NBER WORKING PAPER SERIES

ACCESS TO CARE, PROVIDER CHOICE AND RACIAL DISPARITIES IN INFANT MORTALITY

Anna Aizer
Adriana Lleras-Muney
Mark Stabile

Working Paper 10445
http://www.nber.org/papers/w10445

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 2004

Corresponding authors: alleras@princeton.edu, Anna_Aizer@brown.edu. We would like to thank Sherry Glied, David Cutler and the participants of the lunch seminar at Princeton, the NBER Health Care Meetings, Harris School at the University of Chicago and McGill University for their comments and suggestions. We are also very grateful to Janet Currie for providing us with the vital statistics data and Mark Duggan for providing access to his data and answering many of our questions regarding California's DSH program. Adriana Lleras-Muney received financial support from the National Institute on Aging, Grant Number K12-AG00983 to the National Bureau of Economic Research.The views expressed herein are those of the author(s) and not necessarily those of the National Bureau of Economic Research.

Access to Care, Provider Choice and Racial Disparities in Infant Mortality
Anna Aizer, Adriana Lleras-Muney, and Mark Stabile
NBER Working Paper No. 10445
April 2004
JEL No. I12, I18

ABSTRACT

This paper explores whether choice of provider explains any of the observed infant health gradients, and if so, why poor women choose different providers than their richer neighbors. We exploit an exogenous change in policy that occurred in California in the early 1990s that suddenly increased Medicaid payments to hospitals and which lead to a sharp change in where women with Medicaid delivered. To characterize the extent to which poor women responded to the increase in provider access, we calculate hospital segregation indices (which measure the extent to which Medicaid mothers delivered in separate hospitals than privately insured mothers residing in the same geographic area) both before and after the policy change for each market in California and show that it fell sharply after the policy change. Even though black mothers responded *least* to the increase in provider choice afforded by the policy change, they benefited the most from hospital desegregation in terms of reduced neonatal mortality and decreased incidence of very low birth weight. In contrast, other groups with lower initial neonatal mortality moved more and gained less in terms of improvements in birth outcomes.

Anna Aizer
Department of Economics
Brown University
64 Waterman Street
Box B
Providence, RI 02912
anna_aizer@brown.edu

Adriana Lleras-Muney
Department of Economics
Princeton University
320 Wallace Hall
Princeton, NJ 08544
and NBER
alleras@princeton.edu

Mark Stabile
Department of Economics
University of Toronto
150 St. George Street
Toronto, ON
M5S 3G7
and NBER
mark.stabile@utoronto.ca

I. Introduction

Children born to poor parents in the US are more than twice as likely to die within the first year as those born to higher income parents (Gortmaker and Wise, 1997). It has long been hypothesized that these differences are due, in part, to unequal access to care faced by the poor. Although previous research has shown that efforts to improve financial access to care for low-income pregnant women has resulted in significant declines in infant mortality among the poor (Butler and Scotch, 1978; Currie and Gruber, 1996), income gradients in health remain large: for example in 1990 neonatal mortality rates for Medicaid mothers were 33% larger for privately insured mothers.[1] Despite these efforts, the poor still largely seek care in separate facilities than their privately insured counterparts. For example, in California in 1990, women with Medicaid were 37 percent more likely to deliver in public hospitals relative to their privately insured neighbors. This could explain differences in outcomes if there are large differences across hospitals in the quality of care. Hospital quality, however, is very difficult to measure (McClellan and Staiger, 1999).

In this paper we explore whether choice of provider explains any of the infant health gradients that we observe and if so, why poor women choose different providers than their privately insured counterparts.[2] With respect to the second question, there are two possible (though not mutually exclusive) explanations. Medicaid may pay less than market price and there is some existing evidence to support this (Yudlowski, 1990). As such, women with Medicaid may be constrained in their choice of provider. It may also be that even without such a constraint, poor women still choose alternative (and lower

[1] See Table I.
[2] Along similar lines, Chandra and Skinner (2003) have shown that blacks utilize lower quality hospitals, and suggest they do so due to their geographic proximity to such hospitals.

quality) providers, which would suggest a potential market failure. Whether and to what extent each of these can explain differences in the choice of provider has important (and different) policy implications for improving the health of the poor.

To answer these questions we exploit an exogenous change in policy that occurred in California in the early 1990s that suddenly increased Medicaid payments to hospitals and which lead to a sharp change in where women on Medicaid delivered.[3] We focus on pregnant women because they constitute a large fraction of the Medicaid population, they have adequate time to choose a hospital for delivery and because there is evidence that access to high quality hospital care can affect neonatal mortality (Cutler and Meara, 1999).

In order to characterize the extent to which poor women responded to the increase in provider access, we calculate hospital segregation indices both before and after the policy change for each county in California. The hospital segregation index is a measure of the extent to which women with Medicaid delivered in separate hospitals from women with private insurance residing in the same geographic area. We then look at whether greater rates of hospital desegregation resulted in improved health outcomes, measured by neonatal mortality and birth weight. Our approach is based on the idea that gradients in health cannot be attributed to differences in health care access if there are no differences across income in hospital choice. Rather than attempt to measure differences in the quality of the hospitals mothers choose, we look to see whether a more equal distribution of hospital choice lowers health inequities.

[3] See Duggan, 2000 and Duggan, 2002 for thorough explanation and analysis of this policy change in terms of its impact on the ownership type of hospitals in which Medicaid patients were seen.

We also examine whether within the Medicaid population there were differences in the rate at which specific subgroups of pregnant women switched hospitals. The decision to go a different hospital depends on the costs and benefits associated with the change. There is evidence that suggests that even among the poor these costs and benefits might differ significantly. Hispanics tend to have slightly better birth outcomes compared with the general population of Medicaid mothers, while the less educated and particularly blacks have worse birth outcomes.[4] Thus black and low educated mothers may benefit more from accessing higher quality hospitals. We also hypothesize that more educated mothers may be better informed both about the newly available hospitals and about their quality (or perhaps about the importance of having access to quality care); and thereby may respond at higher rates.[5]

We find that among those with Medicaid, black mothers responded *least* to the increase in provider choice afforded by the policy change. This does not appear related to residential isolation. Interestingly, black mothers benefited the most from hospital desegregation in terms of reduced neonatal mortality and decreased incidence of very low birth weight. The neonatal mortality rate for black mothers with Medicaid coverage declined from 8.6 to 7.8 per thousand over this period. Our estimates suggest that most (92 percent) of this decline can be attributed to increased access to care. In contrast, other groups with lower initial neonatal mortality moved more and gained less in terms of

[4] In 1990, the rate of neonatal mortality in California was 4.1 per 1000 births. For blacks, the figure was more than twice as great (8.6) – which is considerably higher than other low SES groups. For single mothers the rate was 5 per 1000, for high school drop-outs it was 4.6 per 1000 and for Hispanics it was 4 per 1000 for the same period.

[5] Babies of more educated mothers (in the population) have better health outcomes (e.g. Currie and Moretti 2003). Better access to information and differential use of information have been shown to be predict infants' health (Meara, 2001)

improvements in birth outcomes. We do not find any evidence that more educated mothers were more responsive than the average Medicaid mother.

This paper is organized as follows. Section 2 presents the data. In section 3 we describe the policy changes that took place in California in 1991 in further detail. We then look at changes in hospital choice among Medicaid mothers, and for different socio-economic groups within Medicaid in section 4. We then analyze the impact of these hospitals choices on neonatal mortality (Section 5) and present a series of specification checks (Section 6). We discuss the results in Section 7 and Section 8 concludes.

II. Data

We use California Birth certificate data matched to death certificate data from 1989 through 1995. These data contain individual level records of all the births that occurred in California as well as information about the parents. The former includes infant characteristics (gestational age, birth weight, fetal death, infant mortality by cause and age of death). The latter includes mother's age, education, race, marital status, type of insurance coverage, zip code of residence, previous number of live births, and prenatal care (when initiated and number of visits). The hospital of delivery and its location are also recorded.

We restrict our sample to mothers that had either Medicaid or private insurance (eliminating the small proportion of mothers whose primary source of insurance was listed as Medicare, Worker's Compensation, etc. as they are an unrepresentative group of mothers). We drop Medicaid mothers with more than a college degree: they too are likely a very select and unrepresentative group. We also drop teenage moms as teen birth rates are changing over this period for reasons independent of DSH. Finally, we restrict our

attention to urban areas, excluding roughly ten percent of the sample residing in very rural areas.[6] Our results are not sensitive to these sample restrictions. Because we focus on changes at the county level, we collapse all the individual births into cells defined by county, year of birth, maternal race, education, age, marital status, whether foreign-born and Medicaid status.

Descriptive statistics are in Tables I.a and I.b. They indicate that neonatal mortality fell during this period, and it did so more for mothers on Medicaid than others. They also show that during this period some characteristics of mothers changed: the share of mothers on Medicaid, the share Hispanic and the share foreign born rose quite substantially. We discuss our methods to control for these changes in the underlying population of women with Medicaid in the analyses in later sections.

In table I.b we document that in 1990, there were large differences in health outcomes among Medicaid mothers: all outcomes are worse for children of black mothers, followed by high school dropouts, whites and then Hispanics.

III. California's Disproportionate Share (DSH) Program

In the 1980s the Federal government passed legislation that allowed the states to compensate hospitals that served a disproportionate share of disadvantaged patients.[7] Under DSH each state was to design and administer its own program, and the Federal government would provide matching funds for DSH reimbursements. California's DSH program was created at the end of 1990 and it stipulated that hospitals whose Medicaid (and indigent) related costs exceed 25% in the previous year would receive substantial

[6] Rural was defined as a zip code of which less than 25% of the population lived in an urban area as determined by the 1990 Census.
[7] See Appendix A for details on the history and functioning of the DSH program.

per diem reimbursements. These reimbursements increased as a function of the number of low income patients above 25%.[8] Funds were first received by hospitals in the fiscal year 1991-1992.

Because of its generosity, the DSH program provided an incentive for many private hospitals to drastically increase the number of Medicaid patients that they served (Duggan 2000a). As a result, in a short period of time, there was a large re-distribution of Medicaid patients from public to private hospitals. Figures 1a-c document this change: from 1990 to 1995, the share of Medicaid patients going to public hospitals fell from about 65% to 40%, whereas the share of Medicaid patients going to non-profit hospitals rose from about 22% to more than 40%. This redistribution of patients across hospitals was limited to those with Medicaid: the distribution of patients with private insurance across hospitals stayed constant throughout the period.

