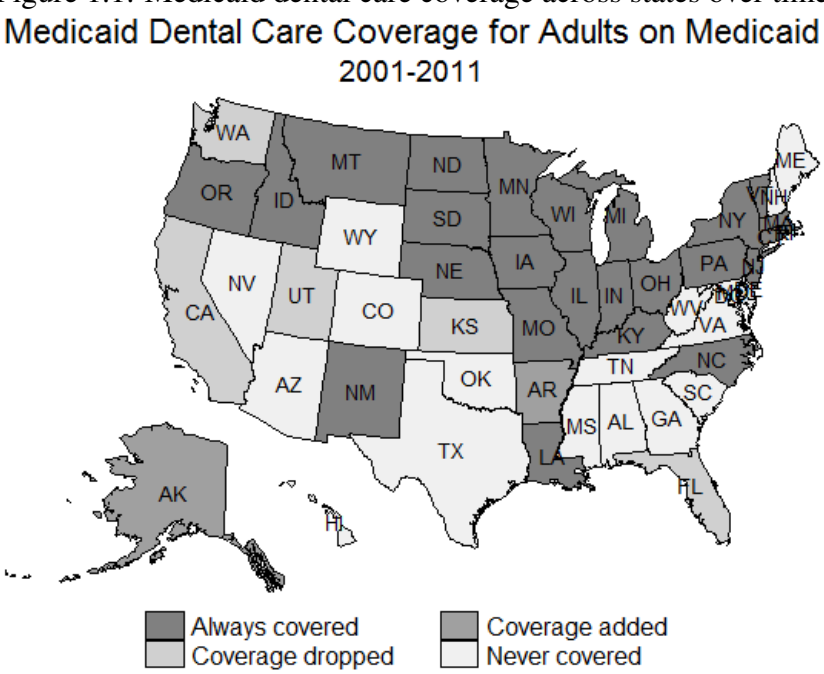
Figures and Tables

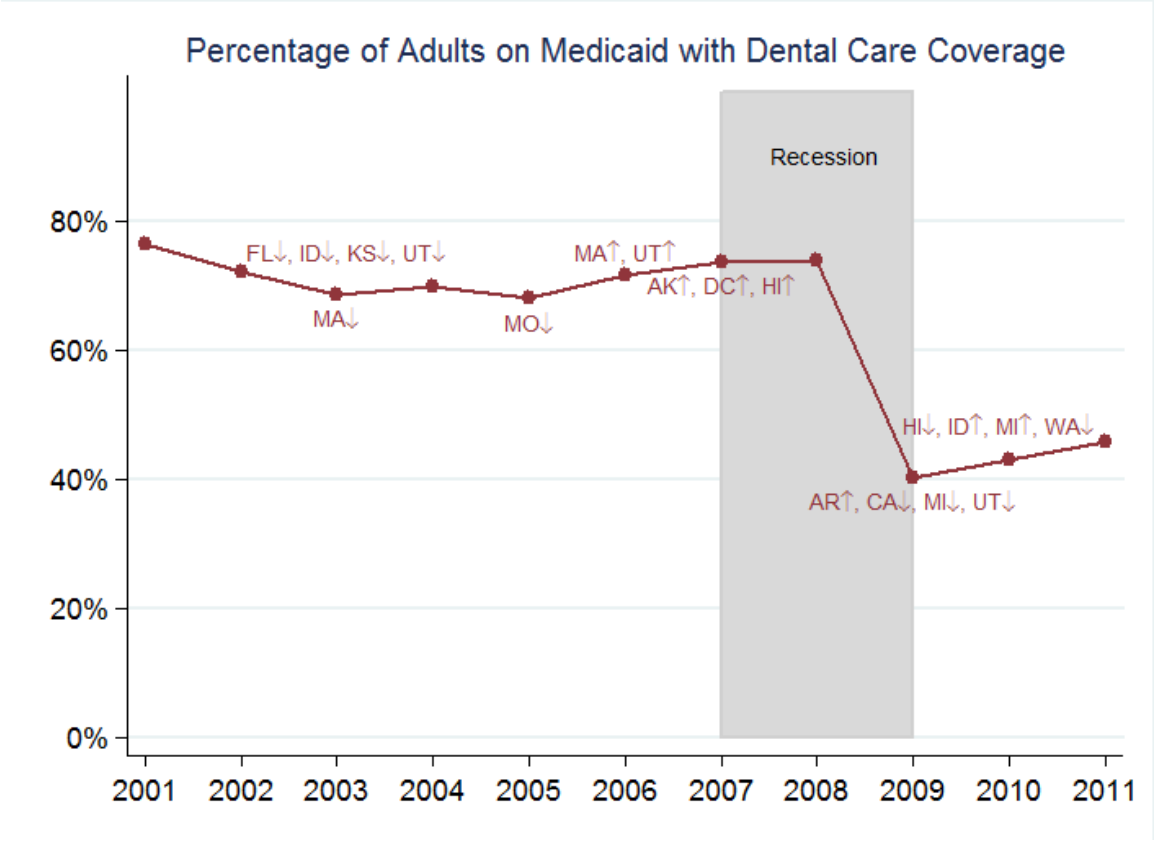
Figure 1.1: Medicaid dental care coverage across states over time



Note: HI, ID, MA, MI, and UT both add and drop coverage between 2001-2011.

Coverage refers to full dental care coverage for adults on Medicaid. Adults are defined as individuals over 21 years of age. Information provided in this chart concerns the main Medicaid program, and does not address dental care coverage in Medicaid participating nursing facilities, intermediate care facilities, pregnancy-related services programs for adults, or other Medicaid program components.
Sources: American Dental Association, GAO survey of state Medicaid and SCHIP agencies from Jan. 2000, and various press releases

Figure 1.2: Percentage of adults on Medicaid with dental care coverage over time



Percentage of adults on Medicaid with dental care coverage is constructed by dividing the number of Medicaid beneficiaries with dental care coverage in a given year by the number of Medicaid beneficiaries in that year. Adults are defined as individuals over 21 years of age. Dental care coverage is defined as 1 if the state provides 'full coverage:' covers some diagnostic, preventive and restorative treatment; it takes on the value of 0 is the state provides no coverage or covers only basic dental care for the relief of pain, infection, or trauma. Sources: American Dental Association (ADA), various press releases, and Center for Medicare and Medicaid Services (CMS)

Figure 1.3: Offset effects for Medicaid dental care coverage: evidence from California

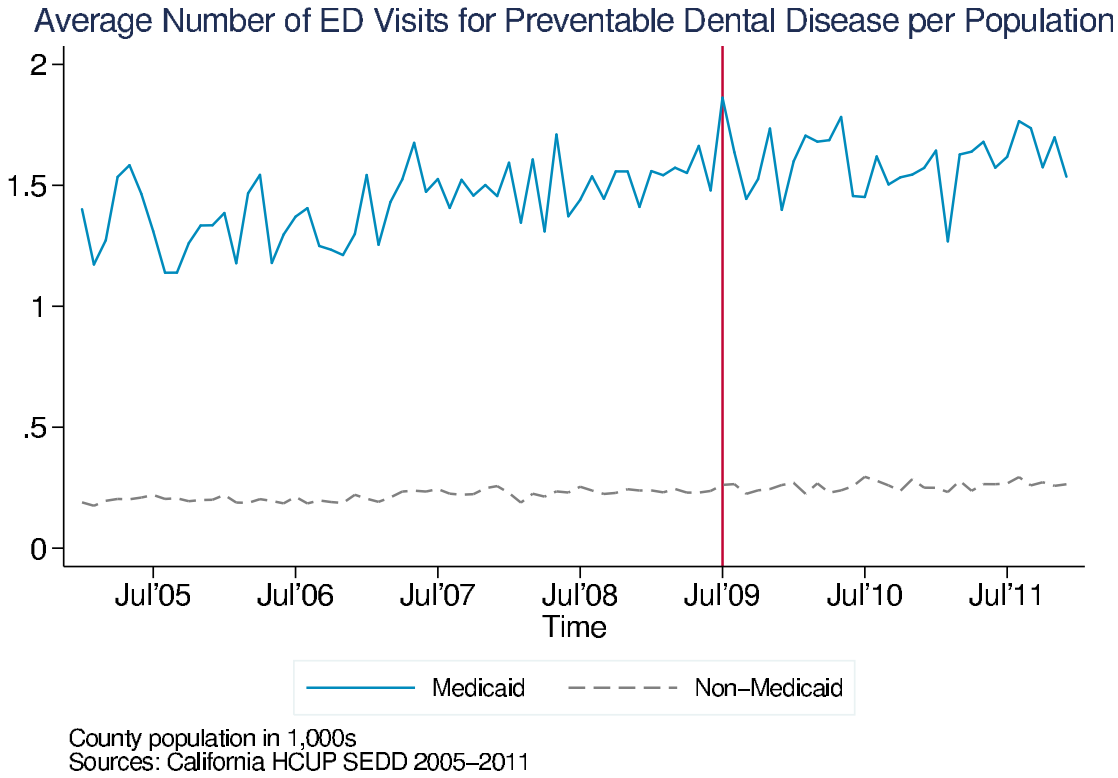
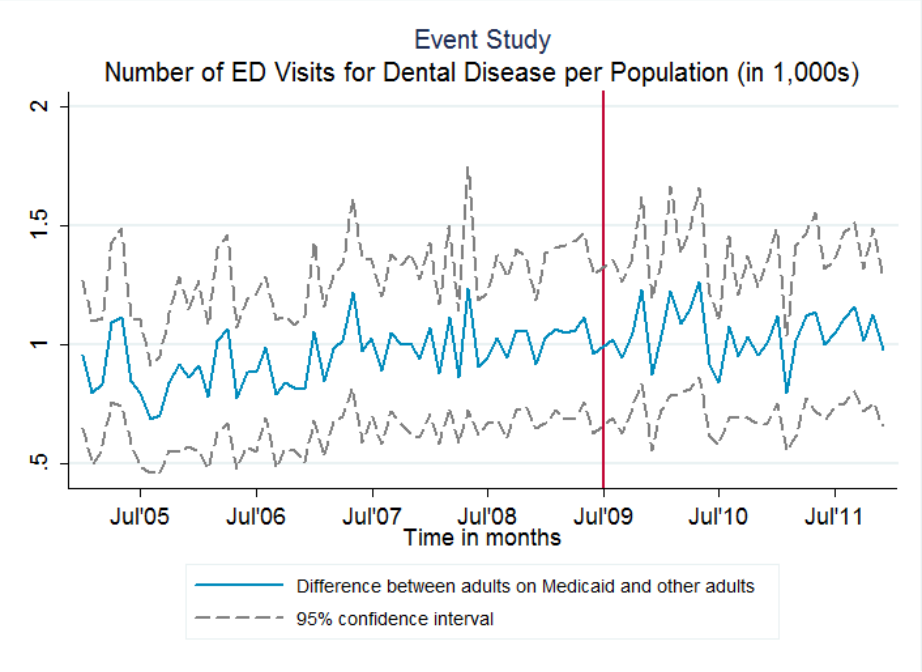


Figure plots the number of ED visits for preventable dental disease per population (in 1,000's).

Figure 1.4: The effect of Medicaid dental care coverage in California on the number of ED visits for dental disease



I estimate an event study model by collapsing ED discharge data to the level of county, month, and insurance category (Medicaid vs. non-Medicaid). The resulting sample has 9,235 observations from 55 counties in California. I use as outcome the number of ED visits for dental disease in each insurance category per county population (in 1,000's). I construct a variable that measures time difference in month to the policy change. This 'event time' ranges from -54 to 29. I estimate the event study model by regressing the outcome on the event time indicator variables, interactions between Medicaid coverage and each event time, county fixed effects, and time-varying county characteristics: number of dentists per 1,000 county resident, number of community health clinics per 1,000 county resident, fraction of population by race (black, American Indian, Asian, Pacific Indian, Hispanic, multi-race), fraction of female population, fraction of employment in 14 major 2-digit NAICS industries, and unemployment rate.

Table 1.1: Medicaid dental care coverage across states over time

	Coverage type										
State name	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Alaska	B	B	B	B	B	**B**	**F**	F	F	**F**	**F**
Arizona	B	B	B	B	B	B	B	**B**	**0**	0	0
Arkansas	0	0	0	0	0	0	0	**0**	**F**	F	F
California	F	F	F	F	F	F	F	**F**	**0**	0	0
District of Columbia	0	0	0	0	0	**0**	**F**	F	F	F	F
Florida	**F**	**B**	B	B	B	B	B	B	B	B	B
Hawaii	B	B	B	B	B	**B**	**F**	F	F	**F**	**B**
Idaho	**F**	**B**	B	B	B	B	B	B	B	**B**	**F**
Indiana	F	**F**	**F**	F	F	F	F	F	F	F	F
Kansas	**F**	**B**	B	B	B	B	B	B	B	B	B
Massachusetts	**F**	**F**	**B**	B	**B**	**F**	F	F	F	F	F
Michigan	F	F	**F**	**F**	**F**	**F**	F	**F**	**B**	**B**	**F**
Minnesota	F	**F**	**F**	F	F	F	F	F	F	F	F
Missouri	F	F	F	**F**	**0**	0	0	0	0	0	0
New Mexico	F	F	**F**	**F**	F	F	F	F	F	F	F
Oklahoma	B	B	**0**	**B**	B	B	B	B	B	B	B
South Dakota	**F**	**F**	F	F	F	F	F	F	F	F	F
Utah	**F**	**B**	B	B	**B**	**F**	F	F	**0**	**0**	**0**
Washington	F	**F**	**F**	F	F	**F**	**F**	F	F	**F**	**0**
0											

Years before and after the change in Medicaid dental care coverage are in **bold**. 0 refers to no Medicaid dental care coverage for adults on Medicaid. States that never provide dental care coverage are Alabama, Colorado, Delaware, Texas, and Virginia. *B* refers to basic dental care coverage for urgent services for the relief of pain, infection or trauma. States that always provide basic dental care coverage are Georgia, Maine, Maryland, Mississippi, Nevada, New Hampshire, South Carolina, Tennessee, and Wyoming. *F* refers to full dental care coverage that includes coverage of at least some preventive services, diagnostic, and restorative services. States that always provide full dental care coverage for adults on Medicaid are Illinois, Indiana, Iowa, Kentucky, Louisiana, Montana, Nebraska, North Carolina, Ohio, Oregon, Rhode Island, Vermont, Connecticut, New Jersey, New Mexico, New York, North Dakota, Pennsylvania, and Wisconsin. Each type of dental care coverage reflects coverage in that state and year for at least six months. Adults are defined as individuals over 21 years of age. Information provided in this chart concerns the main Medicaid program, and does not address dental care coverage in Medicaid participating nursing facilities, intermediate care facilities, pregnancy-related services programs for adults, or other Medicaid program components.
releases

Table 1.2: Key covariates and outcomes from SIPP

	Non-Medicaid	Adults on Medicaid	
	Adults	Parents	Other
Employed	68.40%	59.70%	18.24%
Private coverage	78.14%		
Medicare coverage	20.42%	1.09%	45.43%
Family income	$65,486	$30,228	$26,807
Below poverty line[1]	9.02%	45.47%	36.70%
$\geq$1 visit to the dentist[2]	61.11%	46.12%	39.15%
Number of dentist office visits[2]	1.32	0.92	0.89
Did not see a dentist when needed[3]	8.56%	15.96%	16.01%
Number of bed days[2]	3.81	3.47	17.93
Share of adults w/ $\geq$1 bed days[2]	0.58	0.61	0.69
Number of visits to the doctor[2]	0.78	0.77	0.89
Did not see a doctor when needed[3]	0.07	0.10	0.12
Number of children's dentist visits[2]	0.64	0.58	0.61

[1]Below poverty=1 for all adults whose family income is below the poverty threshold for this family. [2]This variable comes from Medical Expenses and Utilization Module, so it is defined for 66% of 627,984 adults in the sample. [3]This variable comes from Adult Well-Being module, so it is defined for 34% of 627,984 adults in the sample. The sample includes only adults above the age of 21. Unit of observation is individual and year.