Prior to the implementation of DSH, Medicaid mothers were largely seen in separate hospitals than the privately insured. Controlling for location (and thus geographic access to hospitals) women with Medicaid in California were 37 percentage points more likely to go to public hospitals than their privately insured neighbors (only 11% go to public hospitals).[9] After the implementation of DSH, and corresponding with the changes for the Medicaid population as a whole, the share of Medicaid births in public hospitals fell between 1990 and 1995 with a corresponding increase in Medicaid births in private hospitals (see figures 2a and 2b). Consistent with these trends, the

[8] Because funds distributed under DSH increased from 6 to 39% of total Medicaid funds between 1990 and 1992, and due to suspicions that funds were given to hospitals that did not primarily serve the Medicaid population, in 1993 congress reformed DSH, imposing additional eligibility restrictions to contain costs.
[9] Using our sample of mothers, we estimated a linear regression of the probability of delivering in a public hospital as a function of Medicaid status, controlling for zip code fixed effects. We report the coefficient on the Medicaid dummy from this regression.

number of hospitals eligible to receive DSH payments increased over this period, from 13 percent in 1990 to 28 percent in 1994-1995.[10] DSH accounted for 0.2 percent of total Medicaid spending in 1990 and 19.3 percent by 1995.

This suggests that the choice set of Medicaid patients prior to DSH was indeed restricted due to Medicaid payment rates that were lower than market and as the price paid by Medicaid increased, so did competition for these patients. We treat this payment increase introduced by DSH as an exogenous increase in the hospital choice set of Medicaid patients and especially expectant mothers. Expectant mothers are a particularly interesting group to analyze the impact of expansions in access on hospital choice: they have little uncertainty regarding their future health care needs and they have time to make informed choices. Also, they are a large sample: Medicaid moms make up a large fraction of Medicaid patients (46 percent of all Medicaid patients in California in 1990) and Medicaid covers a large fraction of all expectant mothers (40 percent in California in 1990). Finally because Medicaid covers all birth-related expenses, income and direct costs do not play an important role in determining hospital choice for this sample.

IV. Trends in hospital choice

A. Measuring Hospital Segregation

To characterize the change in the distribution of Medicaid deliveries over this period within their market, we calculate a Tauber "segregation" index (Tauber and Tauber, 1965) which measures the extent to which Medicaid mothers deliver in separate hospitals than those privately insured. In our sample 94 percent of mothers gave birth within their

[10] These are the percentages for hospitals in our hospital data, a sample of 339 hospitals for which the State of California provided numbers (Mark Duggan generously gave us access to this information which he obtained).

county. As such, we define a mother's potential choice set as all providers in her county of residence.[11] For each county and year we create a Tauber Hospital Segregation Index[12] (HSI) as follows:

$$\text{HSI}=1/2*\sum_{i=1}^{n}\left|\frac{Mcaid_i}{Mcaid}-\frac{pvtpay_i}{pvtpay}\right|$$

In the expression above, i indexes each hospital in the county. The first term is the number of Medicaid deliveries in hospital i over the total number of Medicaid deliveries in the county in a given year. The second term is similarly defined, but for privately insured deliveries. The segregation index ranges from zero to one, with zero being un-segregated, and one being totally segregated. Levels above 0.6 are considered high (Massey and Denton 1993).

The HSI captures the extent to which Medicaid and privately insured mothers deliver in the same hospitals. In segregated counties, Medicaid mothers deliver in different hospitals from the privately insured. In relatively un-segregated (or integrated) counties, Medicaid and privately insured mothers are more likely to deliver in the same hospitals. Intuitively, the HSI tells us the proportion of Medicaid (or privately insured) mothers who would have to switch hospitals for the county to be un-segregated. The index captures all of the information about the distribution of patients across hospitals within a county, and, importantly, it is NOT a function of the share of Medicaid mothers

[11] More specifically, we find that half of all mothers deliver in a hospital within five miles of her zipcode of residence and 85 percent of mothers deliver in a hospital within 16 miles of her zip code.
[12] This index is also known as the dissimilarity index. There are other measures of spatial segregation, such as the index of centralization or isolation, but they do not seem appropriate in the context of the hospital market.

in the county. If segregation were 0, then health gradients could not be attributed to differential access to care.[13]

The use of the segregation index to characterize the hospital choice set of mothers in a given county is based on the revealed preferences argument: presumably if mothers choose different hospitals after DSH it is because they prefer them along some dimension. We assume throughout this paper that mothers choose the hospital where they deliver (evidence based on patient surveys suggests that patients play a significant role in choice of hospital either indirectly through the choice of physician or directly in consultation with their physicians[14]). Therefore, the segregation index should decrease more in areas where more and "better" hospitals began serving the Medicaid population after the implementation of DSH. Recall from Figures 1b and 2b that there was almost no change in the type of hospitals chosen by privately insured mothers over this period; therefore we operate under the assumption, which we will test in section VI, that most of the changes in segregation are due to the behavior of Medicaid mothers subsequent to the implementation of the DSH policy.

Because the extent to which a county is segregated in a given year might reflect differences in the underlying characteristics of the Medicaid and privately insured populations that vary across counties, we look at within county *changes* in hospital segregation 1990-1995. We argue that changes over this brief period can be attributed to DSH alone, not to any neighborhood sorting, and can therefore be taken as exogenous when explaining changes in birth outcomes at the county level.

[13] Although the existence of hospital segregation does not per se imply that health gradients are due to health care--this is a necessary but not sufficient condition.
[14] For example, work by Berkowitz and Flexnor (1981) states that roughly half of all individuals surveyed reported that the choice of hospital was at least "a 50/50 collaborative effort" with their physician.

B. Trends in Hospital Desegregation: 1989 -1995

Figure 3a shows the trends in hospital segregation throughout the period. Prior to 1991, hospital segregation was rising. But the level of hospital segregation declines from .59 to .51 or 13.5 percent beginning in 1990-1991, coincident with the implementation of DSH. This reflects the fact that pregnant women on Medicaid began delivering in hospitals that previously served mainly privately insured women.

There is considerable variation across counties in the extent to which hospital segregation changed over this period. Most counties (63 percent) experienced a decrease in segregation but segregation remained roughly the same or increased in others. The largest decline occurred in Riverside County (about 35 percentage points) and the largest increase occurred in Fresno. (See Appendix B for individual county trends in segregation over this period). In section VI, we provide evidence that the extent to which counties become desegregated over this period is not related to underlying characteristics of the Medicaid population, but rather the existing structure of the hospital market and the fact that some hospitals faced greater incentives under DSH to serve Medicaid patients than others.

We re-calculate the segregation index for three different subgroups: Hispanic mothers, Black mothers and mothers without a high school degree.[15] The trends for these segregation indexes are in Figure 3b. Overall, it appears that Hispanic mothers and high school drop outs experience the same decline in segregation as the general population of Medicaid mothers (though the initial levels are higher). Black Medicaid mothers appear

[15] We hold constant the privately insured distribution (i.e. all the share $pvtpay^i/pvtpay$ is the same for all indexes) and use the group specific distribution across hospitals (so instead of including all Medicaid mothers in the segregation index, we include black Medicaid or Hispanic Medicaid).

to be the exception, experiencing much smaller declines in segregation relative to non-black Medicaid mothers.

In Tables II and III we examine these patterns more formally. In Table II we present results of a non-parametric analysis of the trend in hospital segregation over this period in which we regress hospital segregation on indicator variables for each year 1989-1995 (with 1991 omitted) as well as indicators for black, Hispanic and whether a high school dropout and include county fixed effects.[16] This enables us to test both whether the trend appears to break in 1991, as well as whether the trend post 1991 is linear in form. As is evident from the table, hospital segregation seems to be increasing prior to 1991 (though the coefficient estimates are not significantly different from zero) but after 1991 appears to be decreasing in a linear fashion. At the bottom of Table II we provide f-statistics of tests of the break in trend which confirm that the break in trend did occur in 1991, coincident with the launching of DSH. Furthermore there are no other breaks in the trends in any other years. We cannot reject the assumption of a linear downward trend post 1991 (f statistic 1.03, p-value 0.379).

To more formally test whether some groups appear to have moved more or less upon the implementation of DSH, we specify a linear trend post-1991 and interact the trend with race and education indicators. This can be written as:

$$HSI_{retc} = \beta_0 + \beta_1 * t + \beta_2 * post91 + \beta_3 * t * post91 + \beta_4 * X_r + \beta_5 * t * X_r + \beta_6 * post91 * X_r + \beta_7 * t * post91 * X_r + \gamma_c + e_{retc}$$

where the dependent variable is hospital segregation index for a given race *r*, educational group *e*, year *t* and county *c*. We interact the time trend *t*, the post 91 dummy, *post91*,

[16] Thus each cell is a race, education, year, county group.

and the trend after 1991 (t*post91) with *X*, which stands for race and education dummies. We include county fixed effects (γ_c). The three (mutually exclusive) race categories are Black, Hispanic and non-Black/non-Hispanic.[17] The two educational groups are HS drop-outs and HS graduates. The results are in Table III. Prior to 1991 there does not appear to be any significant trend in segregation (β_1=0.00384 and imprecisely estimated) but after 1991, segregation begins to decline significantly (β_3 = -0.0359). In addition it appears to decline much more slowly for Blacks post-1991 (β_7 = 0.0169), slightly more slowly for Hispanics (β_7 = 0.00263) and slightly faster for HS drop outs (β_7 = -0.0029). However, only the estimate for blacks is precisely estimated. Below the table we present the results of tests of significance between the post-1991 trends for blacks vs. Hispanics and HS drop outs. The coefficient for less than high school does not support the hypothesis that more educated mothers would move at faster rates due to information advantages (if anything it suggest the less educated mothers moved more). There does not appear to be any significant effect for Hispanics.

Only the post-1991 decline in hospital segregation for blacks is significantly less steep than it is for other groups. While we might expect that as high risk patients, black mothers would move more, prior research has found that even conditional on health insurance coverage, blacks exhibit different patterns of care. For example, Currie and Thomas (1995) find that black children do not receive as many doctor visits or check-ups as other similarly insured children. Currie and Reagan (1998) find that the probability that black children receive regular check-ups is more highly dependent on geographic proximity to public providers than other groups with similar health insurance coverage.

[17] In California, there are very few Black mothers who report Hispanic ethnicity.

As such, the finding that they are less responsive to the increase in provider access despite their risk profile is not necessarily surprising.

V. The effect of hospital desegregation on infant health

A. Preliminary Evidence

The birth outcome we analyze is neonatal mortality (death within 28 days of delivery, excluding fetal deaths[18]) because it better reflects the impact of the hospital of delivery on birth outcomes than does infant mortality (all deaths within one year) or low birth weight (LBW). To identify the impact of changes in access on improvements in neonatal mortality, we examine how changes in hospital segregation affect rates of neonatal mortality for different groups. If mothers moved to better hospitals then this should be reflected in better outcomes. In counties where mothers did not move, i.e. in which segregation did not decline, we do not expect to see any effect.

On average, neonatal mortality improved over the period 1990-1995 although there were differences in the rate of improvement across groups. The natural experiment created by the policy change allows for a number of interesting comparisons. First we can compare changes in birth outcomes for Medicaid mothers relative to the privately insured. Then, we can compare birth outcomes for those with Medicaid in areas that witnessed declines in segregation with those in areas with no decline/small increases in segregation over this period.

Overall, neonatal mortality declined more for Medicaid births relative to the privately insured between 1990 and 1995 (Figure 4a). In addition, as is evident in figure

[18] We exclude fetal deaths because these are well-known to be underreported (CDC 1994)

4b, neonatal mortality among Medicaid births declined more in areas with decreases in segregation than in areas with increases in segregation. But this comparison is subject to the criticism that there may be other differences between counties that witnessed decreases in segregation versus those that did not that might be behind the improvements in birth outcomes. Thus as a second comparison, we can use privately insured deliveries in the same counties as controls and compare the relative improvements in neonatal mortality for Medicaid births versus privately insured births within the same county. We expect the improvements of Medicaid relative to private to be greater in counties with decreases in segregation and that is what we find. In Figure 4c we see that while the rate of neonatal mortality fell by 8 per 10,000 for Medicaid, the rate fell by less (6 per 10,000) for the privately insured in counties with declines in segregation. In figure 4d we present the same rates but for counties with no change or a small increase in segregation. While neonatal mortality fell for privately insured births at the same rate in these counties as they did in counties with declines in segregation (6 per 10,000), the rate of decline for Medicaid births was much lower – only 2 per 10,000.

Thus the preliminary evidence suggests that hospital desegregation lowers income health gradients. In the next section we present results from formal regression analyses that allow more precise measures of changes in segregation while controlling for other factors that may affect birth outcomes. In addition, because existing evidence suggests that within the low-income population there exist important differences in the way subgroups access care and our own evidence suggests that some groups were less responsive to the increase in provider choice, we look more specifically at how

desegregation affects subgroups of the Medicaid population defined by race and education.

B. Regression Results

Our initial estimates of the impact of hospital desegregation on health outcomes are difference-in-differences estimates in which we compare the differences in birth outcomes for Medicaid mothers vs. privately insured mothers in areas that witnessed large declines in segregations vs. those in areas with small/no declines in segregation. The difference-in-difference estimate is represented by β_1 in the following equation:

$$health_{gtc} = \beta_0 + \beta_1 * \ln(1 - segregation_{tc}) * Medicaid + \beta_2 * Medicaid + \beta_3 * \ln(1 - segregation_{tc}) + I(1995 = 1) + \gamma_c + X\delta + \varepsilon_{gtc}$$

where X is a set of age, race, foreign-born and marital status dummies. The dependent variable is neonatal mortality for a given group g in year t county c. The sample consists of two years of data (1990 and 1995),[19] and we include an indicator for 1995 as well as county fixed effects. We chose *ln(1-segregation)* as our measure of segregation because changes in segregation appear to have a greater impact in areas where segregation was initially high, thereby rejecting a linear functional form.[20] If de-segregation results in a decline in neonatal mortality, β_1 (the D-in-D estimate) will be negative. By including an indicator for Medicaid we control for potential differences in underlying trends in neonatal mortality between Medicaid and privately insured mothers. County indicators control for trends at the county level that may be correlated with changes in segregation

[19] Because the changes in segregation occurred slowly (as shown in previous section), we chose to do the analysis with only two years, one immediately before, and one after.
[20] The log of de-segregation (1-segregation) is concave in de-segregation therefore convex in segregation.

and affect neonatal mortality. And the year dummy controls for national trends in neonatal mortality. Therefore β_1 is identified from changes in segregation within counties over time among the Medicaid population. We interpret this coefficient to capture the health benefits that accrued to Medicaid mothers that moved to hospitals the previously served mainly the privately insured. In the absence of any changes in segregation, we should observe no changes in neonatal mortality. To the extent that mother moved to higher quality hospitals, then neonatal mortality should fall more in those counties where mothers moved the most. The standard errors are clustered at the county level.

The difference-in-differences estimate is small and insignificant (Table IV, Column 1). Thus, consistent with Duggan (2000) we find that on average, even though Medicaid mothers chose to deliver in different hospitals once they were able to access them, there appears to have been no observable decline in neonatal mortality.

To test whether expanding access to care matters more for different subgroups defined by education and race, we report triple difference estimates of the impact of a decline in hospital segregation for black, Hispanic and poorly educated mothers with Medicaid. For example, the triple difference estimates for blacks are represented by β_1 in the following equation:

$$\begin{aligned} health_{gtc} &= \beta_0 + \beta_1 * \ln(1 - segregation_{tc}) * Medicaid * Black \\ &+ \beta_2 * \ln(1 - segregation_{tc}) * Medicaid + \beta_4 * Medicaid * Black \\ &+ \beta_5 * Medicaid + \beta_6 * Black + \beta_7 * \ln(1 - segregation_{tc}) + I(1995 = 1) + \gamma_c + X\delta + \varepsilon_{gtc} \end{aligned}$$

This specification includes all the same controls as the previous one. The estimated coefficients with the triple interactions are in column two of Table IV. For blacks (column 2), the triple interaction term is negative and significant. The coefficient

suggests that a decline in segregation of 0.08 (the average over this period) results in a decline in black neonatal mortality of about 0.000738 percentage points. On a baseline of 0.0086 (neonatal mortality rate among black Medicaid), this represents a decline of 8.6 percent (evaluated at the level of segregation in 1990).[21] Note that black neonatal mortality among Medicaid mothers fell from 0.0086 to 0.0078, so the decline in segregation explains about 92 percent of the decline for this group. The results for high school drop-outs (column 3) and Hispanics (column 4) suggest that desegregation had no impact on neonatal mortality for these groups. This could be a result of their lower neonatal mortality rates, suggesting decreasing marginal product of neonatal care.

We investigate these findings further. In the next table (Table V), we present estimates stratified by initial level of segregation. We separate counties into those with high levels of segregation (greater than the mean in 1990) and counties with low initial levels of segregation. This exercise reveals that for blacks all of the effects on neonatal mortality are being driven by reductions in segregation in counties that were originally very segregated. The effect is about 2/3 larger in these counties than for the average. On the other hand the coefficient is insignificant for counties with low levels of segregation in 1990. And we still find that changes in segregation had no impact for Hispanics or high school drop-outs.

We also look at the impact of changes in segregation on a number of other outcomes that could be potentially affected by access to better hospitals, namely low and very low birth weight, and the adequacy of prenatal care.[22] These results are in Table VI. Birth weight an important marker for health, and it is also an outcome that is influenced

[21] Note that the effect of a unit change in segregation on neonatal mortality is given by $\beta(1/(1-HSI))$. Therefore the effect of a change of –0.09 is given by $\beta(1/(1-HSI))(-0.09)$

[22] We do not have any other measures of behaviors during pregnancy.

by events during pregnancy, not just by the quality of the hospital at delivery. For blacks, we find that desegregation significantly lowered the percentage of very low birth weight babies, but had no effect of the percentage of low birth weight babies or in the use of prenatal care.[23] Our estimates suggest the declines in segregation in this period lowered the incidence of very low birth weight among black babies by 0.0018 percentage points or 5% relative to the mean in 1990. According to these results the entire decline in very low birth weight among black babies observed between 1990 and 1995 can be attributed to declines in segregation.

Gould (2000) finds that residential segregation is correlated with low birth weight among blacks; our results suggest that this is partially due to access to higher quality care. These results also suggest that there was some change in maternal behaviors during pregnancy. Finally note that Table VI also shows that there were no effects for Hispanics or high school drop-outs on any other outcome.

Not all decreases in neonatal mortality among blacks are due to increases in birth weight: if we control for low birth weight (Panel C of Table VI) we still find a very large effect of desegregation on neonatal mortality. These results suggest that it is the access to quality care for the delivery that is responsible for most of the improvements in neonatal mortality that we observe. These results are consistent with previous findings that access to high quality neonatal medical care is an important determinant of birth outcomes (Cutler and Meara, 1999).

[23] We present results for the percent of mothers with inadequate prenatal care, but the results are identical if we use the number of prenatal care visits, the month when prenatal care began or the Kotelchuk Index. Irrespective of the measure we use, we do not find that changes in segregation led to improvements in the use of prenatal care.

VI. Specification checks

In this section we investigate the possibility that the hospital desegregation witnessed over this period is due to factors other than DSH, such as changes in the composition of Medicaid (or more generally changes in demographics), changes in residential segregation or changes in the hospital market. We conclude that they did not and provide further evidence that the changes were driven by the new incentives created by DSH. We also test the robustness of our results and include a discussion of other possible mechanisms behind the improvements in outcomes for blacks that we observe. We concentrate on blacks since we do not find any effect of changes in segregation on other Medicaid mothers.

A. Medicaid expansions

Table I showed that the characteristics of Medicaid pregnant women changed over the period 1990-1995 which is most likely due to expansions in Medicaid eligibility at the beginning of the period. It is possible that women who became eligible for Medicaid were both more likely to attend private hospitals and to have lower neonatal mortality risk. The two most significant expansions consisted of an increase in the financial eligibility for Medicaid from 100 to 185 percent of the Federal Poverty Line in 1989 and an expansion of Medicaid eligibility to undocumented pregnant women in 1990.[24] The former would have the effect of increasing the average health of mothers on Medicaid while the latter would likely have the opposite effect. In addition, the financial eligibility expansion also raises the possibility of crowd-out, in which case the

[24] The changes in Medicaid eligibility that took place in California between 1989 and 1995 are documented in Appendix C.

composition of privately insured mothers would also change over this period. This would cast doubt on our ability to use the privately insured as a control in this context, (though the bias introduced by this change in the control group would understate our results.) However, the impact of the expansions in financial eligibility is likely small because according to the state, in 1995, only 8.2 percent of all Medicaid deliveries were to women qualifying under the expansions.[25] In addition, we dropped all Medicaid deliveries to mothers with a college degree, further mitigating the impact of the eligibility expansions.

To better understand the changing composition of Medicaid births and how this might affect our results, we present trends in the number of Medicaid deliveries to native and foreign born mothers over this period. As Figure 5 illustrates, total Medicaid births increased substantially over the 1990s as the expansions took effect. However, it appears that almost all this growth was in foreign-born mothers. The number of Medicaid births to native-born mothers remained relatively constant over this period.

Furthermore the change in segregation does not appear to be driven by this change in the composition of Medicaid. In Figure 3C we show that the trends for the segregation index are not very different if we exclude all foreign-born mothers (both Medicaid and privately insured). And since foreign-born undocumented mothers are on average less healthy than the average Medicaid mother, this change in composition would bias our results downwards (rather than upwards).

Nonetheless, we re-estimate our main results by restricting our sample only to native-born mothers,[26] and recalculate the changes in segregation only for this group. The

[25] Medical Care Statistics, "MediCal Funded Deliveries, 1994-2000." State of California, Department of Health.

[26] We do not know whether foreign-born mother are undocumented, so we exclude all foreign-born mothers from the analyses.

results (panel A of Table VII) are quantitatively similar to those we present in Tables IV and V.[27] We also calculated segregation indexes only for black Medicaid mothers and used it instead of the overall segregation index. Our results, reported in panel B of table VII, are unchanged.[28]

B. Residential segregation

Another possibility is that changes in where Medicaid mothers reside may drive the change in where they deliver. To investigate this possibility we present trends in residential segregation of Medicaid mothers (Figure 3). Residential segregation at the county level is calculated just like hospital segregation but based on share within zip codes rather than hospitals. While hospital segregation begins to fall in 90-91 coincident with the launching of DSH, residential segregation is actually increasing slightly over this period suggesting that any changes in where Medicaid mothers resided over this period did not drive the change in hospital desegregation that we witness.