Table 1.3: Effect of Medicaid dental care coverage on the probability of at least one dentist office visit

	Prob of dentist office visit				
	(1)	(2)	(3)	(4)	(5)
Full dental	-0.010	-0.005	-0.010	-0.005	-0.000
	(0.013)	(0.007)	(0.007)	(0.010)	(0.014)
Medicaid	0.017	0.025***	0.028***	0.065***	0.020*
	(0.014)	(0.008)	(0.008)	(0.010)	(0.011)
Medicaid*Full dental	0.099***	0.091***	0.096***	0.090***	0.111***
	(0.016)	(0.013)	(0.011)	(0.014)	(0.016)
Basic dental	-0.007				
	(0.012)				
Medicaid*Basic dental	0.015				
	(0.016)				
N	451,563	451,563	142,733	86,312	28,513
R^2	0.146	0.146	0.094	0.118	0.067
Mean of dep. Var., Medicaid	0.41	0.41	0.39	0.44	0.37
Restriction	Full sample	Full sample	$\leq$2*FPL	Parents, $\leq$2*FPL	Disabled, $\leq$2*FPL

The table reports coefficient estimates from linear probability models for the probability of at least one dentist office visit.
In the first column, I allow the effects of Medicaid dental care coverage to vary between basic coverage, $Basic\ dental = 1$, and full coverage, $Full\ dental = 1$. In the second column, I compare the effect of full coverage to basic or no coverage. I report the results separately for non-disabled non-elderly adults ('parents') (column 3), and disabled adults (column 4).
Each model includes year, interview month, state fixed effects, state-specific time-trends, and control variables for gender, race, age, private health insurance, Medicare coverage, family income, GSP per capita, fraction of state population with access to fluoridated water, and number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. The unit of observation is individual and year.

Table 1.4: Effect of Medicaid dental care coverage on the number of dentist office visits per year

	Num of dentist office visits				
	(1)	(2)	(3)	(4)	(5)
Full dental	-0.021	0.007	-0.022	0.000	0.015
	(0.038)	(0.021)	(0.034)	(0.045)	(0.064)
Medicaid	0.071**	0.086***	0.092***	0.137***	0.058*
	(0.031)	(0.018)	(0.020)	(0.024)	(0.029)
Medicaid*Full dental	0.224***	0.208***	0.237***	0.220***	0.286***
	(0.038)	(0.029)	(0.029)	(0.037)	(0.041)
Basic dental	-0.042				
	(0.042)				
Medicaid*Basic dental	0.029				
	(0.033)				
N	451,563	451,563	142,733	86,312	28,513
R^2	0.088	0.088	0.061	0.080	0.050
Mean of dep. Var., Medicaid	0.90	0.90	0.84	0.89	0.87
Restriction	Full sample	Full sample	$\leq$2*FPL	Parents, $\leq$2*FPL	Disabled, $\leq$2*FPL

The table reports coefficient estimates for the effect of Medicaid dental care coverage on the number of dentist office visits per year estimated using ordinary least squares.
In the first column, I allow the effects of Medicaid dental care coverage to vary between basic coverage, $Basic\ dental = 1$, and full coverage, $Full\ dental = 1$. In the second column, I compare the effect of full coverage to basic or no coverage. I report the results separately for non-disabled non-elderly adults ('parents') (column 3), and disabled adults (column 4).
Each regression includes year, interview month, state fixed effects, state-specific time-trends, and control variables for gender, race, age, private health insurance, Medicare coverage, family income, GSP per capita, fraction of state population with access to fluoridated water, and number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. The unit of observation is individual and year.

Table 1.5: Effect of Medicaid dental care coverage on the probability of foregoing dental care due to costs

	Prob of foregoing care				
	(1)	(2)	(3)	(4)	(5)
Full dental	0.005	-0.005	0.001	-0.023	0.022
	(0.005)	(0.008)	(0.025)	(0.025)	(0.035)
Medicaid	0.014	0.015	0.017	0.009	-0.036*
	(0.008)	(0.010)	(0.011)	(0.016)	(0.020)
Medicaid*Full dental	-0.061***	-0.062***	-0.063***	-0.060***	-0.061***
	(0.013)	(0.014)	(0.013)	(0.018)	(0.021)
Basic dental	0.017				
	(0.013)				
Medicaid*Basic dental	0.002				
	(0.020)				
N	165,752	165,752	54,804	33,603	10,794
R^2	0.059	0.059	0.050	0.040	0.054
Mean of dep. Var., Medicaid	0.16	0.16	0.18	0.18	0.21
Restriction	Full sample	Full sample	$\leq$2*FPL	Parents, $\leq$2*FPL	Disabled, $\leq$2*FPL

The table reports coefficient estimates from a linear probability model for the probability of foregoing dental care due to costs.
Each regression includes year, interview month, state fixed effects, state-specific time-trends, and control variables for gender, race, age, private health insurance, Medicare coverage, family income, GSP per capita, fraction of state population with access to fluoridated water, and number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. The unit of observation is individual and year.

Table 1.6: Hospital emergency department use for dental disease in California

Disease type	%ED admissions
Dental diseases	1.37
Preventable dental diseases	1.11
Dental diseases, broad def'n	1.92
Injuries	19.19
Abdominal pain	10.22
Musculoskeletal system diseases	7.88
Respiratory system diseases	7.59
Genitourinary system diseases	6.26
Nervous system diseases	5.23
Mental diseases	4.52
Diseases of the skin	4.11
Circulatory system diseases	3.44
Endocrine metabolic and immunity diseases	2.04
Infectious and parasitic diseases	1.42

Dental disease includes diseases of teeth (e.g. cavities), supporting structures (e.g. gums), jaws (e.g. inflammations), salivary glands (e.g. abscess). This variable takes on the value of 1 if each ED patient has dental disease as primary diagnosis and 0 if each ED patient has other disease as primary diagnosis. Preventable dental disease is dental disease that could have been prevented at an earlier time. Broader definition of dental diagnoses includes dental disease, cellulitis, and abscess of face that could originate from dental diseases. Injuries include fractures, dislocations, sprains and strains, open woods and burns. Abdominal pain includes diseases of esophagus or stomach, gernia and appendicitis. Musculoskeletal diagnoses (of locomotor system) include arthropathies (diseases of joint), dorsopathies (diseases of back or spine). Respiratory system diseases include acute common cold, sinusitis, and tonsillitis. Genitourinary system diseases are nephritis (inflammation of kidney), nephrosis (non-inflammatory kidney disease), diseases of urinary system, diseases of male genital organs, disorders of breast, inflammations of female pelvic organs and other disorders of female genital tract. Nervous system diseases are inflammations of central nervous system (e.g. meningitis), sleep disorders, diseases of peripheral nervous system, disorders or eye, or year. Mental diseases are psychoses, mental retardation and other mental disorders. Diseases of skin are infections and inflammations of skin. Circulatory system diseases include hypertension, heart disease, and chest pain. Endocrine metabolic and immunity diseases are diseases of thyroid gland, endocrine gland, nutritional deficiencies, and metabolic and immunity disorders. Infectious and parasitic diseases include intestinal infectious diseases, and bacterial diseases. Each variable takes on value of 1 if primary diagnosis on each discharge reflects respective disease.
Unit of observation is individual and month. N=30 million.

Table 1.7: Descriptive evidence for the effect of Medicaid dental care coverage on the number of ED visits for preventable dental disease per county population (in 1,000s)

	No Medicaid dental cov.	Medicaid dental cov.
Non-Medicaid	0.28	0.33
Medicaid	1.30	1.47

The unit of observation is county, month, and insurance type. N=9,235.

Table 1.8: Effect of Medicaid dental care coverage on the number of hospital ED visits for preventable dental disease

	Num. of ED visit for dental disease		
	(1)	(2)	(3)
Post-June'09	0.059***	0.032***	0.003
	(0.011)	(0.010)	(0.048)
Medicaid	1.029***	1.113***	1.113***
	(0.144)	(0.158)	(0.158)
Post-June'09*Medicaid	0.112*	0.028	0.028
	(0.067)	(0.052)	(0.052)
N	9,235	5,280	5,280
R^2	0.562	0.595	0.599
Controls	No	No	Yes
2005, 2006, 2007?	Yes	No	No
Mean of dep. var, Medicaid adults before July'09	1.30	1.40	1.40

I estimate the effect of Medicaid dental care coverage in California on the number of hospital ED visit for preventable dental disease per population (in 1,000's).
Each column represents a separate regression of the outcome on Medicaid coverage indicator, indicator for Medicaid dental care coverage (*PostJune'*09=1 after June 2009), and interaction between Medicaid dental care coverage and Medicaid coverage. Some specifications include control variables for county fixed effects, indicator variables for each month, and time-varying county characteristics: number of dentists per 1,000 county resident, number of community health clinics per 1,000 county resident, fraction of population by race (black, American Indian, Asian, Pacific Indian, Hispanic, multi-race), fraction of female population, and fraction of employment in 14 major 2-digit NAICS industries, and unemployment rate.
Unit of observation is county, insurance type, and month.

Table 1.9: Effect of Medicaid dental care coverage on preventable dental disease among ED patients

	Prob. of dental disease among ED patients		
	(1)	(2)	(3)
Post-June'09	0.002***	0.001***	-0.001
	(0.000)	(0.000)	(0.001)
Medicaid	0.022***	0.023***	0.023***
	(0.002)	(0.002)	(0.002)
Post-June'09*Medicaid	0.002**	0.001	0.002
	(0.001)	(0.001)	(0.001)
N	9,235	5,280	5,280
R^2	0.253	0.270	0.494
Controls	No	No	Yes
2005, 2006, 2007?	Yes	No	No
Mean of dep. var, Medicaid adults before July'09	0.039	0.040	0.040

The outcome variable takes on the value of 1 if each ED patient is diagnosed with preventable dental disease and 0 if each ED patient is diagnosed with non-dental disease. This outcome is therefore interpreted as the probability of having dental disease among ED patients.
Regression in column 3 includes county fixed effects, indicator variables for each month, indicator variables for gender, race, and age category, and time-varying county characteristics: number of dentists per capita, number of CHC per capita, fraction of employment in 14 major 2-digit NAICS industries, and unemployment rate. Robust standard errors are clusters in parentheses at county-event level. Unit of observation is individual, county and month.

Table 1.10: Effect of Medicaid dental care coverage on the number of bed days

	Number of bed days					
	(1)	(2)	(3)	(4)	(5)	(6)
Full dental	0.264	0.228	0.380*	0.108	0.072	0.068
	(0.208)	(0.416)	(0.218)	(0.097)	(0.238)	(0.138)
Medicaid	8.948***	8.788***	1.556***	1.983***	1.776***	1.061***
	(0.579)	(0.584)	(0.242)	(0.228)	(0.194)	(0.163)
Medicaid*Full dental	-1.751**	-1.406*	-0.281	-0.597*	-0.413	-0.131
	(0.781)	(0.762)	(0.324)	(0.298)	(0.252)	(0.222)
N	451,563	142,733	86,312	296,414	67,344	59,657
R^2	0.048	0.050	0.011	0.014	0.025	0.019
Mean of dep. var., Medicaid	13.83	14.44	3.56	5.30	5.46	3.26
Restriction	Full sample	$\leq$2*FPL	$\leq$2*FPL Parents	Employed	$\leq$2*FPL Employed	$\leq$2*FPL Employed, Parents

The table reports coefficient estimates for the effect of Medicaid dental care coverage on absenteeism.
All three measures of absenteeism are defined only for those adults who report being employed. In column 1, the outcome is the probability of at least one bed day in the past year. In column 2, the outcome is the number of bed days in the past year; values are winsorized at 1%. In column 3, the outcome is the number of positive bed days in the past year, defined as the number of bed days among those adults who report at least one bed day per year; values are winsorized at 1%.
Each regression includes year, interview month, state fixed effects, state-specific time-trends, and control variables for gender, race, age, private health insurance, Medicare coverage, family income, GSP per capita, percent state population with access to fluoridated water, and number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. Unit of observation is individual and year.

CHAPTER II

Do Health Care Providers Respond to Increased Reimbursement Rates? Evidence from Healthy Kids Dental

Over the past two decades there has been a dramatic increase in the number of children covered by public health insurance. The Patient Protection and Affordable Care Act (ACA) expands public insurance to include adults with family incomes up to 138 percent of the Federal Poverty Level. While a fundamental goal of expanding public insurance coverage is to improve access to health care among low income families, this will only occur if there is a sufficient supply of health care providers willing to treat publicly insured patients. Historically, low Medicaid reimbursement rates have limited provider participation, leading to access problems in many communities. For this reason, the ACA legislation not only expands eligibility for public coverage but also provides funding to increase Medicaid reimbursement rates for primary care. To understand the potential impact of this element of the reforms, it is important to understand how reimbursement rates affect the supply of services to Medicaid patients.

Sloan et al (1978) develop a model of a provider's decision to accept Medicaid patients. Assuming that the provider faces a downward sloping demand curve in the private market, is a price taker with respect to Medicaid patients and that the cost of providing care is

the same for all patients, the optimal allocation will be one where the marginal revenue from private patients equals the fixed Medicaid payment rate and the provider's marginal cost. A main prediction of this model is that when Medicaid rates rise relative to private market fees, a greater number of providers treat public patients; those providers who treat a mix of public and private patients start treat more public patients. Using data from a national survey of private practice physicians, the authors find results that are consistent with this prediction. They estimate an elasticity of Medicaid participation with respect to fees of roughly 0.2. Higher private fees discourage physician involvement in Medicaid, suggesting that insurance programs compete with one another for physician time.

Greater provider participation may not necessarily increase the use of care. For example, Baker and Royalty (2000) find that public insurance expansions in the 1980s and 1990s led to increased participation of providers in public setting but not providers in private settings. These results suggest that increases in Medicaid rates merely shifted Medicaid patients from public sector physicians to ones in private practice. Similarly, Gruber et al (1997) find that an increase in Medicaid fees in Tennessee moved patients from outpatient clinics to physician offices. In general, whether higher Medicaid payments translate to greater use of care among Medicaid patients depends on the availability of other sources of care. If patients on Medicaid receive care in public settings when Medicaid reimbursement rates are low, then raising the rates may shift the site of care from those clinics to private practices. If, on the other hand, publicly insured patients do not have access to care in public settings, then the increase in reimbursement rates may increase the use of care.

In the context of dental care, low reimbursement rates are commonly cited as a primary reason that children in low-income families have poor access to care and high rates of tooth decay (GAO 2000). Buchmueller et al (2013) use survey data from Medicaid patients and dental providers across states to show that increased reimbursement rates in the last decade have caused a small increase in provider participation and, hence, on the use of dental care. The study exploits small increases in reimbursement rates to providers. For example, the

Medicaid reimbursement rate for periodic oral exam, one of the most common dental procedures, declines from 62 to 54 percent of private fees, while the Medicaid reimbursement rate for a comprehensive oral exam fell from 50 to 46 percent of private fees. It therefore remains unclear whether provider participation would increase more dramatically with larger increases in reimbursement rates.

This paper examines whether, by increasing provider participation, higher reimbursement rates cause an increase in the use of dental care. I exploit recent changes in insurance coverage due to Healthy Kids Dental (HKD), an innovative program in Michigan aimed at improving access to dental care by increasing the willingness of dental providers to treat children on Medicaid. The key feature of the program is that the state contracts with a private insurer, Delta Dental, to provide dental coverage to children in selected counties. Delta then reimburses providers according to the same fee schedule used for its commercially insured groups. Though reimbursement rates vary by procedure, commercial fees are much larger than Medicaid fees: the median reimbursement per procedure increases from $24 to $42 when the program goes into effect. Providers serving children on Medicaid in counties where HKD is not implemented continue to be reimbursed through Medicaid.

Prior evidence suggests that the original expansion phase of the program to some of Michigan's counties improved access to dental care. Eklund et al (2003) exploit the increase in reimbursement due to the introduction of HKD to 22 counties in May 2000. These counties make up 14 percent of Michigan's population. The authors find that within the first 12 months increases in reimbursement rates are positively correlated with increases in the number of dentists accepting Medicaid and the use of dental care among patients on Medicaid. This result suggests that increasing reimbursement rates may be an effective way of raising the use of care. The original expansion counties were very rural, however, so the results may not generalize to counties where dentists have higher opportunity costs of treating patients on Medicaid.

My analysis focuses on the expansion of the program to two more counties in 2008.