C. The hospital market and incentives created under DSH

Finally we investigate the factors that may explain changes in segregation directly. We regress changes in segregation on other county level changes: changes in demographics, changes in residential segregation, changes in the hospital market (hospital openings and closings) and variables related to hospital incentives created under

[27] The effects of segregation appear to be somewhat larger for counties with initially low levels of segregation, but they remain statistically insignificant.
[28] Using group specific indexes does not alter our previous conclusions for less than high school and Hispanics—Results available upon request.

DSH in 1990. If desegregation is caused by DSH, we expect only the hospital incentives in 1990 to predict changes in segregation.

Following Duggan, we include as the following measures of incentives: the number of hospitals in the county (counties with more hospitals are more competitive), percent of private hospitals (private hospitals responded more strongly to incentives created under DSH), percent of hospitals with low income number between 15 and 25, percent of hospitals with low income number above 25 (these two variables capture the fact that hospitals close to 25 had a large incentive to increase the number of Medicaid patients, but hospitals above the threshold also had incentives since the reimbursements were increasing in the number of Medicaid patients), and the interaction between incorporation and low income number. The dependent variable is the change in segregation from 1990 to 1995, thus positive coefficients correspond to decreases in segregation.

As expected the only variables that are significant are the variables related to incentives (Table VIII). The percent of hospitals with low-income numbers between 15 and 25 or with low-income number above 25 that are private reduce segregation (both coefficients are significant at the 10% level). The percent of public hospitals increases segregation, although the coefficient is only significant for those with low-income numbers between 15 and 25. These "incentive variables" are jointly significant at the 10% level. Not only all the other coefficients are insignificant, they are not jointly significant (both test statistics are reported at the bottom of table VIII). Thus, differences across counties in desegregation can be explained by initial market conditions as predicted by Duggan. They are not explained by changes in hospitals markets or

Medicaid characteristics. We note however that these results must be taken with caution since we only have 30 observations, and therefore our low power may prevent us from finding significant effects. Nonetheless, these results are consistent with our hypothesis that hospital desegregation over this period appears to have been driven mostly by the introduction of DSH.

D. Robustness checks

Another concern arises from the fact that our empirical strategy relies on changes overtime within a small number of counties.[29] In order to verify the robustness of the results and insure that they are not driven by one or two counties, we re-estimate the main specifications, dropping one county at a time. The resulting distribution of the estimated betas suggests that the results are very stable (see Table IX). There does not appear to be any one county that drives our results for black mothers.

E. Why did Blacks move less?

We found that segregation fell more slowly for Blacks than for other Medicaid moms. We have so far interpreted this as reflecting a smaller responsiveness of Blacks to the increased choice set. Another possibility is that the hospitals that sought to attract new Medicaid patients as a result of DSH were located disproportionately close to Hispanics and other low income groups and farther away from blacks. Chandra and Skinner (2003) suggest that one reason blacks use lower quality hospitals is their geographic proximity to such hospitals. We find no evidence for this hypothesis in the California data. In both 1990 and 1995, black Medicaid mothers had access to significantly more hospitals within

[29] There are 58 counties in California and we restrict our sample to 30 of them. 28 counties are dropped because they are mostly rural (and thus sparsely populations) and/or have very few hospitals.

5 miles, both public and private, than other Medicaid mothers (see Appendix D). Although it must be noted that we do not know if the quality of hospitals differs on average, our results suggest that there are additional reasons why blacks attend lower quality hospitals. It does not appear that lower mobility is due to smaller benefits (at least in terms of health gains, since, in fact, we find larger benefits). So we conclude that blacks must face larger costs (of some sort) associated with changing hospitals (although note that we cannot directly test this hypothesis with our data).

F. Alternative Mechanisms

We have argued that the positive impact of desegregation on outcomes reflects the fact that Medicaid mothers chose to deliver in different (presumably better) hospitals when their access to such hospitals increased. However, other factors may be responsible for the declines in neonatal mortality. First, quality within hospitals may have improved with the infusion of DSH funds, although Duggan (2000a) finds that hospitals did not use DSH funds to invest in quality. Alternatively, quality could have improved due to the increase in competition among hospitals that sought to attract Medicaid patients. Both suggest private mothers would have been positively affected as well. If this were the case, it would lead us to underestimate the effect of desegregation on birth outcomes among Medicaid mothers.

Alternatively, we could be overestimating the impact of DSH if Medicaid mothers displaced privately insured mothers into worse hospitals, or resulted in crowded hospitals with lower quality care. We know of no evidence that hospitals were at full capacity over this period. In 1995 in California, among the 405 general acute care hospitals, there were

only 3 hospitals operating at or above 87% occupancy and 9 hospitals at or above 80%. On average occupancy rates for that year were below 50%.[30] Additionally, our evidence suggests that privately insured mothers did not go to different hospitals after the implementation of DSH.

VII. Interpretation and Implications

We have found that implementation of DSH, which effectively increased Medicaid payment rates for hospitals that qualified, resulted in substantial desegregation of poor publicly insured mothers from separate, often public, hospitals. Interestingly, within Medicaid, most subgroups defined by race, ethnicity or education, took advantage of the increase in access at roughly similar rates with the exception of one group – black mothers. Ironically, it is black mothers who benefited the most from the increase in provider access in terms of reduced neonatal mortality. Over this period, neonatal mortality for black mothers on Medicaid declined 8.6 percent, and nearly the entire decline is attributable to the increase in access to hospital care.

Several conclusions can be drawn from these findings. First, differential access to health care is still an important determinant of health for blacks and has not been eliminated through expansions in public health insurance, nor can it be explained by persistent residential segregation. Yet simply expanding the number and quality of hospitals available to blacks is not sufficient to induce them to utilize higher quality care, as evidenced by our finding that blacks (who stood to gain the most) moved the least.

[30] Statistics come from the annual hospital financial data maintained by OSHPD.

Second, the fact that so many women with Medicaid switched providers after the introduction of DSH suggests that their choice of provider had previously been constrained because Medicaid payments were below market price. Raising payments increases the amount of competition among hospitals for poor patients and enhances their access to high quality hospital care. In addition, our finding that neonatal mortality declined and that the decline was in most part not due to increases in birth weight implies that quality of care at the hospital of delivery is an important determinant of birth outcomes.

The fact that we find significant improvements in birth outcomes only among those with the highest initial levels of mortality suggests that the marginal productivity of neonatal medical technology is declining. As a result we should expect further increases in access to care to result in smaller improvements in neonatal mortality. Also, it suggests that hospital quality may matter only for extreme cases, thus it may not be surprising to find small or no effects of hospital quality on health for the average patient.

And finally, the finding that among Medicaid mothers, those who stood to gain the most because of higher initial rates of neonatal mortality moved less than others with relatively little to gain has important implications for both the proper functioning of the market for health care as well as how to value high quality care. The fact that black mothers moved at lower rates could be a sign of inefficiency in the hospital market - either a lack of information or possible discrimination. It is also possible that black mothers have higher costs of switching hospitals relative to other mothers. It is not possible with our data to investigate these issues but our results certainly suggest that more research in this area is needed.

As to why other Medicaid mothers moved, even though they appeared to have received no benefit - we can think of two distinct reasons. One is that these mothers moved because private hospitals offered amenities that these mothers value but that are not related to the quality of care provided. Alternatively these mothers value ex-ante the availability of high quality care. In other words, it is possible that quality serves as insurance: it is very unlikely that any one-mother may need a neonatal intensive care unit, but the value of its availability in the event of a complication is extremely high. Again, we do not have the ability to distinguish between these hypotheses. But in either case since mothers took advantage of the increase in access by choosing alternative hospitals; this implies that their choices were previously constrained and that DSH improved their welfare. This suggests that an evaluation of the social benefits of programs such as DSH should include improvements in welfare that are not captured by changes in objective measures of health such as infant mortality.

References

Almond, D., K. Chay and M. Greenstone (2001), "Civil Rights, the War on Poverty, and Black-White Convergence in Infant Mortality in Mississippi," Berkeley University Mimeo.

Berkowitz E. and W. Flexnor (1981), "The Market for Health Services: Is there a Non Traditional Consumer?," Journal of Health Care Marketing. 81: 25-34.
Butler, J. A. and R. K. Scotch (1978), "Medicaid and Children: Some Recent Lessons and Reasonable Next Steps." *Public Policy* 26:3. 1978.

Kenneth C. Y. and M. Greenstone (2003), "The Impact Of Air Pollution On Infant Mortality: Evidence From Geographic Variation In Pollution Shocks Induced By A Recession," *Quarterly Journal of Economics*, Vol. 118 (3) pp. 1121-1167.

Center for Disease Control (1994), *From Data to Action. CDC's Public Health Surveillance for Women, Infants, and Children.* Lynne S. Wilcox and James S. Marks, Eds. Center for Disease Control's Maternal & Child Health Monograph

Chandra, A. and J. Skinner (2003), "Geography and Racial Health Disparities," National Bureau of Economic Research Working Paper 9613, February.

Coughlin, T. A. and D. Liska (1997), "The Medicaid Disproportionate Share Hospital Payment Program: Background and Issues," The Urban Institute Series A., No. A-14, October.

Currie, J. and E. Moretti (2003), "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings," *Quarterly Journal of Economics*, 118(4)

Currie, J. and D. Thomas (1995), "Medical Care for Children: Public Insurance, Private Insurance and Racial Differences in Utilization," *Journal of Human Resources*, XXX, 1.

Currie, J. and P. Reagan (1998), "Distance to Hospital and Children's Access to Care: Is Being Closer Better and for Whom?," National Bureau of Economic Research Working Paper 6836.

Cutler, D. M. and E. Meara (1999), "The Technology of Birth: Is it Worth it?," National Bureau of Economic Research Working Paper 7390.

Deaton, A. and C. Paxson, "Mortality, Education, Income, and Inequality among American Cohorts," The Economics of Aging, Vol. 8, Wise, David A., ed., Chicago: University of Chicago Press for NBER, forthcoming

Duggan, M. G. (2000a), "Hospital Ownership and Public Medical Spending," *Quarterly Journal of Economics*, November.

Duggan, M. G. (2000), "Hospital Market Structure and the Behavior of Not-for-profit Hospitals: Evidence from Responses to California's Disproportionate Share Program," National Bureau of Economic Research Working Paper 7966.

Gortmaker, S. and P. Wise (1997), "The First Injustice: Socioeconomic Disparities, Health Services Technology and Infant Mortality," *American Review of Sociology*. 23: 147-70.

Huen, W. (1999), "California's Disproportionate Share Hospital Program: Background Paper," Medi-Cal Policy Institute, January.

Massey, D. S. and M. L. Eggers (1990), "The Ecology of Inequality: Minorities and the Concentration of Poverty, 1970-1980," *The American Journal of Sociology*, Vol. 95, No. 5, pp. 1153-1188.

Massey, D. S. and N. A. Denton (1993), *American Apartheid: Segregation and the Making of the Underclass*. Cambridge, Mass.: Harvard University Press.

McClellan, M. and D. Staiger (1999), "The Quality of Health Care Providers," National Bureau of Economic Research Working Paper 7327

Meara, E. (2001) "Why is Health Related to Socio-Economic Status," NBER Working Paper No. w8231

Pappas, G. S. Queen, W. Hadden and G. Fisher (1993), "The Increasing Disparity in Mortality Between Socioeconomic Groups in the United States, 1960 and 1986," *The New England Journal of Medicine*.

Smedley, B. D., A. Y. Stith, and A. R. Nelson (2002), Editors, Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care, "Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care," National Academy Press.

Yudlowsky, B. K., J. D. C. Cartland and S. S. Flint (1990), "Pediatrician Participation in Medicaid: 1979 to 1989." *Pediatrics* 85:567-77.

Figure 1a. Share of Medicaid Patients at Each Type of Hospital

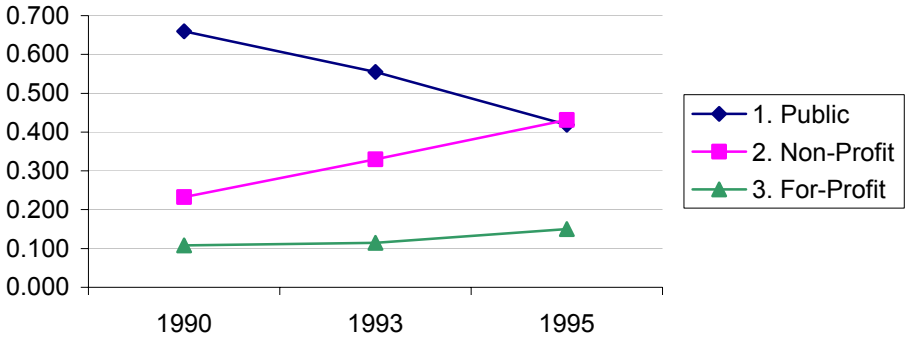

Figure 1b. Share of Indigent Patients at Each Type of Hospital

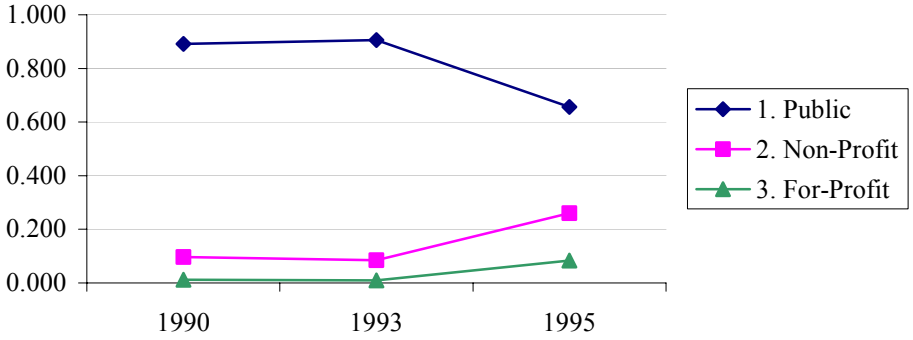