These 'transition'08' counties make up about 6 percent of Michigan's population. I also rely on data from four additional counties that joined the program in 2012. These 'transition'12' counties make up about 3 percent of Michigan's population. I use a difference-in-difference strategy and an event-study framework to identify the effect of increased reimbursement rates on provider participation and the use of dental care. Because I condition on county fixed effects, my estimates are identified by within-county variation in reimbursement rates. This approach mitigates the bias that might result from a correlation between changes in reimbursement rates and other county-level factors that influence provider participation and the use of dental care.

Detailed claims data from the Michigan Department of Community Health (MDCH) for January 2007 to June 2012 allow me to precisely measure the temporal association between increased reimbursement rates to providers and provider participation. I measure provider participation using the number of dentists participating in Medicaid and the number of children on Medicaid per dentist. I further test whether higher provider participation increases the use of dental care. The American Academy of Pediatric Dentistry (AAPD) recommends that children visit dental providers at least every six months (AAPD, 2009). Focusing on the number of children with at least one dental visit therefore allows me to examine the extent to which increased reimbursement rates improve the level of care up to the recommended levels. An alternative measure for the use of dental care is the number of dental visits by children on Medicaid.

I find that dentists serving children on Medicaid in transition'08 counties respond to increased reimbursement rates by seeing more patients on Medicaid: the number of dentists participating in Medicaid per county and six-month period increases by 36.1 percent on average (mean number of dentists per county and six-month period=199). The number of children on Medicaid per dentist, however, remains unchanged. This observation may suggest that greater participation of dentists treating fewer children on Medicaid comes at the expense of declines in participation of dentists treating large volumes of children on

Medicaid. In line with this hypothesis, increased reimbursement rates lead to very small increases in the share of children on Medicaid with any dental care of about 3 percent (mean share of children on Medicaid with any dental care per county and six-month period=0.265). A similar increase is observed in the number of dental visits per child enrolled in Medicaid. I find little evidence that increased reimbursement rates affect enrollment in Medicaid, suggesting that the above effects are driven by increased use of dental care.

Substantial increase in provider participation and smaller increase in the use of dental care are consistent with a shift in the source of care away from public providers (e.g. public clinics and hospital clinics) to private providers. Consistent with this hypothesis, prior studies found that public insurance expansions led to increased participation of providers in public setting but not providers in private settings. In particular, Baker and Royalty (2000) examine physician response to Medicaid eligibility expansions for pregnant women on Medicaid. They find that the expansions increased the percentage of patients who are poor or on Medicaid among physicians in public settings, but not among physicians in private practices.

If increased reimbursement rates are evaluated based on their ability to increase the use of dental care up to the recommended levels, then even the large increases implemented in Michigan fall short of achieving this goal. Higher reimbursement rates may, however, have other advantages. For example, by increasing provider participation in Medicaid, they may allow Medicaid patients to find providers that better suit their needs (e.g. providers who are located closer to their homes).

2.1 Background

The Healthy Kids Dental program was introduced gradually over time. Table 2.1 summarizes the roll-out of the program and Figure 2.1 provides a map for its implementation across Michigan's counties. The program was originally implemented in 2000 in 37 of Michigan's 83 counties; 22 more counties were added in 2006. In the period prior to the in-

crease in reimbursement rates (January 2007 to June 2008) these 'old HKD' counties have a higher unemployment rate than most other counties (Table 2.2). The old HKD counties are more rural and have fewer dentists per capita than other counties in Michigan. In parts of the analysis, these counties are used as counterfactuals for the experience of counties that transition to increased reimbursement during the time frame for the analysis, 'transition counties'.

In 2008, the program was rolled out in two more counties: Saginaw and Genesee. Like the old HKD counties, these 'transition 2008 counties' have a high unemployment rate in the period before reimbursement rates are increased. They are more urban than the rest of Michigan and have a greater number of dentists per population than either the old HKD counties or the non-HKD counties. The program was further expanded to four more counties (Mason, Muskegon, Newaygo, and Oceana) on February 1, 2012. I refer to these counties as 'transition 2012 counties.' These counties are more rural than the counties that transitioned to HKD in 2008.

The counties where dentists are still paid according to the Medicaid fee schedule, 'non-HKD counties,' are located in the southern part of the state.[1] These counties are similar to transition 2008 counties when it comes to unemployment, the number of dentists per capita and rurality. They constitute another comparison group for the transition counties.

Children are enrolled in the program based on their county of residence. All children enrolled in Medicaid under 21 are enrolled into the program automatically. Each enrolled child receives a letter in the mail with instructions on how to contact Delta Dental for assistance in finding a participating dentist in their area. Dentists also receive a letter outlining participation requirements, counties included, plans offered in each county, and other administrative information.[2] As with traditional Medicaid, HKD covers a com-

[1]The program was expanded to 10 counties on October 1, 2012 and 3 more counties on October 1, 2013. Since these last transitions take place after the end my data period, they are among the set of non-HKD counties for the whole duration of my analysis.

[2]Dentists who do not contract with Delta Dental cannot get reimbursed for treating children in HKD counties. Over 93 percent of Michigan's dentists contract with Delta Dental.

prehensive range of diagnostic, preventive and restorative dental services with no required out-of-pocket costs.

The distinguishing feature of the program is that from the provider's perspective HKD is identical to commercial insurance coverage through Delta Dental: Delta pays dentists using the same policies and procedures, claim submission, and reimbursement methods as with its other commercial dental contracts. I calculate that the median commercial fee is \$42, while the median Medicaid fee is \$24.[3] Figure 2.2 illustrates fee differences by plotting median reimbursement rates to dentists for eight common procedures over the period of my analysis. The Medicaid fees for these procedures range from \$3 for a single X-ray ('Intraoral periapical first film'[4]) to about \$60 for a simple filling ('Amalgam, one surface'). Medicaid fees are fixed over this time period. Commercial fees are not fixed, but they change very little. The difference between HKD and Medicaid rates is therefore fairly constant. For all procedures, Delta rates are significantly higher than the corresponding Medicaid amount, but the magnitude of the gap varies substantially across procedures. For instance, both Medicaid and Delta pay under \$10 for a single X-ray ('Intraoral periapical first film'). Medicaid reimbursement rate for prophylaxis[5], however, is \$24, while the corresponding amount for dentists in the Delta network is \$42.[6]

2.2 Data

The main data for the analysis come from the Michigan Department of Community Health. The first set of files is Medicaid enrollment files that cover the time period between

[3]To make this comparison, I first compute median reimbursement per procedure in non-HKD counties. I then average over these median reimbursement rates, weighting each procedure by the number of claims corresponding to it. I use a similar construction for HKD counties.

[4]Intraoral periapical film is radiograph that is taken with X-ray film placed inside the patient's mouth.

[5]Oral prophylaxis is a dental procedure that removes tartar and plaque build-up from the teeth through polishing and scaling. This normally involves cleaning under the gums and the surface of the teeth. The procedure helps to prevent tooth decay, gum disease and staining. Since braces make it hard to clean teeth and gums, it is also recommended for those who are getting braces or other orthodontic work. The procedure is generally performed by an experienced dental hygienist or dentist.

[6]In percentage terms, the increase in reimbursement rates ranges from 0 for resin-based composites to 79 percent for intraoral periapical film.

2007 and 2012. Monthly enrollment in the HKD program is determined based on a child's county of residence in that month. In addition to each child's county of residence, the files contain basic demographic data (race, age and gender), and whether a child's dental coverage is Healthy Kids Dental or standard Medicaid fee-for-service. The study population includes all children below the age of 21 who were enrolled in Medicaid for at least three consecutive months every six months (97.83 percent of observations). I also exclude children with a missing county of residence (0.02 percent of the observations) and children whose longest county of residence does not line up with the indicator variable for enrollment in HKD vs Medicaid (0.75 percent of the observations). The above exclusion restrictions have no effect on the mean of each outcome. I assign children to county groups based on the coverage for the majority of their enrollment period. The county groups considered in this analysis are the 'old HKD' counties (the 59 counties that had implemented HKD prior to fiscal year 2007), transition'08 counties (the 2 counties that transitioned to HKD in July 2008), transition'12 counties (the 4 counties that transitioned to HKD by February 2012) and 'non-HKD counties' (the 18 counties that remained on Medicaid as of January 2013).

The second set of files is dental claims data from Michigan Department of Community Health. They cover the time period between 2007 and 2012 and include the information on the date of the visit, the procedures provided and the amount reimbursed. I combine enrollment files with claims files and exclude from the sample children who appear in the claims files but not in enrollment files (1.72 percent of claims). The resulting data set is based on about 5.8 million children between July 2007 and June 2012. It is on the level of county and six-month period (January to June and July to December).[7] This aggregation is convenient, since reimbursement rates vary at the county level and six-month periods ensure that the outcomes of interest are relatively stable over time and are easily interpreted.

[7]Each county corresponds to the child's county of residence, since that is the level at which the policy varies: if a child on Medicaid residing in an HKD county goes to the dentist office in another county, that dentist is still reimbursed at HKD rates. The resulting use of dental care appears in the data under the county of child's residence.

I identify dentists participating in Medicaid by using the variable 'rendering NPI.' Out of some 6,000 dentists registered in Michigan between 2007 and 2011,[8] 4,212 participate in Medicaid. The average number of dentists participating in Medicaid per participating dental practice is 1.1. This number is not directly comparable to the number of dentists per dental practices, since I only observe a subset of dentists who treat children on Medicaid.[9] The unit of observation is county and six-month period. If a single dentist treats children on Medicaid from two different counties, then she serves two different counties and is recorded as two separate dentists. This approach prevents me from measuring the total number of dentists treating children on Medicaid in Michigan, but it allows me to measure the number of dentists serving children on Medicaid in each county. I identify dental practices participating in Medicaid by using the variable 'billing NPI.' This variable is missing for 18 percent of claims. Since the name of the practice, 'billing NPI name,' is never missing, I use the non-missing billing NPI to infer missing billing NPI based on the name of each dental practice. Between 2007 and 2011, 4,452 dental practices participate in Medicaid.

I use data from several other sources to account for changes that may affect both the supply of dental care and Medicaid coverage. Changes in unemployment rates may cause individuals to lose private dental insurance, both for themselves and for their children, and become eligible for Medicaid, so I control for county-level unemployment rate. These data come from the Bureau of Labor Statistics (BLS).[10] I also control for the fraction of children between the ages of 0 and 18 below the federal poverty line and for the median household income in each county and year. This information is part of the Small Area Income and Poverty Estimates (SAIPE), based on data from the American Community Survey (ACS). Since these data are yearly, I interpolate them to the six-month period. I control for changes

[8]The number of dentists registered in Michigan increased slightly from 5,817 to 6,138 between 2007 and 2011 (ADA 2007-2011).

[9]Buchmueller et al (2014) find that the average 1.9 dentists per dental practice on average in the U.S. between 1999 and 2011 (Buchmueller et al, 2014).

[10]Unemployment data are available on a monthly basis. To combine them with administrative data from the Michigan Department of Community Health, I compute average unemployment rate from July of one year to June of the next year.

in the supply of dental care by using the number of dentists in each county and year per population in 1,000s. This information comes from the American Dental Association. Finally, because access to care varies across rural and urban counties, I use county-level rural-urban continuum codes compiled by the United States Department of Agriculture (USDA).[11] For each six-month period between 2007 and 2013, each county is assigned a code between 1 and 9; 9 corresponds to the most rural counties, and 1 corresponds to the most urban counties.[12]

2.3 Descriptive Evidence

To characterize the supply of dental care, I focus on the average number of dentists in Medicaid per county and six-month period across different sets of counties (Panel 1 of Table 2.3). As reimbursement rates increased from the 'pre' period to the 'post' period, the average number of dentists participating in Medicaid per county in transition'08 counties increases from 199 to 241. It declined to its original levels between January 2010 and June 2011 but then increased to 226 in the final sample period. The average number of dentists serving children on Medicaid declined steadily in the old HKD counties and increased slightly in the non-HKD counties. It remained mostly unchanged in transition'12 counties before 2012, when reimbursement rates increased in these counties.

By raising the profits from treating patients on Medicaid, increased reimbursement rates may lead to an average increase in the volume of Medicaid patients per each dentist participating in the program. I test this hypothesis by focusing on the number of visits from

[11] These data are available for download at `http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx#.U993c_lkSSo`.

[12] Counties in metro areas of 1 million population or more are assigned the value of 1. Counties in metro areas of 250,000 to 1 million population are assigned the value of 2. Counties in metro areas of fewer than 250,000 population are assigned the value of 3. Urban population of 20,000 or more, adjacent to a metro area are assigned the value of 4. Urban population of 20,000 or more, not adjacent to a metro area are assigned the value of 5. Urban population of 2,500 to 19,999, adjacent to a metro area are assigned the value of 6. Urban population of 2,500 to 19,999, not adjacent to a metro area are assigned the value of 7. Completely rural or less than 2,500 urban population, adjacent to a metro area are assigned the value of 8. Completely rural or less than 2,500 urban population, not adjacent to a metro area are assigned the value of 9.

children on Medicaid per participating dentist. The second panel of Table 2.3 reports this variable across the three sets of counties over time. The number of visits from children on Medicaid per participating dentist increases steadily across the four sets of counties. The increase of 34.6(=(70-52)/52) percent in transition'08 counties is smaller than the increase of 62.5 in the old HKD counties but larger than the 31.2 percent in the non-HKD counties, so increased participation of dentists in Medicaid does not seem to increase the number of children on Medicaid per dentist.

Lack of increased participation in Medicaid among dentists treating children on Medicaid may be due to consolidation of participating dentists into dental practices. To provide suggestive evidence for this hypothesis, I plot the number of dentists treating children on Medicaid per dental practice participating in Medicaid in Figures 2.3- 2.4. Figure 2.3 reveals a trend away from consolidation of participating dentists into dental practices in transition'08 counties as reimbursement rates increase. The opposite is true for dentists serving children on Medicaid in transition'12 counties (Figure 2.4). Since most of the increase in provider participation comes from providers treating few children on Medicaid (Figures **??** and **??**), this trend towards consolidation may confound the effect of increased reimbursement on the number of dentists serving children on Medicaid in transition'12 counties, this trend towards consolidation may confound the effect of increased reimbursement on the number of dentists serving children on Medicaid in transition'12 counties.

Two outcomes capture changes in both the demand and access to dental care. The first outcome is the percentage of children on Medicaid with at least one dental visit in each county and six-month period. About 26 percent of children enrolled in Medicaid end up receiving care in transition'08 counties before reimbursement rates are increased, in the 'pre' period (Panel 1 of Table 2.4).[13] This is well below the recommended two visits per year even for healthy children (AAPD, 2009). It increases to 32 percent immediately

[13]The patterns of dental care use are persistent over time: 75 percent of those who do not go to the dentist this year have no dental visit in the following year either, while 67 percent of those with at least one visit to the dentist office in a year come back in the next year.

after reimbursement rates are increased and to 39 percent by the end of 2012. Overall, the rate increases of 13 percentage points (=39-26) over this time period is substantial. It is equivalent to the 13 percentage point increase in the old HKD counties and larger than the 7 percent increase in the non-HKD counties. A similar pattern is observed for the number of dental visits per enrolled child in each county and six-month period (Panel 2 of Table 2.4): the 20 percentage point increase in the number of visits observed between 2007 and 2012 in transition'08 counties is much larger than the 6 percentage point increase in the old HKD counties or the 13 percentage point increase in the non-HKD counties.

2.4 Econometric Framework

I estimate the effect of increases in reimbursement rates to providers on provider participation and the use of dental care using a difference-in-difference (DID) approach. My approach is to compare changes in the outcome between children on Medicaid in transition counties and children on Medicaid in non-transition counties (old HKD or non-HKD) before and after reimbursement rates are increased:

$$Y_{ct} = \alpha_1 HKD_{ct} + X_{ct}\alpha_2 + \mu_c + \tau_t + \varepsilon_{ct} \tag{2.1}$$

In this model Y_{ct} represents one of the key outcomes of interest (in natural logs)[14], HKD_{ct} is an indicator variable that equals one if HKD was in place in county c during year t, μ_c is a set of county indicator variables, τ_t is a set of indicator variables for each six-month period and ε_{ct} is an i.i.d. disturbance term. X_{ct} includes a linear time trend specific to non-HKD counties, a linear time trend specific to the old HKD counties, a linear time trend specific to transition'08 counties and a linear time trend specific to transition'12 counties. It also includes the fraction of children (0-19 years old) below poverty line, median household

[14]The residuals are strongly positively skewed, so the transformation helps to obtain residuals that are approximately symmetrically distributed around zero. In addition, Michigan counties vary significantly by size, so a log-linear specification is more likely to correctly capture the relationship between increased reimbursement and the supply of dental care. The results are similar in the linear specification.

income, number of dentists per population, fraction of unemployed population (in 1,000's), binary measures of county rurality, share of children in each age group (1-5, 6-10, 11-16, 17-20), share of girls on Medicaid, and share of children on Medicaid by race (black, non-white other than black)[15].

County fixed effects mitigate the bias that may occur if time-invariant county characteristics (e.g. opportunity costs) drive the supply of dental care. The use of county fixed effects means that identification comes from changes in within counties and over time. In other words, α_1 measures the change in the outcome as reimbursement rates increase. Time-varying control variables help to account for county-specific shocks that may drive the supply of dental care. For example, greater unemployment rate reduces the availability of private patients, thereby reducing dentists' opportunity costs. Time dummy variables capture any difference over time that may affect dental providers serving children on Medicaid (e.g. regulation). Linear time trends specific to each set of counties allow me to control for differential trends in the outcomes across counties over time. For example, Table 2.3 reveals a steady increase in the number of children on Medicaid per participating dentist across all four sets of counties over time. Such pattern would bias the estimated effect of reimbursement rates on the outcome of interest if I simply compared its values before and after the increase in reimbursement. Since I compare the change in the outcome in transition'08 counties relative to other counties net of time trends that are specific to each set of county, this problem is mitigated.

I estimate the model using Ordinary Least Squares regression (OLS). In order to conduct correct inference in the presence of serial correlation in the error term within counties and over time, I compute standard errors clustered at the county level (Wooldridge, 2002). Some specifications allow for differences between transition'08 and transition'12 counties, and shorter run (first 1.5 years) vs. the longer run (second 1.5 years).

The difference-in-difference framework assumes no differential trend between providers

[15]The last three sets of variables change very little over the time period.

participating in Medicaid in transition'08 counties and their counterparts in other counties in the period before the introduction of the program. To test this parallel trend assumption, I restrict the sample to the period before July 2008 in the following specification:

$$\begin{aligned} Y_{ct} =& \gamma_1 old\ HKD_c + \gamma_2 non\ HKD_c + \gamma_3 T_t \\ &+ \gamma_4 old\ HKD_c * T_t + \gamma_5 non\ HKD_c * T_t + \gamma_6 X_{ct} + \mu_c + \varepsilon_{ct} \end{aligned} \tag{2.2}$$

where Y_{ct} is the outcome of interest in county c and month t, $old\ HKD_c$ takes on the value of 1 for all transition'08 counties before July 2008, $non\ HKD_c$ takes on the value of 1 for all non-transition counties, T is a linear time trend that takes on values from 1 to 3, X_{ct} represents a full set of variables that control for differences in the supply and the demand for dental care, μ_c are county fixed effects, and τ_t are time fixed effects. Since the omitted category is transition'08 counties, a large and significant coefficient on the interaction terms for a particular set of counties implies that the use of care grew at a different rate among children on Medicaid in these counties relative to transition counties. For ease of presentation, I exclude transition'12 counties from the estimation of model (2.2). In a separate analysis, I restrict the sample to the period before January 2012 and exclude transition'08 counties from the analysis to test whether the outcomes trend at different rates in the non-HKD counties and the old-HKD counties relative to transition'12 counties.

Results from estimating model (2.2) are presented in Table 2.5. The first column presents the results for the log number of dentists serving children on Medicaid. *Time* captures any trend in the outcome through time, $HKD * Time$ measures the difference in trends between the old HKD counties and transition'08 counties, $HKD * Time$ measures any difference in trends between the non-HKD counties and transition'08 counties. All estimated coefficients are insignificant in column (1), suggesting that the there is no difference in the trend of the outcome across different sets of counties. The results are analogous for the number of children on Medicaid per participating dentist (column 2). Columns (3) and (4) reveal upwards trends in the share of children on Medicaid with at least one dental

visits and the number of Medicaid visits per child in the old HKD counties but not in the non-HKD counties. Since upward trends in the old-HKD counties relative to transition'08 counties may lead to a downward bias in the estimated α_1 in model (2.1), non-HKD counties provide a better counterfactual for the experience of transition'08 counties absent the increase in reimbursement rates.

I account for differential trends in the outcomes across counties more flexibly through an event-study model:

$$Y_{ct} = \gamma_1 \sum_{j=1}^{11} M_j + \gamma_2 \sum_{j=1}^{13} Trans_{ct} M_j + \gamma_3 X_{ct} + \varepsilon_{ct}, \tag{2.3}$$

where each M_j=1 in the j^{th} 6-month period to/from the introduction of the program (the omitted 6-month period starts in July 2008, $j = 4$), $Trans_{ct}$=1 children residing in transition counties at time t, and X_{ct} is a set of variables that control for the supply and the demand of dental care, as before. Some of the DID estimates are based on a model that excludes the old HKD counties from the analysis. To make the event-study estimates comparable to the DID estimates, I also exclude these counties from model (2.3). γ_1 represent the time path for the outcome variable relative to the period of the policy change, and γ_2 capture the difference in the outcome between children on Medicaid in transition counties and those in non-HKD counties. If greater reimbursement rates increase the supply of dental care, then γ_2 should become positive and statistically after the period of policy change.

2.5 Results

Previous studies have found that low Medicaid reimbursement rates lead to low participation of providers in Medicaid (GAO, 2000; Eklund et al, 2003; Buchemueller, 2013). I show how HKD has affected participation of dentists in Medicaid (Tables 2.7). I distinguish between transition'08 counties and transition'12 counties in column 1. Column 2

presents the results for a pre and post analysis. I distinguish between the short-run[16] and the long-run[17] in column 3. Column 4 presents estimates that are analogous to column 2 except that the comparison group is non-HKD counties only.

I examine the effect of increased reimbursement rates on the number of dentists (in natural log's) participating in Medicaid in Table 2.7. The increase in the number of dentists due to increased reimbursement rates is large, at 36.1 percent in transition'08 counties. It is equivalent to an increase in the number of dentists from 199 to 271. No analogous effect is observed in transition'12 counties: the effect of increased reimbursement rates on the log number of dentists is estimated at very close to 0. As discussed above, consolidation of dentists serving children on Medicaid in transition'12 counties into dental practices may provide one explanation for the difference in the change of provider participation in Medicaid across transition'08 counties and transition'12 counties as reimbursement rates increase. Not surprisingly, averaging over the effects across the two sets of counties yields a smaller increase of 14.2 percent (column 2). The effect of increased reimbursement on provider participation is similar in the short-run and the long-run (p-value=0.420) (column 3). Average effect of increased reimbursement rates on the log number of dentists participating in Medicaid is similar in magnitude when compared to only the old HKD counties (column 4) and only non-HKD counties (column 5). Evaluated at the sample means for the data, the point estimate in the preferred specification in column 5 of of 13.1 percent translates into the elasticity of supply of 0.175. This estimate is similar to the supply elasticity that Sloan et al. (1978) and Decker (2007) estimate in their studies of physician participation in Medicaid.

Increased reimbursement rates may lead to an average increase in the volume of children on Medicaid per participating dentist. To capture the extent of provider participation in the program, I focus on the number of children on Medicaid per participating dentist.

[16] $Short-run$=1 for all counties c within 18 months of the increase in reimbursement rates, so most of the identification comes from transition'08 counties.

[17] $Long-run$=1 for all counties c 18 months after the increase in reimbursement rates, so the effect is identified off of transition'08 counties as well as the old HKD counties.

In line with a shift from in the number of dental visits among children on Medicaid away from dentists with many children on Medicaid to dentists with few children on Medicaid observed in Figure 2.3, the number of dental visits from children on Medicaid reduces by 17 from 111 to 94 in transition'08 counties (column 1). Consistent with no effect of increased reimbursement rates on the number of dentists serving children on Medicaid in transition'12 counties on average, the number of dental visits by children on Medicaid does not change in transition'12 counties as reimbursement rates increase. As expected, averaging over the effect of increased reimbursement rates across the two sets of counties reduces the estimate (column 2). The short-run effect is similar to the long-run effect (column 3), revealing a persistent decline in the load of children on Medicaid through time as a result of the increase in reimbursement rates. Finally, the estimated effect is similar, when only the old HKD counties or only non-HKD counties as used as counterfactuals for the experience of transition'08 counties.[18]

Results so far suggest that, on the one hand, increased reimbursement rates increase provider participation in transition'08 counties, and, in the long-run, in transition'08 counties and the old HKD counties. A simultaneous reduction in the number of visits by children on Medicaid in these counties, however, suggests that the use of dental care may not increase as a result of increased reimbursement rates. To examine the implications of the increase in provider participation on the use of dental care, I focus on the number of children on Medicaid (in natural log's) with any dental care (Table 2.8). The average increase of 11.8 percent across transition'08 counties and transition'12 counties is small relative to the increase in provider participation in Medicaid (column 2). In the preferred specification in column 4, the increase of 11.2 percent is equivalent to the increase in the percentage of children on Medicaid in transition counties with any dental care increased from 27.2 per-

[18]One may be concerned that the estimated effects of increased reimbursement rates on provider participation are driven by outliers: a few providers treating large volumes of children on Medicaid. I therefore estimate model (2.1) after excluding from the sample the counties and six-month period for which the outcome variables of interest is above the 95^{th} percentile. The estimated effects are similar in magnitude, so they are not reported here.

cent (=3,712/ 13,627) to 30.3 percent (=1.112*3,712/ 13,627) (column 2). This increase is still much below the recommended one dental visit every six months. The short-run effect of 7.4 percent is somewhat below the longer-run effect of 10.6 percent (p-value=0.094).

The effect of increased reimbursement on the number of dental visits among children on Medicaid is even smaller than that on the number of children on Medicaid with any dental care (p-value$\leq$0.001 for all comparisons of analogous specifications in Table 2.8 and Table 2.9). The average increase of 4.7 percent in the preferred specification in column 4 of Table 2.9 is very small and statistically insignificant. The largest increase in the number of dental visits among children on Medicaid that I cannot reject is 12.1 percent (=0.047+1.96*0.038). If present, it would increase the number of dental visits per child enrolled in Medicaid from from 0.589 dental visits per child enrolled in Medicaid from 0.589 to 0.660.

One may be concerned that enrollment in Medicaid changes with increases in reimbursement rates. For example, children may enroll in Medicaid in expectation of receiving high-quality dental care. If increased enrollment in Medicaid drives increases in the use of dental care, then the estimated effect of increased reimbursement rates on the number of dental visits could be biased upward. To test for changes in Medicaid enrollment that may coincide with changes in reimbursement rates, I estimate model (2.1) for enrollment in Medicaid as a dependent variable.

Table 2.10 reports the results. I distinguish between transition'08 counties and transition'12 counties in column 1. There is no evidence that the number of children enrolled in Medicaid changes in either transition'08 or transition'12 counties. I fail to reject that the effect of transition on Medicaid enrollment is jointly significant (p-value=0.1606). The second column combines the transition'08 counties and transition'12 counties and uses both the old HKD counties and the non-HKD counties for comparison. The resulting reduction of 1,265 is significant at the 10-percent significance level. The small reduction of 9 percent relative to average enrollment of 13,627 may reflect greater scrutiny towards who qualifies

for the program. The difference is no longer significant when I compare Medicaid enrollment in transition'08 counties to that in only the non-HKD counties that are more similar to transition'08 counties and therefore provide a better counterfactual for their experience (Table 2.2).

The difference-in-difference strategy assumes to differential trend in the outcome across different sets of counties. The results in Table 2.5 from the estimation of model (2.3) support the validity of this assumption. Still, I account for potential differential trends in the outcomes across counties more flexibly using an event-study model. Figures 2.5 - 2.8 plot the estimated γ_2 coefficients from model (2.3) that capture the difference in the outcome for children on Medicaid in the transition counties and children on Medicaid in non-HKD counties relative to the period of the policy change. Dashed lines represent 95 percent confidence intervals for each coefficient. For each figure, there is no evidence of differential trends in the outcome between children on Medicaid in transition counties and their counterparts in non-HKD counties. This finding validates my empirical strategy, as it suggests that both groups experienced similar trends in the outcomes prior to the increase in reimbursement rates. Event-study estimates in Figures 2.5 - 2.8 are in line with the results from the difference-in-difference estimation in Tables 2.7- 2.9.

2.6 Alternative measure of provider participation

An alternative measure of provider participation in Medicaid is the number of dental practices participating in Medicaid. I tabulate this outcome across the four sets of counties over time in Panel 1 of Table B.1. Transition'08 counties experience an increase in the number of dental practices participating in Medicaid from 197 to 242 between 2008 and 2009 and a decline in the outcome to 174 by 2012. This is a 12(=(242-197)/197) percent decline relative to the number of dentists in 2008. The number of dental practices also declines even more dramatically across all other sets of counties: the largest decline is observed in transition'12 counties, at 54.5 percent, and the smallest decline is observed

in the old HKD counties, at 36.1 percent. Given that there is no decline in the number of dentists over time (Table 2.3), this observation suggests that dentists participating in Medicaid consolidate into dental practices. In line with this hypothesis, average number of dental visits by children on Medicaid per participating practice increases steadily across all types of counties, from 48.2 percent in transition'08 counties to 122 percent in transition'12 counties (Panel 2 of Table B.1).

I estimate the effect of increased reimbursement rates on the number of dental practices participating in Medicaid (in natural log's) in Tables B.2- B.3. Column 1 of Table B.2 indicates that the number the dental practices participating in Medicaid increased by some 50 percent in both transition'08 counties and transition'12 counties as reimbursement rates increased. Such substantial effects in transition'12 counties are in sharp contrast to no change in the number of dentists participating in Medicaid in transition'12 counties found in Tables 2.7. In addition, the long-run effect of increased reimbursement rates on the number of dental practices participating in Medicaid of 12.7 percent appears much smaller than its short-run effect of 42.5 percent (mean=78). Evaluated at the sample means for the data, the point estimate in the preferred specification in column 5 of of 45.9 percent translates into the elasticity of supply of 0.615. The smallest increase in the number of dental practices due to increased reimbursement rates that I cannot reject is an increase of 34.3 percent. Its implied elasticity is 0.458, well above those estimated by prior studies (Sloan et al., 1978; Decker, 2007; Baker and Royalty, 2000). The discrepancies in the effects of reimbursement rates on the number of dentists and the number of dental practices suggest that organizational changes among providers present a major challenge for estimating the effect of reimbursement rates on provider participation.

2.7 Discussion and conclusion

I find that dentists serving children on Medicaid in transition'08 counties respond to increased reimbursement rates by seeing more patients on Medicaid: the number of dentists

participating in Medicaid per county and six-month period increases by 36.1 percent on average from 199 to 271. The number of children on Medicaid per dentist, however, remains unchanged. This observation may suggest that greater participation of dentists treating fewer children on Medicaid comes at the expense of declines in participation of dentists treating large volumes of children on Medicaid. In line with this hypothesis, increased reimbursement rates lead to very small increases in the share of children on Medicaid with any dental care of about 3 percent (mean=0.265).

Substantial increase in provider participation and smaller increase in the use of dental care are consistent with a shift in the source of care away from public providers (e.g. public clinics and hospital clinics) to private providers. Consistent with this hypothesis, prior studies found that public insurance expansions led to increased participation of providers in public setting but not providers in private settings. In particular, Baker and Royalty (2000) examine physician response to Medicaid eligibility expansions for pregnant women on Medicaid. They find that the expansions increased the percentage of patients who are poor or on Medicaid among physicians in public settings, but not among physicians in private practices.

Because the number of dental visits among children on Medicaid increases only slightly in response to increased reimbursement rates, the incremental cost of an additional visit to the dentist office induced by the policy is very high. Increased reimbursement rates lead to an average increase in the number of dental visits of 0.056, from 0.587 to 0.690 visits (Table 2.9). At the average Medicaid enrollment per county and six-month period of 12,376 children, this increase is equivalent to an increase of 693 dental visits. Because of the increase in reimbursement rates, average reimbursement rates in transition counties increase from $64 to $121 per dental visit. Program spending increased for all dental visits from by $464,942(=$64*0.587 visits per child*12,376 enrolled children) to $1,033,272(=$121*0.690 visits per child*12,376 enrolled children), so an additional visit to the dentist office induced by the policy costs $820(=(1,033,272-464,942)/693).