Figure 1c. Share of Private Patients at Each Type of Hospital

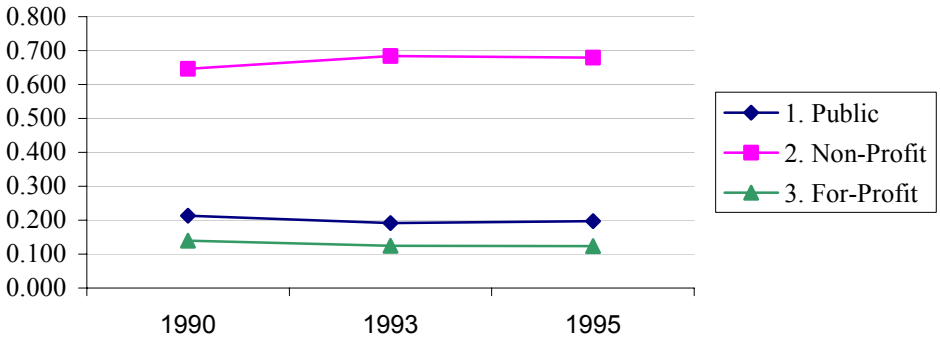

Figure 2a. Share of Medicaid Deliveries at Each Type of Hospital

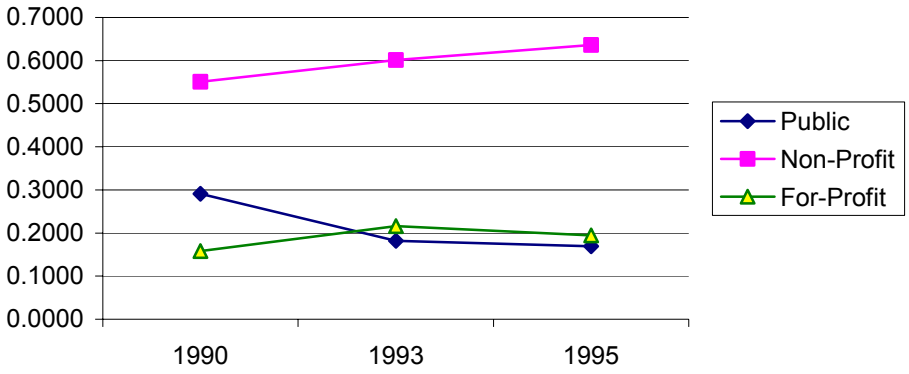

Figure 2b. Share of Private Deliveries at Each Type of Hospital

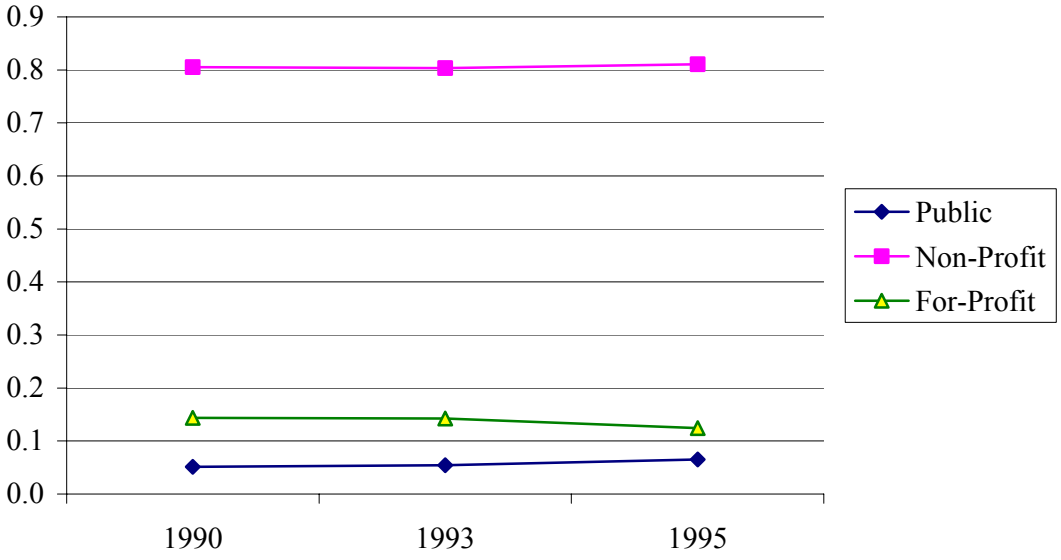

Figure 3a: County Segregation in California, 1989-1995

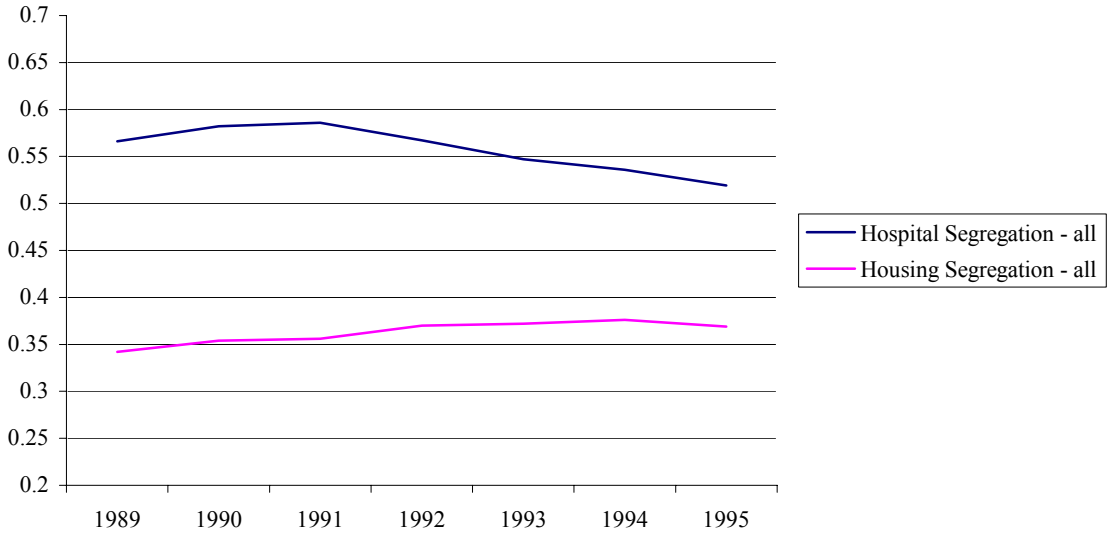

Figure 3b: Segregation index for sub groups of the Medicaid population

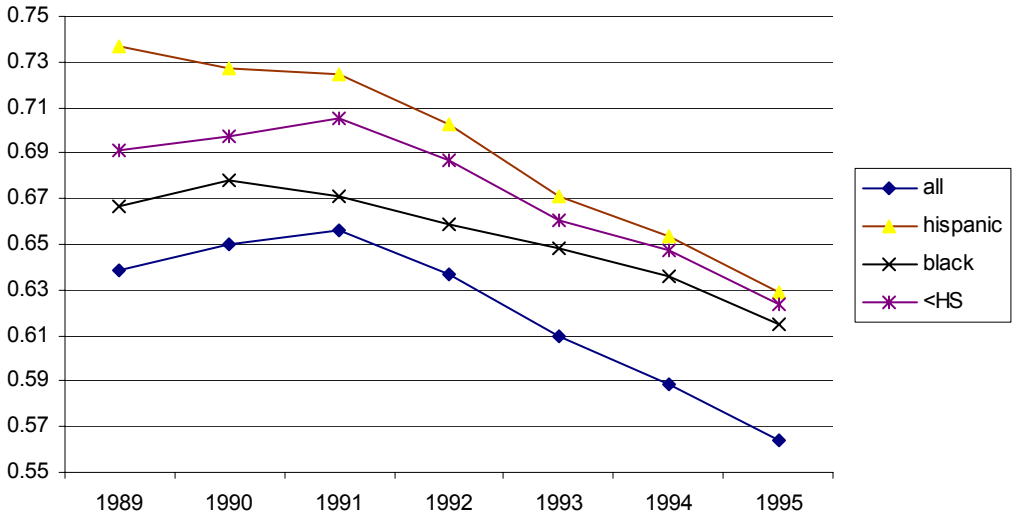

Figure 3c: Trends in segregation, all mothers and native born only

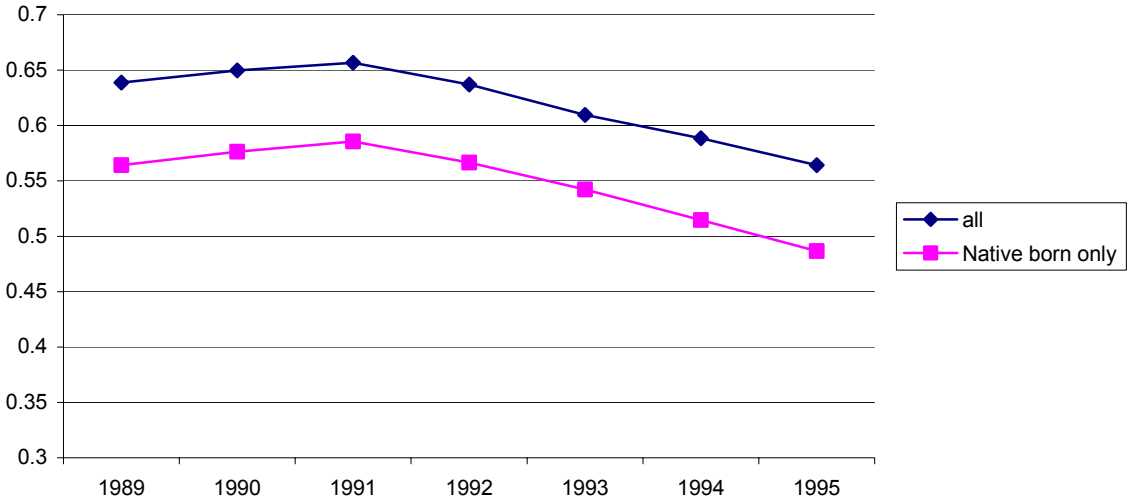

Figure 4A: Changes in neonatal mortality 1990-1995 by insurance status

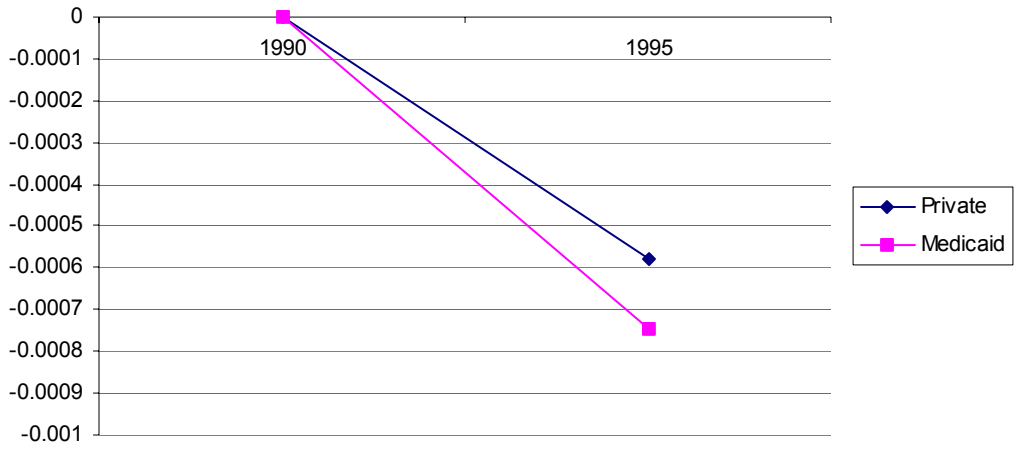

Figure 4b: Changes in neonatal mortality amond Medicaid mothers, by change in segregation

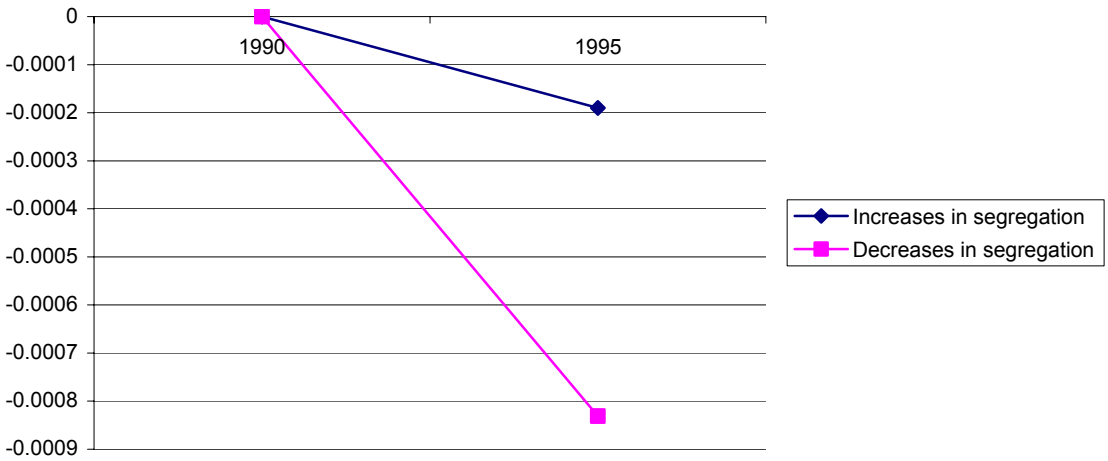

Figure 4c: Changes in neonatal mortality 1990-1995 for counties with decreases in segregation, by insurance status

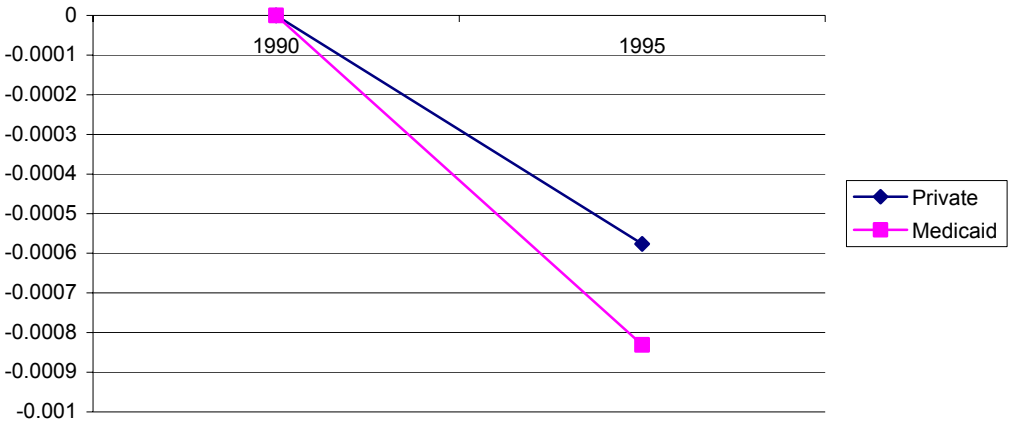

Figure 4d: Changes in neonatal mortality 1990-1995 for counties with increases in segregation, by insurance status