If increased reimbursement rates are evaluated based on their ability to increase the use of dental care up to the recommended levels, then even the large increases implemented in Michigan fall short of achieving this goal. Higher reimbursement rates may, however, have other advantages. For example, by increasing provider participation in Medicaid, they may allow Medicaid patients to find providers that better suit their needs (e.g. providers who are located closer to their homes).

This analysis sets the stage for an investigation into the reasons for continued non-participation among some providers, and for an examination of organizational and quality differences between providers with low volumes of patients on Medicaid and those with the largest volumes of patients on Medicaid. In addition, future work may examine some of the benefits of increased provider participation. These may include lower incidence of disease, shorter distance traveled, or lower absenteeism of parents to children on Medicaid.

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Figures and Tables

Figure 2.1: Phase-in of Michigan's Healthy Kids Dental program

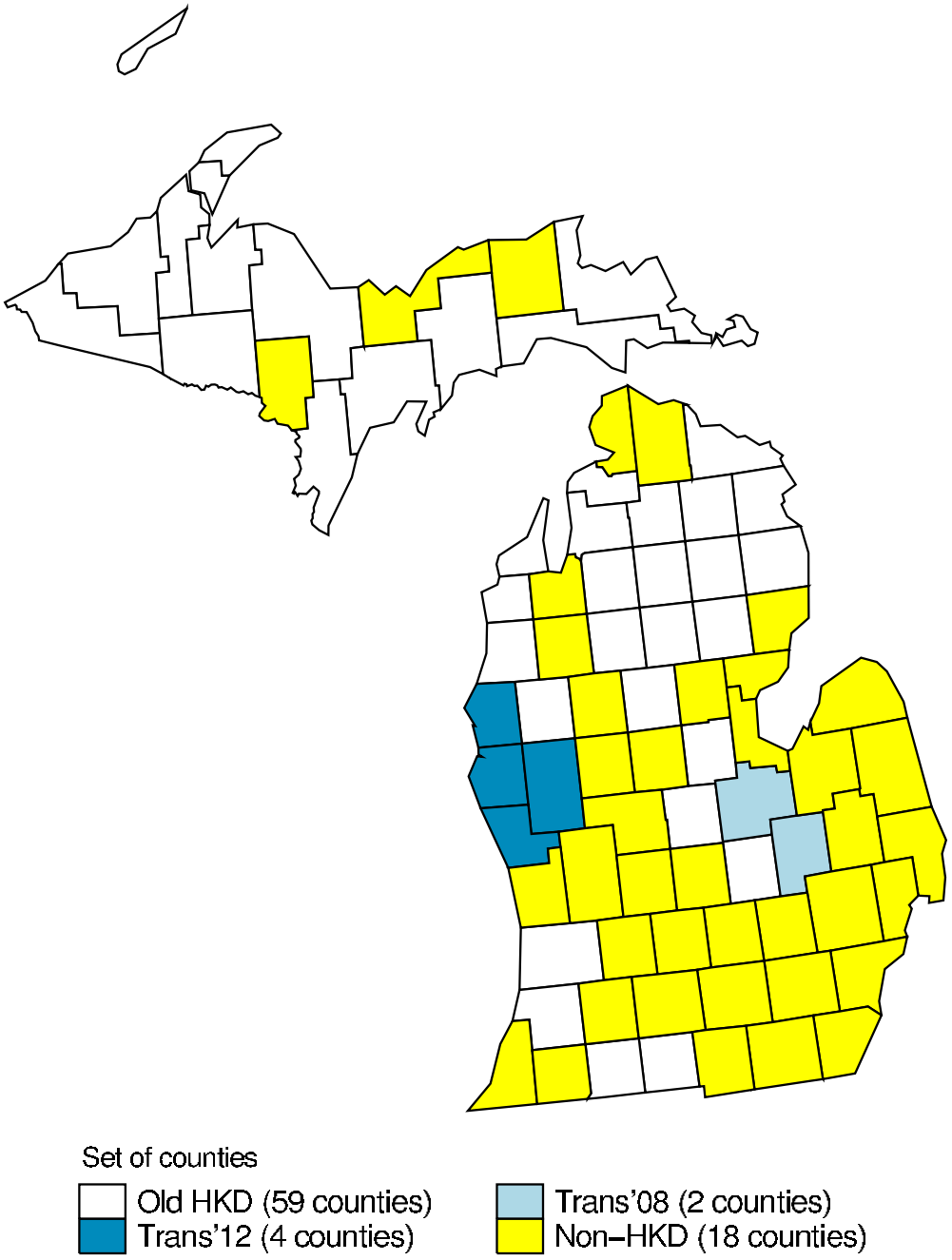
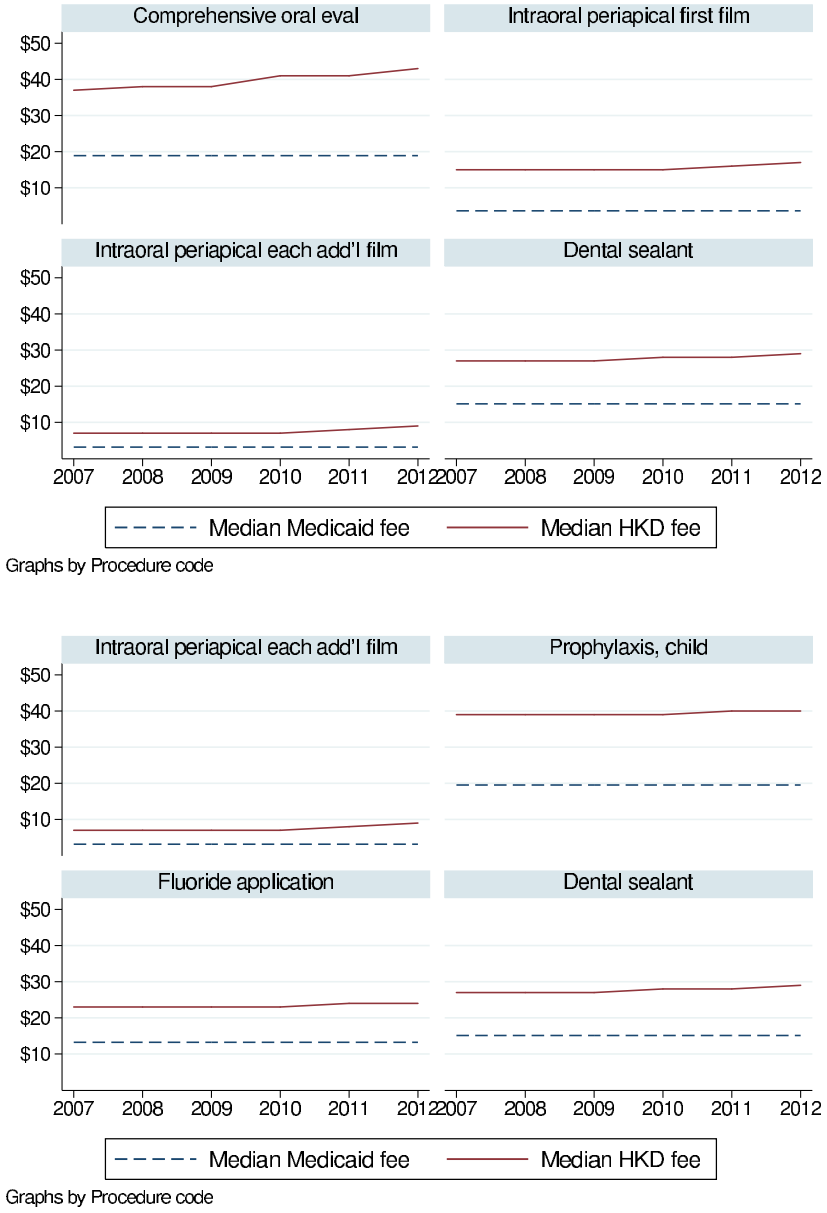
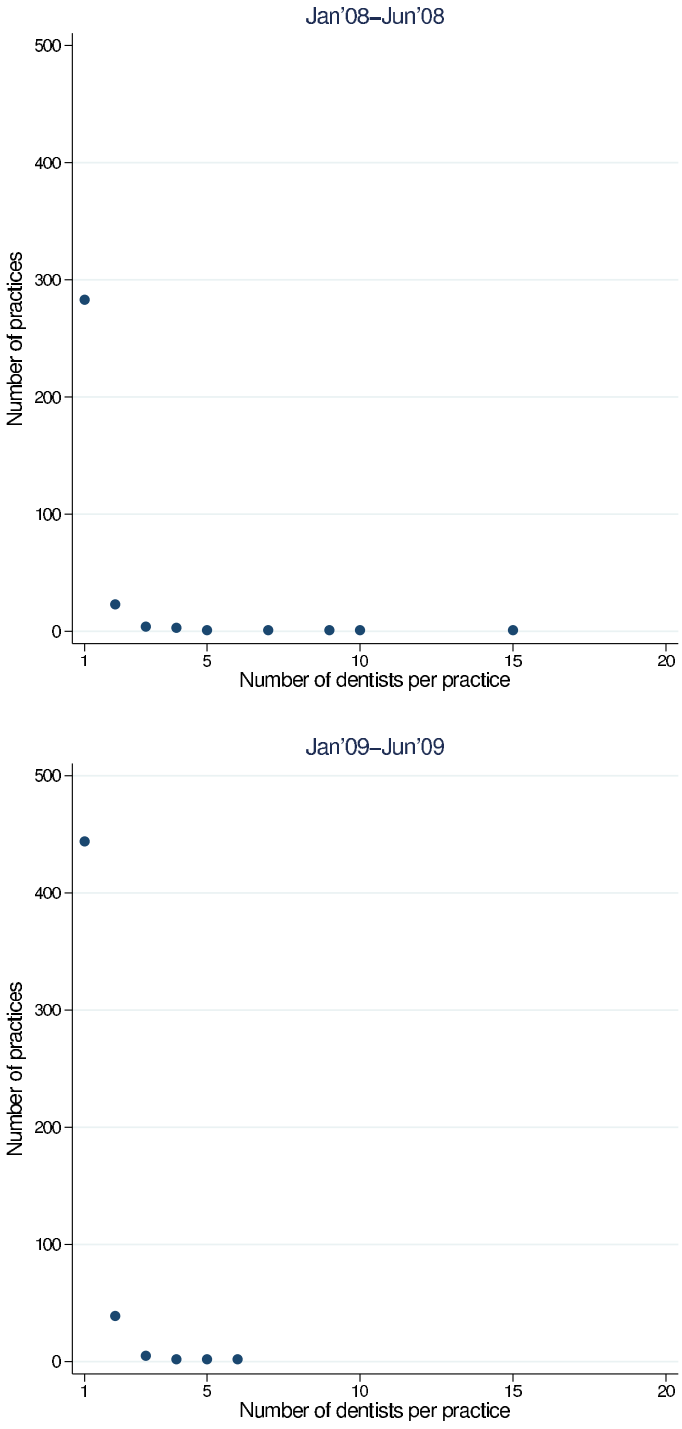


Figure 2.2: Reimbursement rates for common dental procedures in Medicaid and Healthy Kids Dental programs



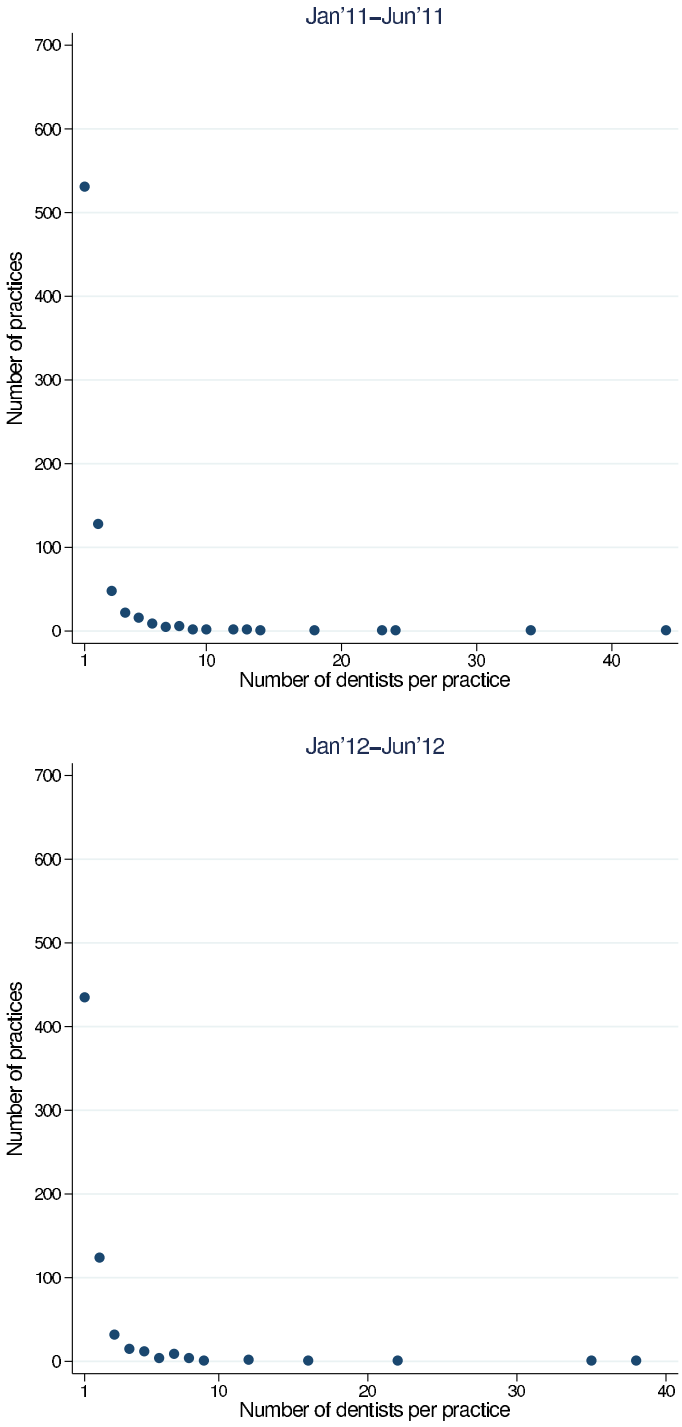
Notes: An intraoral X-ray is a radiograph that is taken with X-ray film placed inside the patient's mouth. This is the most common method of a dental X-ray. A periapical X-ray is a specific type of intraoral X-ray that is used to investigate the structural integrity of an individual tooth.

Figure 2.3: Number of dentists treating children on Medicaid per participating dental practice: Transition'08 counties in 2008 and 2009



Dental practices treating no children on Medicaid are omitted, since these data are not available.

Figure 2.4: Number of dentists treating children on Medicaid per participating dental practice: Transition'12 counties in 2011 and 2012



Dental practices treating no children on Medicaid are omitted, since these data are not available.

Figure 2.5: Effect of increased reimbursement rates on the log number of dentists participating in Medicaid: event study

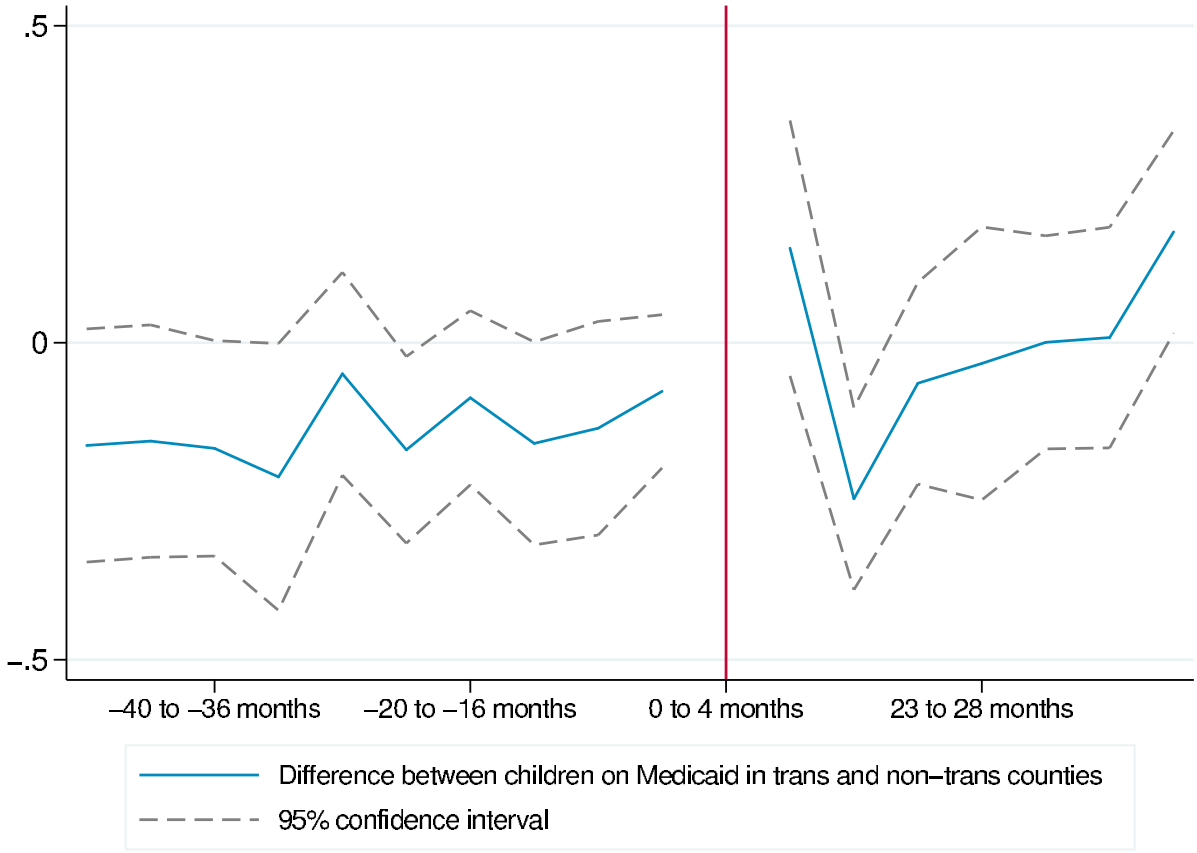


Figure 2.6: Effect of increased reimbursement rates on the number of children on Medicaid per dentist participating in Medicaid: event study

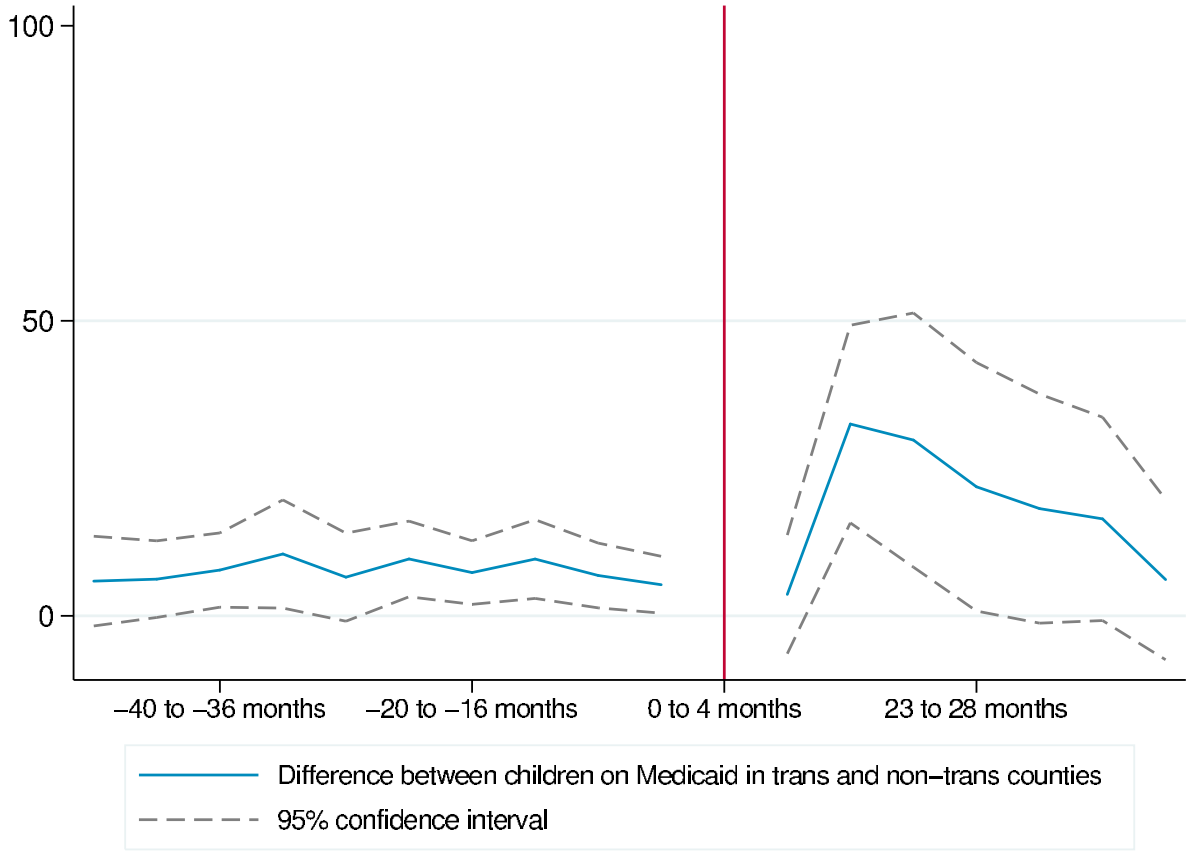
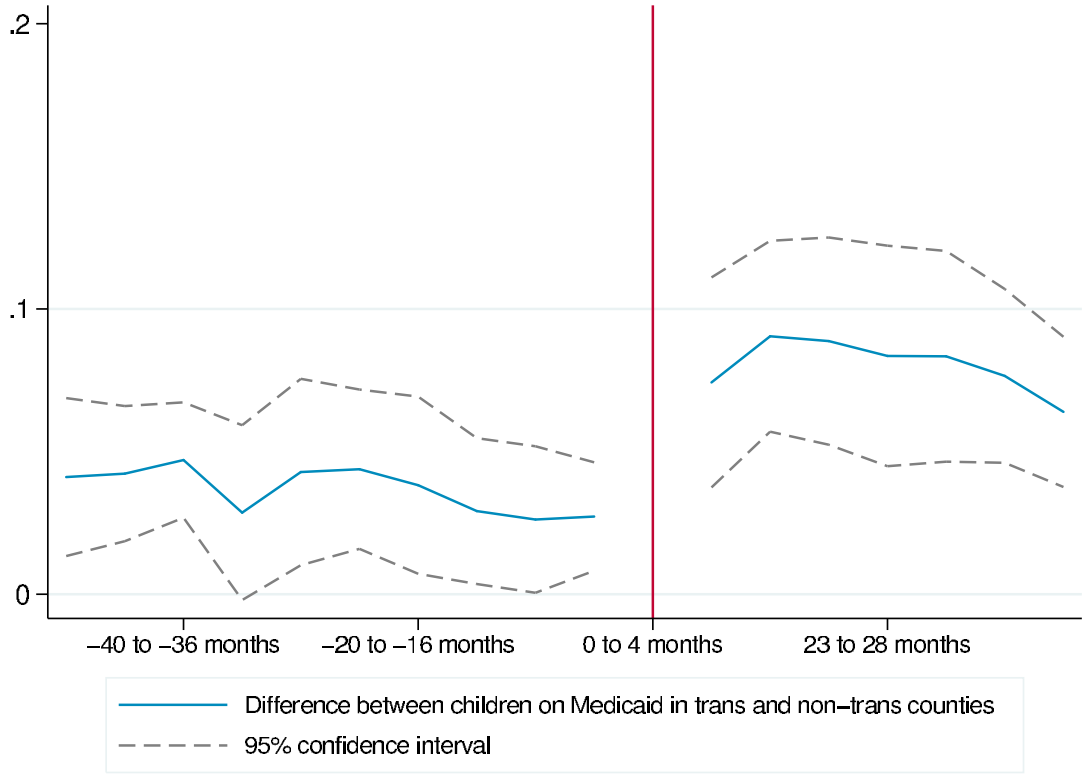
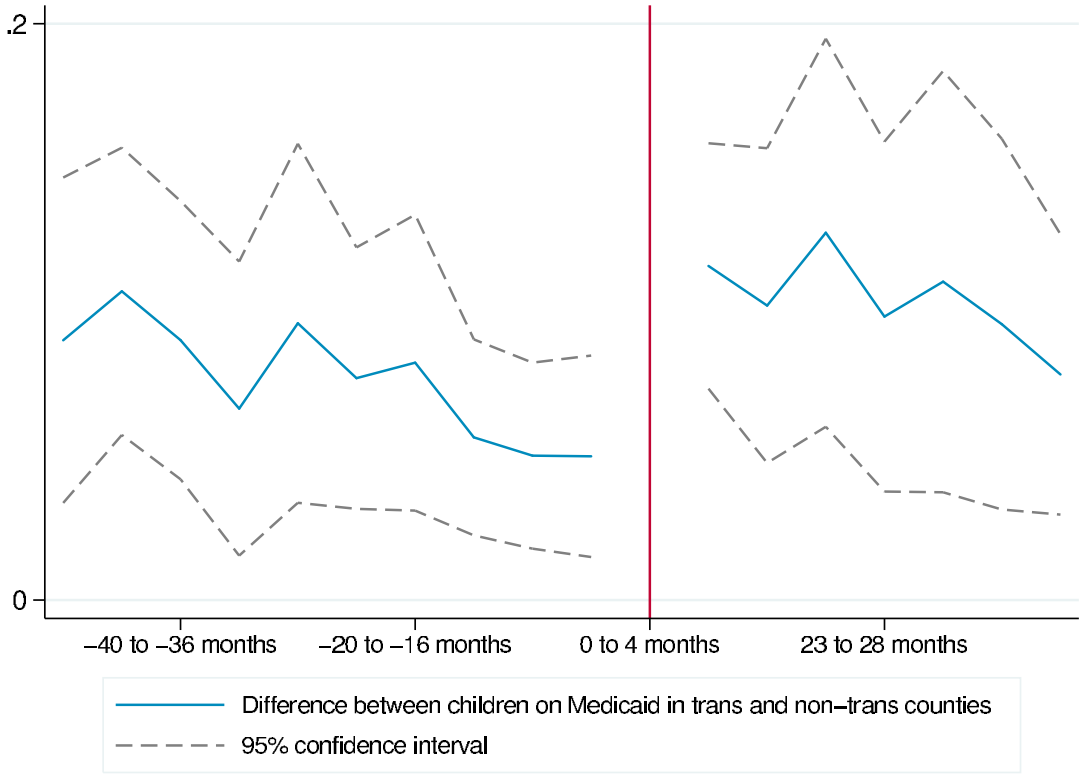


Figure 2.7: Effect of increased reimbursement rates on the log number of children enrolled in Medicaid with at least one dental visit: event study



Sources: Michigan Department of Community Health, American Dental Association; United States Department of Agriculture

Figure 2.8: Effect of increased reimbursement rates on the log number of dental visits: event study



Sources: Michigan Department of Community Health, American Dental Association; United States Department of Agriculture

Table 2.1: Implementation of Healthy Kids Dental

Date	Description
1-May-00	HKD is introduced in 22 of Michigan's 83 counties.
1-Oct-00	HKD expands to 15 more counties (37 total).
1-May-06	HKD expands to 22 more counties (59 total).
1-Jul-08	HKD expands to 2 more counties (Genesee, Saginaw; 61 total).
1-Feb-12	HKD expands to 4 more counties (Mason, Muskegon, Newaygo, Oceana; 65 total).
1-Oct-12	HKD expands to 10 more counties (Bay, Berrien, Calhoun, Cass, Grand Traverse, Jackson, Mecosta, Montcalm, Osceola, Wexford; 75 total).

Counties where HKD has not been introduced as of Dec 2012 are Ottawa, Kent, Kalamazoo, Ingham, Oakland, Macomb, Washtenaw, and Wane.

Table 2.2: Key demographics across counties

	Old-HKD	Trans'08	Trans'12	Non-HKD
Pct below poverty, 0-18yo	21.34%	24.50%	25.25%	19.33%
Median HH income	$42,578	$43,317	$41,790	$47,855
Pct unemployed	8.38%	8.20%	7.90%	7.06%
Rurality index (1-9=most rural)	6.10	2.50	5.20	3.21
Number of dentists per pop	0.40	0.53	0.34	0.57
Number of counties	59	2	4	18

Summary statistics are provided for the period between January 2007 and June 2008, before reimbursement rates are increased in transition'08 counties.
Sources: American Community Survey; American Dental Association; United States Department of Agriculture

Table 2.3: Characterizing dentists participating in Medicaid

	Pre		Post	
	Jan'07-Jun'08	Jul'08-Dec'09	Jan'10-Jun'11	Jul'11-Dec'12
Average number of dentists participating in Medicaid				
Transition'08	199	241	192	226
Old HKD	71	59	54	58
Non-HKD	176	176	168	184
Transition'12	88	85	79	91
Average number of Medicaid visits per dentist				
Transition'08	111	110	149	128
Old HKD	32	43	52	50
Non-HKD	71	79	95	87
Transition'12	48	57	70	66

Table 2.4: Average use of dental care among children on Medicaid

	Pre		Post	
	Jan'07-Jun'08	Jul'08-Dec'09	Jan'10-Jun'11	Jul'11-Dec'12
Share of Medicaid children with $\geq$ 1 dental visit				
Transition'08	0.265	0.335	0.375	0.384
Old HKD	0.316	0.356	0.392	0.395
Non-HKD	0.225	0.241	0.260	0.266
Transition'12	0.252	0.267	0.292	0.328
Average number of Medicaid dental visits per enrollee				
Transition'08	0.564	0.643	0.693	0.710
Old HKD	0.653	0.703	0.742	0.752
Non-HKD	0.518	0.529	0.555	0.567
Transition'12	0.556	0.582	0.618	0.686

Table 2.5: Testing for trends in the outcomes of interest

	Ln number of dentists treating Mcaid children (1)	Number of Mcaid children per dentist (2)	Share of Mcaid children w/ $\geq$1 visit (3)	Number of Mcaid visits per enrollee (4)
Time	0.046	-1.511	0.008**	0.000
	(0.037)	(2.751)	(0.004)	(0.006)
HKD*Time	0.045	1.029	0.011**	0.024***
	(0.040)	(2.761)	(0.004)	(0.007)
Non-HKD*Time	-0.061	3.181	-0.004	-0.005
	(0.038)	(2.793)	(0.005)	(0.008)
Observations	237	237	237	237
Mean Old HKD, 'pre'	71	32	0.32	0.65
Mean non-HKD, 'pre'	176	71	0.22	0.52

Table 2.6: The effect of increased reimbursement rates on the log number of dentists participating in Medicaid

	Ln number of participating dentists				
	(1)	(2)	(3)	(4)	(5)
HKD'08	0.361***				
	(0.046)				
HKD'12	-0.003				
	(0.035)				
HKD		0.142*		0.148	0.131***
		(0.081)		(0.091)	(0.046)
HKD: short-run			0.171**		
			(0.068)		
HKD: long-run			0.114***		
			(0.041)		
Observations	913	913	913	715	264
p-value (HKD'08=HKD'12)			0.420		
p-value (short-run=long-run)	$\leq$0.001				
Comparison	All	All	All	Old HKD	non-HKD

Mean number of dentists in transition'08 counties in the 'pre' period is 199.
Mean number of dentists in transition'12 counties in the 'pre' period is 85.
Mean number of dentists across all transition counties in the 'pre' period (July '08 for transition'08 counties and Jan'12 for transition'12 counties) is 100.
I estimate the model by using Ordinary Least Squares regression (OLS) and cluster standard errors at the county level.