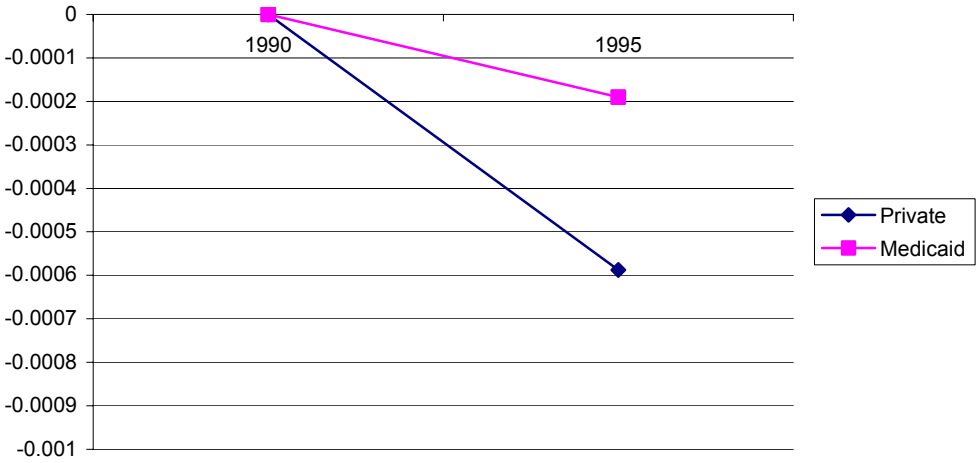

Figure 5: Number of Medicaid births by foreign status, 1989-1995

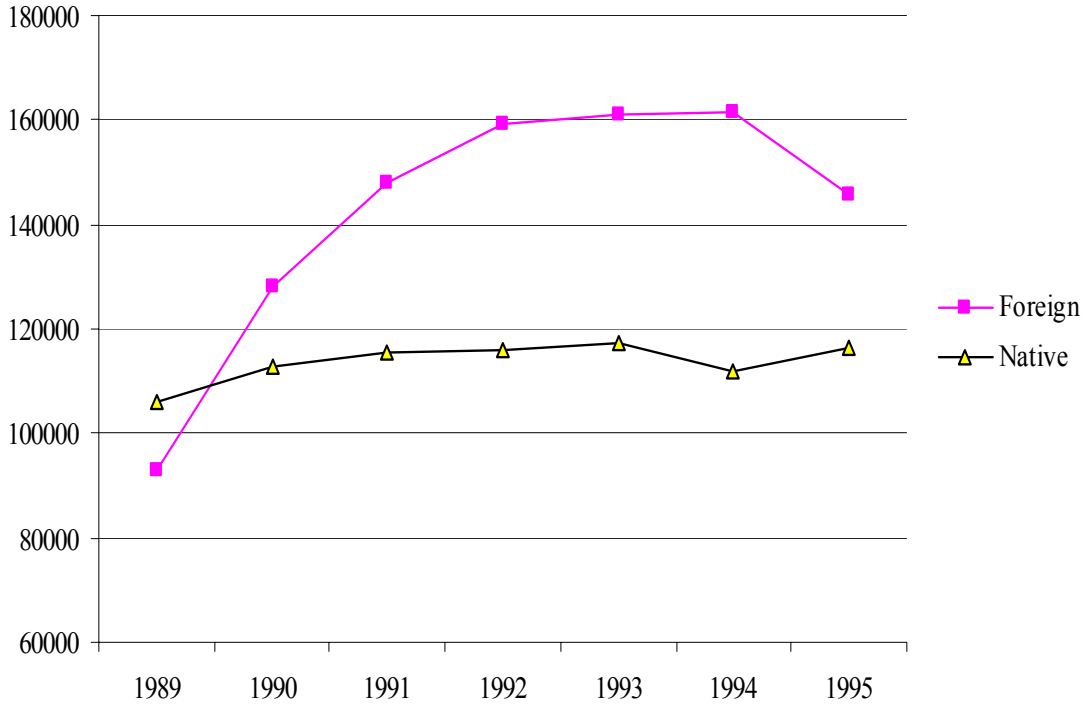

Table I.a
Summary statistics

	All		Medicaid		Private	
Year	1990	1995	1990	1995	1990	1995
Hospital Segregation	0.6552	0.5637	0.6504	0.5615	0.6583	0.5656
	(0.0002)	(0.0002)	(0.0004)	(0.0003)	(0.0003)	(0.0003)
Neonatal Mortality	0.0041	0.0035	0.0048	0.0040	0.0036	0.0031
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
LBW	0.0592	0.0617	0.0712	0.0680	0.0513	0.0563
	(0.0004)	(0.0004)	(0.0007)	(0.0006)	(0.0004)	(0.0005)
Medicaid	0.3955	0.4651				
	(0.0008)	(0.0008)				
Foreign-born	0.4213	0.4666	0.5985	0.6241	0.3054	0.3297
	(0.0008)	(0.0008)	(0.0013)	(0.0012)	(0.0010)	(0.0011)
Black	0.0826	0.0749	0.1123	0.0921	0.0632	0.0599
	(0.0004)	(0.0004)	(0.0008)	(0.0007)	(0.0005)	(0.0005)
Hispanic	0.4078	0.4656	0.6262	0.6756	0.2640	0.2826
	(0.0008)	(0.0008)	(0.0013)	(0.0012)	(0.0009)	(0.0010)
<HS	0.3160	0.3169	0.5915	0.5585	0.1348	0.1055
	(0.0008)	(0.0008)	(0.0013)	(0.0012)	(0.0007)	(0.0007)
Single	0.2888	0.2915	0.5310	0.4628	0.1303	0.1426
	(0.0007)	(0.0008)	(0.0013)	(0.0012)	(0.0007)	(0.0008)

Notes: standard errors in parenthesis

Table I.b
Summary statistics among Medicaid mothers,
by demographic characteristics, 1990 and 1995

	1990	1995
Neonatal Mortality		
Black	0.0084	0.0077
non-Black	0.0043	0.0036
Hispanic	0.0043	0.0034
<HS	0.0047	0.0035
Very Low Birth Weight (VLBW)		
Black	0.038	0.036
non-Black	0.011	0.012
Hispanic	0.011	0.012
<HS	0.012	0.012
Low Birth Weight (LBW)		
Black	0.162	0.152
non-Black	0.060	0.059
Hispanic	0.056	0.056
<HS	0.063	0.062
Inadequate prenatal care		
Black	0.347	0.244
non-Black	0.386	0.237
Hispanic	0.409	0.233
<HS	0.424	0.254

Table II
Non-Parametric Trends in Hospital Segregation

Dependent variable:	Hospital segregation index
1989	-0.0118
	[0.0057]
1990	-0.0044
	[0.0056]
1992	-0.0155
	[0.0055]
1993	-0.045
	[0.0055]
1994	-0.0685
	[0.0055]
1995	-0.0962
	[0.0055]
Black	0.0936
	[0.0040]
Hispanic	0.0677
	[0.0036]
HS drop out	0.0569
	[0.0031]
Constant	0.5511
	[0.0044]
Observations	1552
R-squared	0.91
Constant	0.5511
P-values	
Test of trend break 1990	0.752
Test of trend break 1991	0.038
Test of trend break 1992	0.134
Test of trend break 1993	0.521
Test of trend break 1994	0.662
Test of linear trend post 1991	0.379

Table III
Differences in Linear Trend post-1991 by Race and Education

Dependent variable:	HSI	HSI
year*post 1991	-0.03244	-0.03589
	[0.00332]	[0.00560]
year*post 1991*Black		0.01689
		[0.00829]
year*post 1991*<HS		-0.0029
		[0.00687]
year*post 1991*Hispanic		0.00263
		[0.00788]
year	0.00589	0.00384
	[0.00283]	[0.00477]
year*Black		-0.00529
		[0.00697]
year*<HS		0.00737
		[0.00585]
year*Hispanic		0.00085
		[0.00678]
indicator- post 1991	2.9612	3.28456
	[0.30215]	[0.50998]
post 1991*Black		-1.5481
		[0.75434]
post 1991*<HS		0.26148
		[0.62524]
post 1991*Hispanic		-0.25653
		[0.71715]
Black	0.09361	0.56251
	[0.00399]	[0.62731]
Hispanic	0.06772	-0.00354
	[0.00362]	[0.61096]
HS drop out	0.05692	-0.61549
	[0.00310]	[0.52644]
Constant	0.01524	0.20423
	[0.25495]	[0.42956]
Observations	1552	1552
R-squared	0.91	0.91

Notes: standard errors (in brackets) are clustered at the county level.

Table IV
Impact of Hospital Segregation on Neonatal Mortality

	(1) All	(2) Black	(3) <HS	(4) Hispanic
Medicaid* ln(1-HSI)*black		-0.0032		
		[0.0016]		
HSI*black		0.0015		
		[0.0014]		
Medicaid*black		0.0115		
		[0.0058]		
Medicaid* ln(1-HSI)*<HS			-0.0007	
			[0.0011]	
HSI*<HS			-0.0001	
			[0.0009]	
Medicaid*<HS			0.0013	
			[0.0038]	
Medicaid*ln(1-HIS)*Hispanic				0.0006
				[0.0008]
HSI*Hispanic				-0.0009
				[0.0004]
Medicaid*Hispanic				-0.0002
				[0.0009]
Medicaid*ln(1-HSI)	0.0001	0.0003	0.0004	0.0000
	[0.0004]	[0.0004]	[0.0005]	[0.0005]
HSI	-0.0004	-0.0005	-0.0004	-0.0002
	[0.0006]	[0.0006]	[0.0006]	[0.0003]
HS drop out	0.0005	0.0005	0.0014	0.0005
	[0.0002]	[0.0002]	[0.0032]	[0.0003]
Age 20-29	0.0006	0.0006	0.0006	0.0006
	[0.0002]	[0.0002]	[0.0002]	[0.0001]
Age 30-34	0.0009	0.0009	0.0009	0.0009
	[0.0002]	[0.0002]	[0.0002]	[0.0003]
Black	0.0042	-0.0014	0.0041	0.004
	[0.0003]	[0.0049]	[0.0003]	[0.0005]
Asian	-0.0002	-0.0002	-0.0002	-0.0003
	[0.0004]	[0.0004]	[0.0004]	[0.0002]
Hispanic	0.0004	0.0004	0.0003	-0.0002
	[0.0002]	[0.0002]	[0.0002]	[0.0005]
other race	0.0007	0.0007	0.0007	0.0006
	[0.0004]	[0.0004]	[0.0004]	[0.0003]
single	0.0000	0.0000	0.0000	0.0000
	[0.0002]	[0.0002]	[0.0002]	[0.0002]
Foreign Born	-0.0008	-0.0008	-0.0008	-0.0008
	[0.0002]	[0.0002]	[0.0002]	[0.0002]
commercial HMO penetration	-0.0047	-0.0048	-0.0046	-0.0045
	[0.0021]	[0.0021]	[0.0021]	[0.0018]
Observations	9068	9068	9068	9068
R-squared	0.04	0.04	0.04	0.04

Notes: standard errors (in brackets) are clustered at the county level. Regressions are weighted by number of observations in each cell and they include county fixed effects

Table V
The effect of hospital segregation on neonatal mortality, by initial level of segregation

	High	Low	High	Low	High	Low
Medicaid* Ln(1-segregation)*black	-0.0053	0.0033				
	[0.0021]	[0.0055]				
Ln(1-segregation)*black	0.0035	-0.0016				
	[0.0025]	[0.0028]				
Medicaid*black	-0.0056	0.0019				
	[0.0024]	[0.0028]				
Medicaid* Ln(1-segregation)*<HS			-0.0005	-0.0019		
			[0.0009]	[0.0044]		
Ln(1-segregation)*<HS			-0.0002	-0.0038		
			[0.0006]	[0.0038]		
Medicaid*<HS			-0.0017	-0.0026		
			[0.0010]	[0.0024]		
Medicaid* Ln(1-segregation)*Hispanic					0.0003	0.0064
					[0.0010]	[0.0036]
Ln(1-segregation)*Hispanic					-0.0005	-0.0055
					[0.0006]	[0.0014]
Medicaid*Hispanic					-0.0003	0.0024
					[0.0011]	[0.0019]
Medicaid*Ln(1-segregation)	0.0005	-0.0017	0.0005	0.0012	0.0002	-0.0031
	[0.0005]	[0.0023]	[0.0007]	[0.0014]	[0.0007]	[0.0014]
Ln(1-segregation)	-0.0004	0.0002	-0.0002	0.0005	-0.0001	0.0013
	[0.0007]	[0.0014]	[0.0006]	[0.0014]	[0.0005]	[0.0015]
Medicaid	0.0013	0.0001	0.0017	0.0020	0.0013	-0.0002
	[0.0006]	[0.0013]	[0.0009]	[0.0009]	[0.0009]	[0.0010]
HS drop out	0.0004	0.0007	0.0009	-0.0001	0.0004	0.0007
	[0.0003]	[0.0007]	[0.0008]	[0.0022]	[0.0003]	[0.0007]
Black	0.0083	0.0018	0.0044	0.0028	0.0044	0.0027
	[0.0034]	[0.0019]	[0.0006]	[0.0008]	[0.0006]	[0.0008]
Observations	4331	4737	4331	4737	4331	4737
R-squared	0.06	0.02	0.06	0.03	0.05	0.02

Notes: standard errors (in brackets) are clustered at the county level. Regressions are weighted by number of observations in each cell and they include county fixed effects Regressions include all other controls in table IV (age, HMO penetration, other races, foreign born dummies)