Table 2.7: The effect of increased reimbursement rates on the number of visits from children on Medicaid per dentist participating in Medicaid

	Number of Medicaid visits per participating dentist				
	(1)	(2)	(3)	(4)	(5)
HKD'08	-17.424***				
	(3.833)				
HKD'12	2.046				
	(6.433)				
HKD		-5.683		-5.007	-7.515
		(5.731)		(5.547)	(5.089)
HKD: short-run			-12.387**		
			(5.914)		
HKD: long-run			-8.212***		
			(2.303)		
Observations	913	913	913	715	264
p-value (HKD'08=HKD'12)			0.495		
p-value (short-run=long-run)	0.0104				
Observations	913	913	913	715	264
p-value (HKD'08=HKD'12)			0.966		
p-value (short-run=long-run)	0.031				
Comparison	All	All	All	Old HKD	non-HKD

Mean number of visits from children on Medicaid per participating dentist in transition'08 counties in the 'pre' period is 111.
Mean number of visits from children on Medicaid per participating dentist in transition'12 counties in the 'pre' period is 59.
Mean number of visits from children on Medicaid per participating dentist across all transition counties in the 'pre' period (July '08 for transition'08 counties and Jan'12 for transition'12 counties) is 66.
I estimate the model by using Ordinary Least Squares regression (OLS) and cluster standard errors at the county level.

Table 2.8: The effect of increased reimbursement rates on the share of children on Medicaid with at least one dental visit

	Share of children w/ ≥1 visit				
	(1)	(2)	(3)	(4)	(5)
HKD'08	0.032***				
	(0.009)				
HKD'12	0.066***				
	(0.014)				
HKD		0.053***		0.056***	0.047***
		(0.012)		(0.013)	(0.009)
HKD: short-run			0.037***		
			(0.012)		
HKD: long-run			0.007		
			(0.005)		
Observations	913	913	913	715	264
p-value (HKD'08=HKD'12)			0.018		
p-value (short-run=long-run)	0.038				
Comparison	All	All	All	Old HKD	non-HKD

Mean share of children w/ ≥1 visit in transition'08 counties in the 'pre' period is 0.265, so the estimate in column (1) implies that the share of children on Medicaid with at least one dental visit in transition'08 counties increased from 0.265 to 0.297 with the increase in reimbursement rates.
Mean share of children w/ ≥1 visit in transition'12 counties in the 'pre' period is 0.274, so the estimate in column (2) implies that the share of children on Medicaid with at least one dental visit in transition'08 counties increased from 0.274 to 0.340 with the increase in reimbursement rates.
Mean share of children w/ ≥1 visit in transition counties in the 'pre' period is 0.272, so the estimate in column (3) implies that the share of children on Medicaid with at least one dental visit in transition'08 counties increased from 0.272 to 0.325 with the increase in reimbursement rates.
I estimate the model by using Ordinary Least Squares regression (OLS) and cluster standard errors at the county level.

Table 2.9: The effect of increased reimbursement rates on the number of dental visits by children on Medicaid per enrollee

	Number of dental visits per enrollee				
	(1)	(2)	(3)	(4)	(5)
HKD'08	0.037***				
	(0.008)				
HKD'12	0.098***				
	(0.025)				
HKD		0.074***		0.079***	0.056***
		(0.021)		(0.022)	(0.017)
HKD: short-run			0.050**		
			(0.020)		
HKD: long-run			0.012		
			(0.009)		
Observations	913	913	913	715	264
p-value (HKD'08=HKD'12)			0.061		
p-value (short-run=long-run)	0.020				
Comparison	All	All	All	Old HKD	non-HKD

Mean number of dental visits per enrollee in transition'08 counties in the 'pre' period is 0.564, so the estimate in column (1) implies that the number of dental visits by children on Medicaid per enrollee in transition'08 counties increased from 0.564 to 0.601 with the increase in reimbursement rates.
Mean number of dental visits per enrollee in transition'12 counties in the 'pre' period is 0.590, so the estimate in column (2) implies that the number of dental visits by children on Medicaid per enrollee in transition'08 counties increased from 0.590 to 0.688 with the increase in reimbursement rates.
Mean number of dental visits per enrollee in transition counties in the 'pre' period is 0.587, so the estimate in column (3) implies that the share of number of dental visits by children on Medicaid per enrollee in transition'08 counties increased from 0.587 to 0.661 with the increase in reimbursement rates.
I estimate the model by using Ordinary Least Squares regression (OLS) and cluster standard errors at the county level.

Table 2.10: The effect of increased reimbursement rates on enrollment for Medicaid

	Number of children enrolled in Medicaid			
	(1)	(2)	(3)	(4)
HKD'08	-1,830			
	(1,365)			
HKD'12	-589.5			
	(391.1)			
HKD		-1,265*	-464.8*	-1,362
		(759.9)	(241.1)	(1,419)
Observations	913	913	715	264
p-value (HKD'08=HKD'12)	0.422			
Comparison	All	All	Old HKD	Non-HKD

Mean number of children enrolled in Medicaid in transition'08 counties in the 'pre' period is 40,690.
Mean number of children enrolled in Medicaid in transition'12 counties in the 'pre' period is 9,568.
Mean number of children enrolled in Medicaid across all transition counties in the 'pre' period (July '08 for transition'08 counties and Jan'12 for transition'12 counties) is 13,627, so the estimate in column (3) implies that the number of children enrolled in Medicaid in transition counties declined by 9 percent from 13,627 to 12,362 with the increase in reimbursement rates. This effect is no longer statistically significant when only non-HKD counties are used as counterfactuals for the experience of the transition counties.

APPENDICES

APPENDIX A

Appendix to Chapter 1

Table A.1: Core and Topical Modules from SIPP panel data

	# individuals	
	Module 1	Module 2
Panel 2001		
# respondents 2001	71,280	
# respondents 2002	69,143	
# respondents 2003	65,901	67,530
Panel 2004		
# respondents 2004	99,978	
# respondents 2005	94,617	95,856
# respondents 2006		
Panel 2008		
# respondents 2009	91,219	
# respondents 2010	85,397	88,164
# respondents 2011	79,231	82,260
Total	656,766	333,810

SIPP is collected in a series of panels. Each panel includes 'topical modules' with detailed questions on specific subjects that are conducted with varying frequency. *Module* 1 refers to the 'Medical Expenses and Utilization of Health Care' Module, and *Module* 2 refers to the 'Adult Well-Being' Module.

Table A.2: Testing for the effect of Medicaid dental care coverage on Medicaid enrollment

	Medicaid coverage		
	(1)	(2)	(3)
Time	-0.005*	0.010**	-0.017*
	(0.003)	(0.004)	(0.009)
Dental, drop	-0.007*	-0.004	-0.025*
	(0.004)	(0.006)	(0.014)
Time*Dental, drop	0.001*	0.002	0.002
	(0.001)	(0.002)	(0.002)
N	589,052	190,103	69,373
R^2	0.24	0.24	0.36
Restriction	None	Parents	Disabled

I measure state economic conditions with gross state product (GSP) per capita. I measure conditions in state health care markets with the number of community health clinics per capita and the number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. Unit of observation is state and year.

Table A.3: Effect of Medicaid dental care coverage on the probability of yearly dentist office visit: probit estimates

	Prob of dentist office visits			
	(1)	(2)	(3)	(4)
Full dental	0.007	0.007	0.006	0.052
	(0.010)	(0.010)	(0.014)	(0.047)
Medicaid	0.078***	0.084***	0.017	0.018
	(0.022)	(0.024)	(0.039)	(0.016)
Medicaid*Full dental	0.082***	0.100***	0.084***	0.128***
	(0.014)	(0.015)	(0.018)	(0.022)
N	451,563	142,733	86,312	28,513
R2	0.11	0.07	0.09	0.05
Mean of dep. Var., Medicaid	0.41	0.39	0.42	0.38
Restriction	Full sample	$\leq$2*FPL	Parents, $\leq$2*FPL	Disabled, $\leq$2*FPL

The table reports coefficient estimates from the probit model for the effect of Medicaid dental care coverage on the probability of yearly dentist office visit. The coefficient on $Medicaid * Full\ dental$ is computed by taking a cross derivative of the expected value of the dependent variable (Norton et al, 2004).
The regression includes year, interview month, and state fixed effects, state-specific time trends, and controls for gender, race, age, private health insurance, Medicare coverage, family income, GSP per capita, fraction of state population with access to fluoridated water, and number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. Unit of observation is individual and year.

Table A.4: Effect of Medicaid dental care coverage on the probability of at least one visit to the doctor's office

	Prob $\geq$1 doctor visit
Full dental	0.002
	(0.007)
Medicaid	0.251***
	(0.008)
Full dental*Medicaid	0.014
	(0.010)
N	451,563
R^2	0.14
Mean of dep. var., Medicaid	0.86

The table reports coefficient estimates for the effect of Medicaid dental care coverage on the probability of at least one visit to the doctor's office.
The regression includes year, interview month, and state fixed effects, state-specific time trends, and controls for gender, race, age, private health insurance, Medicare coverage, family income, GSP per capita, fraction of state population with access to fluoridated water, and number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. Unit of observation is individual and year.

Table A.5: Effects of Medicaid dental care coverage on the use of dental care through time

	Prob of dentist office visit		
	(1)	(2)	(3)
Full dental	0.001	0.017	0.027**
	(0.009)	(0.011)	(0.013)
Medicaid	0.023***	0.025***	0.025***
	(0.006)	(0.007)	(0.007)
Full dental*Medicaid	0.096***	0.100***	0.100***
	(0.013)	(0.013)	(0.013)
Full dental*Medicaid*Year0			0.029*
			(0.016)
Full dental*Medicaid*Year1			0.033*
			(0.017)
Full dental*Medicaid*Year2			0.028*
			(0.016)
Full dental*Medicaid*Year3			0.030
			(0.018)
Full dental*Medicaid*Year3+			0.024
			(0.029)
N	432,490	412,758	412,758
R^2	0.146	0.147	0.147
Mean of dep. var., Medicaid		0.41	
Impl year	No	Yes	Yes

The table reports coefficient estimates from the linear probability model for effect of Medicaid dental care coverage on the probability of yearly dentist office visit.
All regressions exclude the year of implementation. In columns 2 and 3, I restrict the sample to individuals in years for which their state of residence either added or did not change Medicaid dental care coverage. In column 3, I allow the effect of Medicaid dental care coverage to vary in the first three years after the policy change.
Each regression includes year, interview month, and state fixed effects, state-specific time trends, and controls for gender, race, age, private health insurance, Medicare coverage, family income, GSP per capita, fraction of state population with access to fluoridated water, and number of dentists per capita.
*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.1$ Robust standard errors in parentheses are clustered at state level. Unit of observation is individual and year.

Table A.6: List of Conditions from ICD-9-CM Classification

ICD-9 code	Description
Dental Conditions ("Diseases of Oral Cavity, Salivary Glands, and Jaws")	
520	Disorders of tooth development and eruption
521	**Diseases of hard tissues of teeth**
522	**Diseases of pulp and periapical tissues**
523	**Gingival and periodontal diseases**
524	Dentofacial anomalies, including malocclusion
525	**Other diseases and conditions of the teeth and supporting structures**
526	Diseases of the jaws
527	Diseases of the salivary glands
528	**Diseases of the oral soft tissues, excluding lesions specific for gingiva and tongue**
529	Diseases and other conditions of the tongue

Preventable dental diseases are in **bold**.

Table A.7: Detailed List of Preventable Dental Disease in Hospital Emergency Department

ICD-9 code	Description	ICD-9 code	Description
521	Dental caries	523.4	Chronic periodontitis
521.1	Excessive attrition	523.5	Periodontosis
521.2	Abrasion	523.6	Accretions on teeth
521.3	Erosion	523.8	Other specified periodontal diseases
521.4	Pathological resorption	523.9	Unspecified gingival and periodontal disease
521.5	Hypercementosis	525	Exfoliation of teeth due to systemic causes
521.6	Ankylosis of teeth	525.1	Loss of teeth (trauma, extraction, or periodontal)
521.7	Intrinsic posteruptive color changes	525.2	Atrophy of edentulous alveolar ridge
521.8	Other spec disease of hard tissues of teeth	525.3	Retained dental root
521.9	Unspec disease of hard tissues of teeth	525.4	Complete edentulism
522	Pulpitis	525.5	Partial edentulism
522.1	Necrosis of the pulp	525.6	Unsatisfactory restoration of tooth
522.2	Pulp degeneration	525.8	Other spec disorders of the teeth/ support structures
522.3	Abnormal hard tissue formation in pulp	525.9	Unspec disorder of the teeth/ supporting structures
522.4	Acute apical periodontitis of pulpal origin	528	Stomatitis and mucositis (ulcerative)
522.5	Periapical abscess without sinus	528.1	Cancrum oris
522.6	Chronic apical periodontitis	528.2	Oral aphthae
522.7	Periapical abscess with sinus	528.3	Cellulitis and abscess
522.8	Radicular cyst	528.4	Cysts
522.9	Other diseases of pulp and periapical tissues	528.5	Diseases of lips
523	Acute gingivitis	528.6	Leukoplakia of oral mucosa, including tongue
523.1	Chronic gingivitis	528.7	Other disturbances of oral epithelium/ tongue
523.2	Gingival recession	528.8	Oral submucosal fibrosis, including of tongue
523.3	Aggressive and acute periodontitis	528.9	Other diseases of the oral soft tissues

Table A.8: Number of ED visits for dental disease in California from various data sources

Source	Outcome	2005	2006	200
SEDD	Number of ED visits for dental disease	71,474	76,513	86,506
	Medicaid	22,101	23,251	26,759
OSHPD	Number of ED visits for dental disease	70,578	76,054	81,508
	Medicaid	22,585	24,337	26,083

Source	Outcome	2005	2007	2009
SEDD	Number of adults[1] with $\geq$1 ED visit per pop	0.22	0.22	0.23
	Medicaid	0.27	0.26	0.27
CHIS[2]	Number of adults[1] $\geq$1 ED visit per pop	0.19	0.19	0.19
	Medicaid	0.31	0.31	0.29

[1] Adults are defined as individuals of age 18 or older. [2]Estimates from this telephone survey are based on 43,000-51,000 adults, depending on the year.
Sources: HCUP SEDD, Office of Statewide Health Planning and Development (OSHPD)

Table A.9: Effect of Medicaid dental care coverage on the probability of preventable dental disease among ED patients: probit estimates.

	Prob of dental disease, ED patients
Full dental	-0.005
	(0.011)
Medicaid	-0.002
	(0.001)
Mediciad * Full dental	-0.001**
	(0.001)
N	7,512,858
R^2	0.01
Mean of dep. var.	0.04

The table reports coefficient estimates from a probit model for the effect of Medicaid dental care coverage in California on the probability of preventable dental disease among ED patients. The coefficient on $Medicaid * Full\ dental$ is computed by taking a cross derivative of expected value of the dependent variable (Norton et al, 2004).

Preventable dental disease is dental disease that could have been prevented at an earlier time (Table A.7). Estimates are based on 25 percent of the sample.

The model includes county fixed effects, month-year time trend, month-year Medicaid-specific month-year time trend, indicator variables for each month, indicator variables for gender, race, and age category, and time-varying county characteristics: number of dentists per capita, number of CHC per capita, fraction of employment in 14 major 2-digit NAICS industries, and unemployment rate.

24% of the sample are on Medicare, 17% are on Medicaid, 34% have private insurance, and 19% are uninsured. The unit of observation is individual and month.

Table A.10: Offset effect of Medicaid dental care coverage on hospital ED: alternative control groups

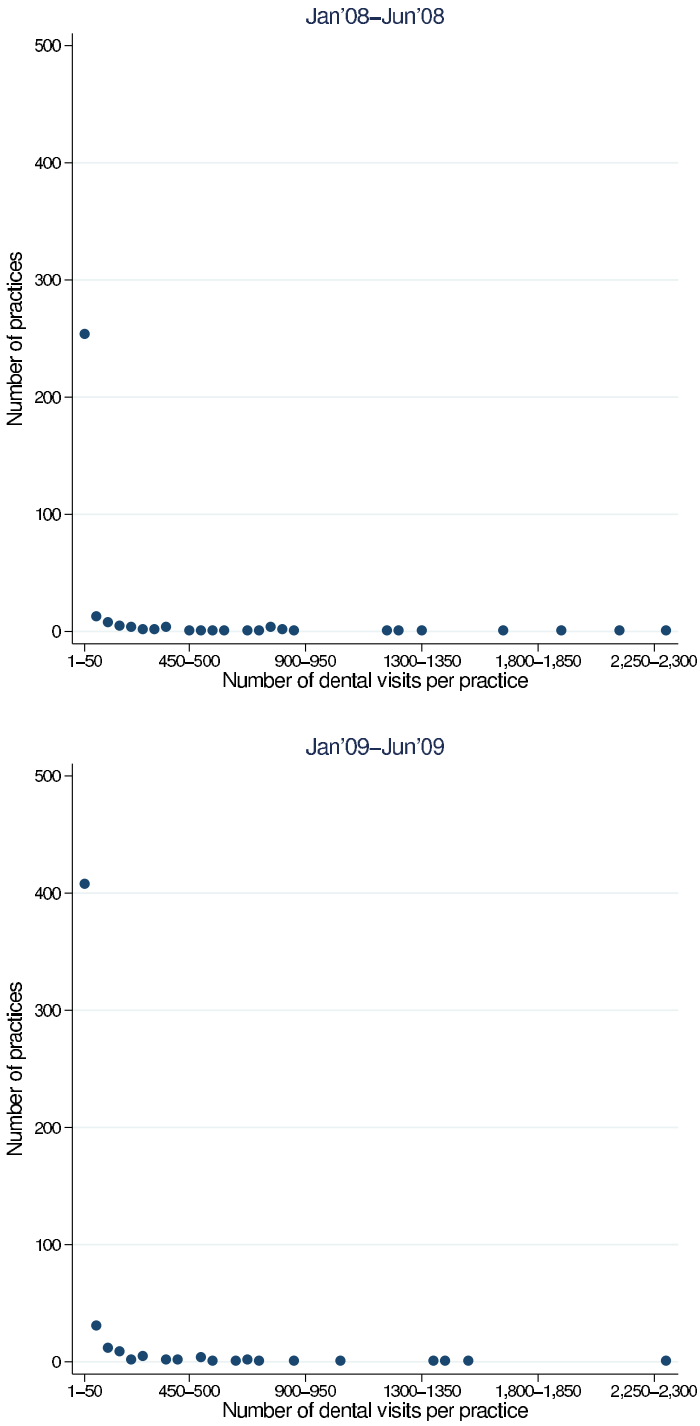
	Num. of ED visits for dental disease per pop (in 1,000's)		
	(1)	(2)	(3)
Post-June'09	0.008	-0.030	-0.099*
	(0.011)	(0.050)	(0.053)
Medicaid	0.038	1.690***	1.062***
	(0.025)	(0.228)	(0.196)
Post-June'09 *Medicaid	-0.020	0.044	0.117*
	(0.018)	(0.067)	(0.065)
N	2,979	5,012	4,975
R^2	0.799	0.596	0.620
Sample	21+yo ≥65yo, Medicare+Medicaid	21-64yo, Medicaid+uninsured	Medicaid 0-20yo and 21-65yo
Mean of dep. var, Medicaid adults before July'09	0.108	1.780	1.780
N	2,979	5,012	4,992
R^2	0.799	0.596	0.619

The table reports coefficient estimates from an OLS model for the effect of Medicaid dental care coverage in California on the number of hospital ED visit for preventable dental disease per population (in 1,000's).
Each column represents separate regression of the outcome on Medicaid coverage indicator, indicator for Medicaid dental care coverage (*PostJune*'09=1 after June 2009), and interaction between Medicaid dental care coverage and Medicaid coverage. I control for county fixed effects, indicator variables for each month, and time-varying county characteristics: number of dentists per 1,000 county resident, number of community health clinics per 1,000 county resident, fraction of population by race (black, American Indian, Asian, Pacific Indian, Hispanic, multi-race), fraction of female population, and fraction of employment in 14 major 2-digit NAICS industries, and unemployment rate.
The unit of observation is county, insurance type, and month.

APPENDIX B

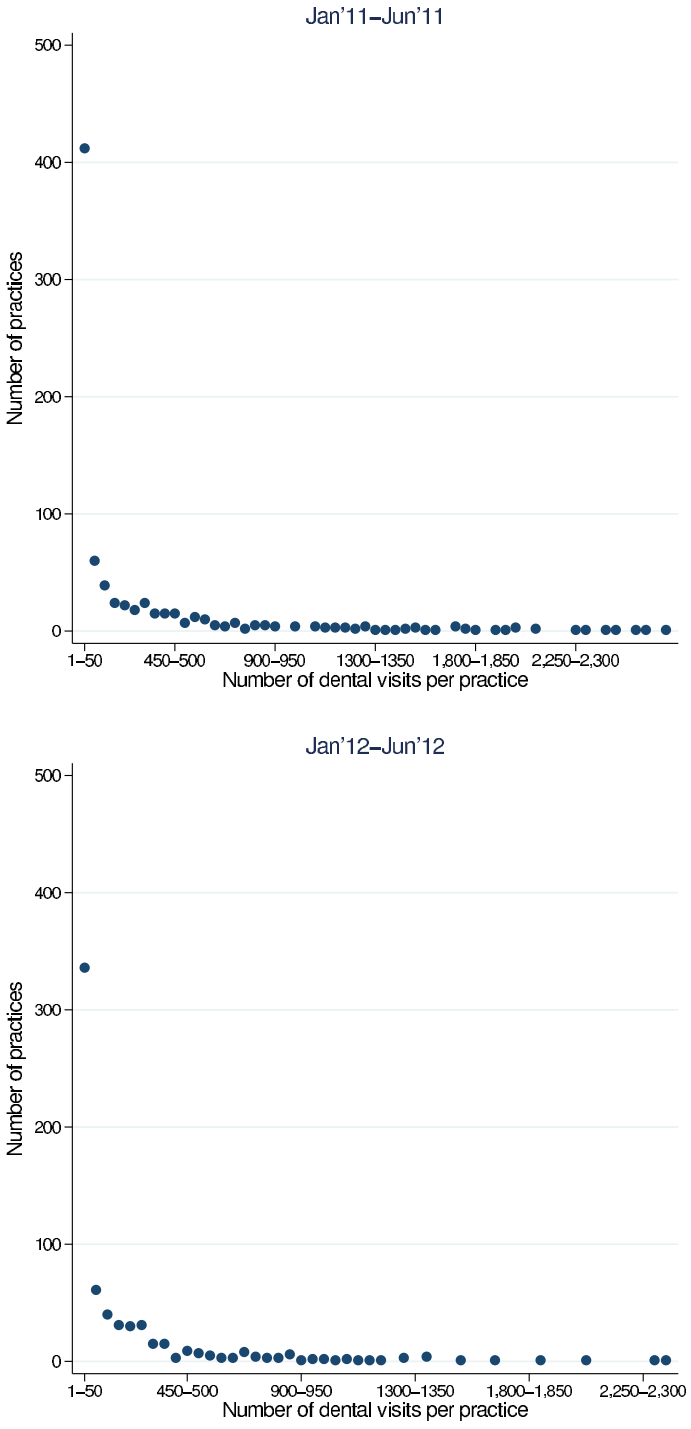
Appendix to Chapter 2

Figure B.1: Number of dental practices treating different volumes of children on Medicaid: Transition'08 counties in 2008 and 2009



Dental practices treating no children on Medicaid are omitted, since these data are not available.

Figure B.2: Number of dental practices treating different volumes of children on Medicaid: Transition'12 counties in 2011 and 2012



Dental practices treating no children on Medicaid are omitted, since these data are not available.

Figure B.3: Effect of increased reimbursement rates on the log number of dental practices participating in Medicaid: event study

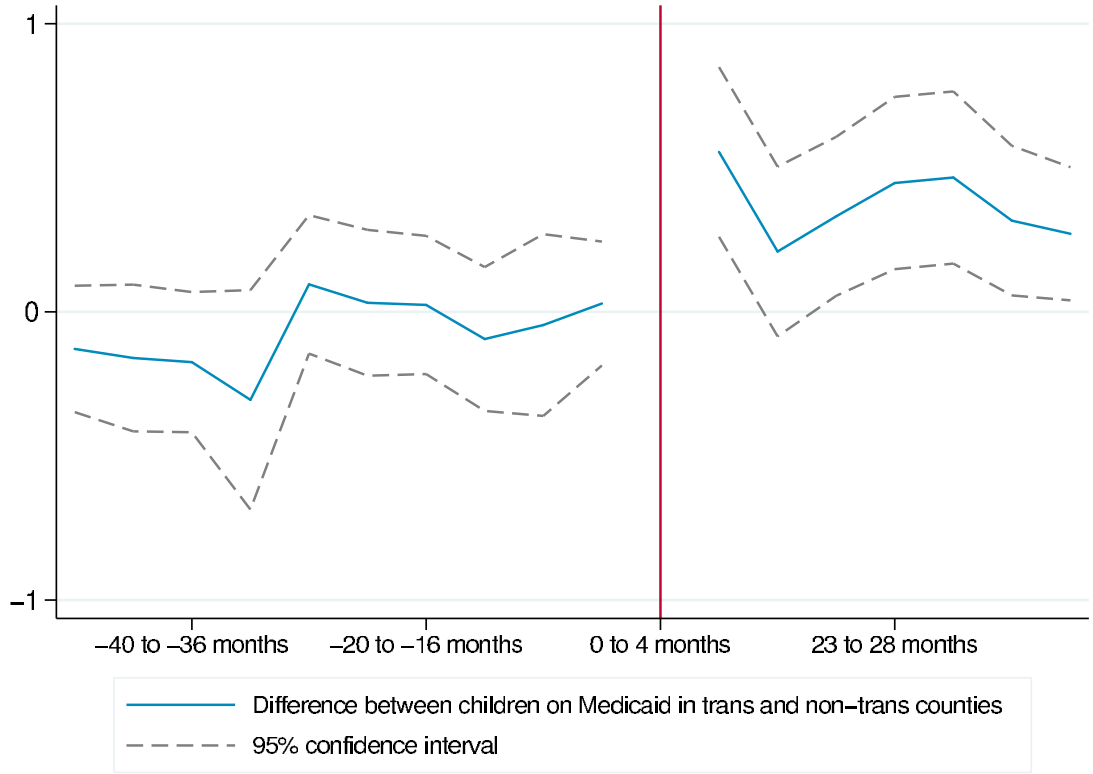


Figure B.4: Effect of increased reimbursement rates on the number of children on Medicaid per dental practice participating in Medicaid: event study

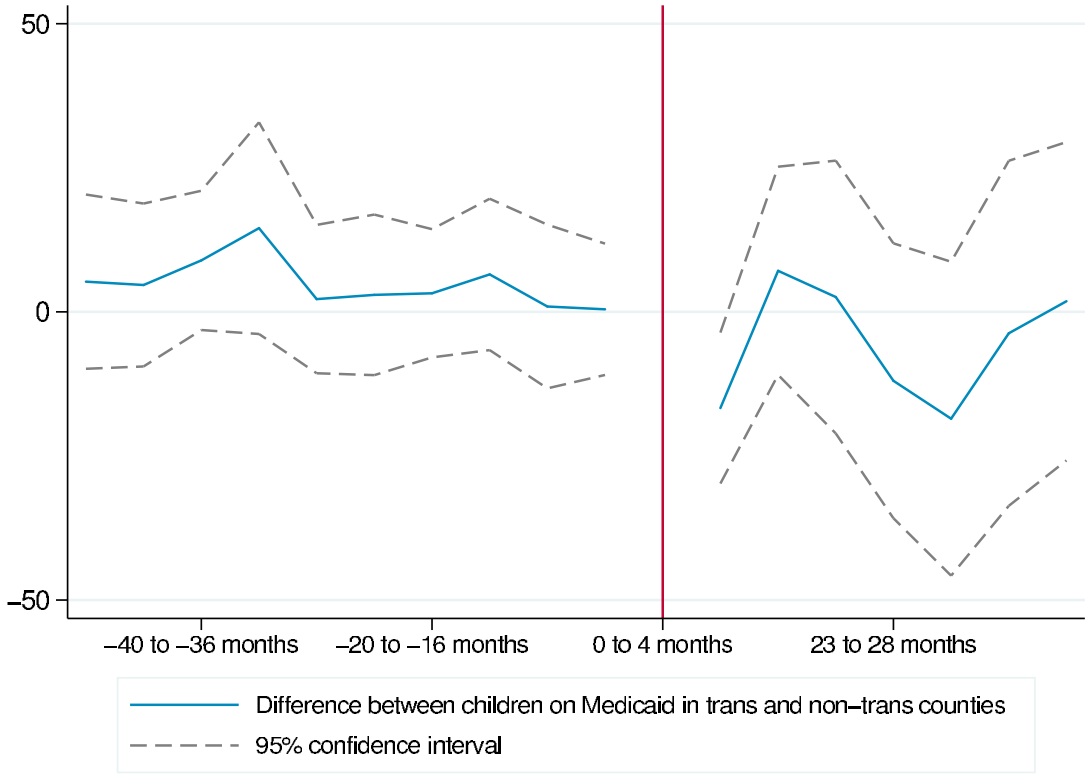


Table B.1: Characterizing dental practices participating in Medicaid

	Pre		Post	
	Jan'07-Jun'08	Jul'08-Dec'09	Jan'10-Jun'11	Jul'11-Dec'12
Average number of practices participating in Medicaid				
Transition'08	197	242	197	174
Old HKD	72	57	54	46
Non-HKD	172	137	120	120
Transition'12	85	55	47	55
Average number of children on Medicaid per practice				
Transition'08	112	109	146	166
Old HKD	32	46	53	64
Non-HKD	74	106	138	139
Transition'12	50	90	119	111

Table B.2: The effect of increased reimbursement rates on the log number of dental practices participating in Medicaid

	Ln number of practices				
	(1)	(2)	(3)	(4)	(5)
HKD'08	0.561***				
	(0.035)				
HKD'12	0.497***				
	(0.042)				
HKD		0.522***		0.556***	0.459***
		(0.031)		(0.026)	(0.059)
HKD: short-run			0.425***		
			(0.030)		
HKD: long-run			0.127***		
			(0.037)		
Observations	913	913	913	715	264
p-value (HKD'08=HKD'12)			$\leq$0.001		
p-value (short-run=long-run)	0.258				
Observations	913	913	913	264	869
Comparison	All	All	All	Old HKD	non-HKD

Mean number of dental practices in transition'08 counties in the 'pre' period is 197, so the estimate in column (1) implies that the mean number of dental practices participating in Medicaid in transition'08 counties increased by 56.1 percent from 197 to 308 per county and six-month period with the increase in reimbursement rates.

Mean number of dental practices in transition'12 counties in the 'pre' period is 61, so the estimate in column (2) implies that the mean number of dental practices participating in Medicaid in transition'12 counties increased by 49.7 percent from 61 to 91 per county and six-month period with the increase in reimbursement rates.

Mean number of dental practices across all transition counties in the 'pre' period (July '08 for transition'08 counties and Jan'12 for transition'12 counties) is 78, so the estimate in column (3) implies that the mean number of dental practices participating in Medicaid in transition counties increased by 52.2 percent from 78 to 119 per county and six-month period with the increase in reimbursement rates.

I estimate the model by using Ordinary Least Squares regression (OLS) and cluster standard errors at the county level.

Table B.3: The effect of increased reimbursement rates on the number of visits from children on Medicaid per dental practice participating in Medicaid

	Number of Medicaid visits per participating practice				
	(1)	(2)	(3)	(4)	(5)
HKD'08	-17.495***				
	(1.539)				
HKD'12	-16.162***				
	(5.262)				
HKD		-16.691***		-17.163***	-18.697***
		(3.251)		(3.038)	(4.414)
HKD: short-run			-14.003***		
			(2.376)		
HKD: long-run			-4.925***		
			(1.511)		
Observations	913	913	913	715	264
p-value (HKD'08=HKD'12)			0.001		
p-value (short-run=long-run)	0.808				
Comparison	All	All	All	Old HKD	non-HKD

Mean number of visits from children on Medicaid per participating practice in transition'08 counties in the 'pre' period is 112.
Mean number of visits from children on Medicaid per participating practice in transition'12 counties in the 'pre' period is 90.
Mean number of visits from children on Medicaid per participating practice across all transition counties in the 'pre' period (July '08 for transition'08 counties and Jan'12 for transition'12 counties) is 93.
I estimate the model by using Ordinary Least Squares regression (OLS) and cluster standard errors at the county level.