Table VI
The effect of segregation on other outcomes

	% Very low birth weight	% Low birth weight	% Inadequate prenatal care
Panel A: Blacks			
Medicaid* Ln(1-segregation)*black	-0.0090	-0.0103	-0.0085
	[0.0029]	[0.0123]	[0.0183]
Ln(1-segregation)*black	0.0021	-0.0047	-0.0080
	[0.0031]	[0.0071]	[0.0122]
Medicaid*black	-0.0014	0.0319	-0.0196
	[0.0034]	[0.0137]	[0.0222]
Medicaid*Ln(1-segregation)	0.0010	-0.0019	-0.0345
	[0.0005]	[0.0016]	[0.0297]
Ln(1-segregation)	0.0014	0.0024	0.0058
	[0.0012]	[0.0021]	[0.0288]
Medicaid	0.0043	0.0104	0.1288
	[0.0008]	[0.0023]	[0.0379]
Black	0.0205	0.0435	0.0404
	[0.0036]	[0.0066]	[0.0177]
Panel B: High School dropouts			
Medicaid* Ln(1-segregation)*<HS	0.0012	0.0016	0.0291
	[0.0011]	[0.0032]	[0.0157]
Ln(1-segregation)*<HS	-0.0038	-0.0123	0.0143
	[0.0010]	[0.0032]	[0.0178]
Medicaid*<HS	-0.0008	0.0018	-0.0146
	[0.0009]	[0.0022]	[0.0124]
Medicaid*ln(1-segregation)	-0.0005	-0.0065	-0.0456
	[0.0008]	[0.0031]	[0.0232]
Ln(1-segregation)	0.0017	0.0023	0.0068
	[0.0012]	[0.0021]	[0.0293]
Medicaid	0.0053	0.0146	0.1217
	[0.0010]	[0.0031]	[0.0301]
<HS	0.0034	0.0141	0.0658
	[0.0010]	[0.0026]	[0.0159]
Panel C: Hispanics			
Medicaid* Ln(1-segregation)*Hispanic	0.0020	0.0034	-0.0170
	[0.0018]	[0.0039]	[0.0346]
Ln(1-segregation)*Hispanic	-0.0025	-0.0181	-0.0498
	[0.0017]	[0.0038]	[0.0356]
Medicaid*Hispanic	0.0002	0.0015	-0.0073
	[0.0009]	[0.0022]	[0.0050]
Medicaid*Ln(1-segregation)	-0.0014	-0.0078	-0.0267
	[0.0013]	[0.0045]	[0.0168]
Ln(1-segregation)	0.0016	0.0027	0.0081
	[0.0012]	[0.0021]	[0.0284]
Medicaid	0.0051	0.0197	0.1515
	[0.0013]	[0.0039]	[0.0223]
Hispanic	0.0036	0.0086	0.0295
	[0.0009]	[0.0027]	[0.0058]

Table VII
Specification checks--Black Medicaid mothers

	(1) All	(2) High HSI	(3) Low HSI
Panel A: Native only			
Medicaid*ln(1-HIS)*black	-0.0034	-0.0047	-0.0027
	[0.0019]	[0.0026]	[0.0101]
Observations	4812	2359	2453
R-squared	0.06	0.07	0.04
Panel B: Black segregation index			
Medicaid*ln(1-HSI)*Black	-0.0027	-0.0047	0.0021
	[0.0016]	[0.0022]	[0.0062]
Observations	9068	4548	4520
R-squared	0.04	0.06	0.02
Panel C: Controlling for low birth weight			
Medicaid*ln(1-HSI)*black	-0.0026	-0.0053	-0.0009
	[0.0016]	[0.0022]	[0.0078]
Observations	9065	4546	4519
R-squared	0.08	0.09	0.06

Notes: standard errors (in brackets) are clustered at the county level.

Table VIII
What county characteristics explain decreases in segregation?

Dependent variable: Segregation change (1990-1995) Mean 0.088, s.d. (0.80)	Coef.	mean	std dev
1990 incentive variables			
Low Income Number (LIN) between 15 and 25	-0.915	0.128	0.088
	[0.395]		
LIN above 25	-0.200	0.202	0.126
	[0.320]		
Private hospital	-0.007	0.833	0.173
	[0.108]		
Private * LIN(15-25)	0.790	0.111	0.089
	[0.377]		
Private * LIN(25+)	0.973	0.135	0.085
	[0.486]		
Total number of hospitals	-0.001	34.116	28.462
	[0.002]		
Changes in population and market characteristics			
Change in % less than high school	0.196	-0.005	0.024
	[1.102]		
Change in % 20-29	-2.156	0.044	0.020
	[2.599]		
Change in % age 30-35	-0.973	-0.014	0.010
	[3.679]		
Change in % single	-0.214	-0.006	0.023
	[0.962]		
Change in % black	-4.419	0.007	0.009
	[4.257]		
Change in % Hispanic	-0.525	-0.060	0.030
	[1.474]		
Change in % Asian	-1.076	-0.011	0.014
	[2.676]		
Change in % other race	3.881	-0.007	0.008
	[2.672]		
Change in % foreign born	0.070	-0.050	0.022
	[2.287]		
Change in housing segregation index	-0.941	-0.012	0.024
	[0.671]		
Change in the number of hospitals	-0.082	-0.058	0.083
	[0.204]		
F-statistics (p-value)			
Joint significance of the 1990 incentive variables	2.68		
	(0.07)		
Joint significance of the changes in population and market	1.19		
	(0.38)		

Table IX
Distribution of Estimated Coefficients, dropping one county at a time

	All	High Segregation	Low Segregation
Mean	-0.00315	-0.00523	-0.00137
Median	-0.00216	-0.00527	-0.00099
Minimum	-0.00406	-0.00664	-0.02330
Maximum	-0.00196	-0.00404	0.00489
Standard Error	0.00006	0.00006	0.00061
95 % CI	[-.00327, -.00303]	[-.00535, -.00511]	[-.00260, -.00014]

Appendix A
Background on the Disproportionate Share program

History

Hospitals that served Medicaid patients often lost money: Medicaid reimbursement rates were not sufficient to cover the cost of treating Medicaid patients. Additionally, hospitals that did not serve many private patients did not have enough profits from these patients to cross-subsidize the cost of low-income patients. The Disproportionate Share program (DSH) was first introduced in the 1980 and 1981 Omnibus Reconciliation Acts (OBRA) to attempt to alleviate this problem. However it wasn't until 1986, when caps on reimbursements were freed, that states could fully exploit DSH. Each state instituted its own DSH program.

How DSH works

- DSH payments made by the states are eligible for federal reimbursements at a rate of 50 to 80%
- Hospitals qualify for DSH if:
  1- # Medicaid inpatient days > state mean + s.d.
  2- Low income number (revenues from low income patients, i.e. Medicaid and indigent)> 25% total revenues
- Reimbursement for hospitals that qualify:
  1- If qualify in year t, then in year t+1 get a per diem amount
  2- Reimbursement is a increasing non-linear function of a hospitals' low income number
  3- Low income number is calculated using a formula that weights Medicaid patients more than indigent patients
- Restrictions:
  - In 1992 reimbursements were capped at 12% of total Medicaid spending, with exceptions for high spending states such as California.
  - There are other restrictions at the hospitals level, like hospitals cannot make a profit using DSH funds
- Hospitals have greater incentives to attract Medicaid rather than indigent patients
  - Because the low income formula weights them more heavily than indigent patients
  - Because Medicaid patients are also reimbursed at a certain rate through regular Medicaid
  - They may be healthier
- Indirect effects
  - No effects on other Medicaid programs
  - HMO: DSH and managed care are in conflict. Managed care lowers costs mostly through decreasing inpatients care (making it into outpatient care or lowering utilization rates). However the DSH formal is based in inpatient days.

Appendix B
Hospital Segregation Index by county and year, for 30 urban counties

County	1989	1990	1991	1992	1993	1994	1995
Alameda	0.671	0.677	0.667	0.637	0.647	0.623	0.630
Butte	0.209	0.156	0.270	0.201	0.139	0.084	0.031
Contra Costa	0.781	0.809	0.824	0.833	0.844	0.810	0.749
Fresno	0.432	0.535	0.547	0.602	0.615	0.630	0.649
Kern	0.976	0.977	0.984	0.971	0.952	0.914	0.908
Los Angeles	0.723	0.722	0.723	0.693	0.657	0.644	0.621
Marin	0.025	0.116	0.038	0.080	0.107	0.078	0.083
Merced	0.052	0.002	0.035	0.004	0.012	0.055	0.026
Monterey	0.331	0.404	0.478	0.421	0.401	0.349	0.325
Napa	0.073	0.199	0.193	0.197	0.308	0.277	0.265
Orange	0.700	0.690	0.669	0.634	0.623	0.615	0.621
Placer	0.012	0.029	0.005	0.001	0.007	0.012	0.027
Riverside	0.718	0.820	0.758	0.672	0.557	0.511	0.471
Sacramento	0.446	0.455	0.467	0.467	0.465	0.413	0.371
San Bernardino	0.636	0.662	0.741	0.744	0.686	0.567	0.461
San Diego	0.338	0.359	0.418	0.443	0.439	0.431	0.395
San Francisco	0.645	0.669	0.659	0.684	0.692	0.674	0.661
San Joaquin	0.367	0.373	0.361	0.365	0.360	0.336	0.344
San Mateo	0.514	0.532	0.490	0.511	0.483	0.474	0.395
Santa Barbara	0.447	0.338	0.339	0.304	0.269	0.322	0.327
Santa Clara	0.732	0.755	0.749	0.703	0.645	0.624	0.605
Santa Cruz	0.346	0.364	0.411	0.433	0.432	0.470	0.418
Shasta	0.069	0.042	0.040	0.000	0.000	0.001	0.129
Solano	0.614	0.649	0.721	0.720	0.703	0.707	0.636
Sonoma	0.256	0.543	0.615	0.662	0.668	0.640	0.617
Stanislaus	0.401	0.280	0.297	0.331	0.348	0.367	0.384
Sutter	0.006	0.002	0.006	0.000	0.000	0.000	0.000
Tulare	0.216	0.267	0.319	0.216	0.210	0.192	0.027
Ventura	0.760	0.795	0.789	0.791	0.736	0.651	0.547

Appendix C
Changes in Medicaid Eligibility Laws Between 1989 and 1995

Year	Change in Medicaid Law
1989	Income eligibility increased from 110% to 185% of the federal poverty line. Eligibility workers are out stationed to high-volume clinics. Increased reimbursement to obstetric providers.
1990	Coverage extended to undocumented foreign-born women
1992	Asset test eliminated for women with incomes between 185% and 200% of the federal poverty line.
1993	Presumptive eligibility implemented, allowing immediate temporary coverage for women who believe they are eligible. Shortened application form introduced.
1994	Asset test eliminated for all women with incomes below 200% of the federal poverty line.

Appendix D
Geographic Access to Hospitals for Medicaid Mothers, by Race

	1990				1995			
	Total Hospitals within 5	Private Hospitals within 5	Public Hospitals within 5	Hospital Chosen within 5	Total Hospitals within 5	Private Hospitals within 5	Public Hospitals within 5	Hospital Chosen within 5
Black	3.962	3.359	0.603	0.592	3.67	3.137	0.533	0.641
Non-Black	3.123	2.733	0.39	0.619	3.097	2.716	0.381	0.643
Difference	0.839	0.626	0.213	-0.027	0.573	0.421	0.152	-0.002
	[0.024]	[0.023]	[0.005]	[0.005]	[0.024]	[0.024]	[0.005]	[0.005]
Obs.	51930	51930	51930	51930	55955	55955	55955	55955
Within County Means								
Black	3.482	2.967	0.514	0.604	3.291	2.829	0.462	0.656
Non-Black	3.297	2.875	0.422	0.615	3.211	2.809	0.402	0.638
Difference	0.185	0.092	0.092	-0.011	0.08	0.02	0.06	0.018
	[0.020]	[0.019]	[0.005]	[0.005]	[0.020]	[0.018]	[0.005]	[0.005]
Obs.	51930	51930	51930	51930	55955	55955	55955	55955