Public Hospitals and Black-white Health Gap

Yuan Tian*

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Abstract

The U.S. experienced substantial convergence in black and white infant mortality rates during 1950 to 1970. One important contributing factor was the growth of public hospitals after the enactment of the Hill-Burton Act in 1946. Public hospitals then were less discriminative against black patients, and were especially important in the South where medical resources were more scarce. In this paper, I quantify the role of public hospital expansion in reducing the black-white health gap. Concerned by the fact that distribution of public hospitals could be correlated with other factors, I use the distribution of Hill-Burton funds to instrument for the the increase in public hospital resources. I find that 100% increase in public hospital expenditure resulted in 1.7-5.2 per thousand decrease in difference in black and white infant mortality rate. Overall, the increase in public hospital resources accounted for 13-42% of overall racial convergence from 1950s to 1970s. The paper highlights the importance of government intervention in helping the minority group, and role of access to care in improving health outcomes.

Historically in the United States, black people had substantially worse health than white people. In 1951, the average infant mortality rate (IMR) in U.S. counties for black was 50 per thousand live births, while for the white was 30 per thousand.[1] In addition to the fact that a lot of black people were living in the south where medical resources were relatively scarce, racial segregation in the healthcare sector also substantially limited the access to care for black patients. Black patients were denied admission in white hospitals, admitted on the segregated basis, and placed in wards with worse conditions. Although

*Department of Economics, UCLA, 405 Hilgard Ave., Los Angeles, CA 90095 (email: ytian14@ucla.edu). I thank Adriana Lleras-Muney, Dora Costa, and Leah Boustan for support and guidance. I thank participants in the UCLA history proseminar for helpful comments. I am especially grateful to Amy Finkelstein for generously sharing the American Hospital Association hospital survey data, Adriana Lleras-Muney and coauthors for sharing infant mortality data, Heidi Williams for sharing the Hill-Burton Register data, and Martin Gaynor and coauthors for sharing additional AHA data. All errors are mine.

[1] This is the average value across 939 counties where the infant mortality rate was reported separately for white and non-white. Since the people of races other than black and white was relatively low at that time (less than 1%), I will use non-white and black interchangeably in the paper.

not entirely immune from racial segregation, public hospitals were still more inclusive in terms of admitting black patients.

The racial IMR gap decreased from 20 per thousand in 1946 to to 11 per thousand in 1975. Hill-Burton Act was passed in 1946, and by June 30, 1971, 3.7 billion dollars were issued by the federal government to help construct and renovate different types of health facilities (both publicly owned facilities and voluntary nonprofit facilities). From 1951 to 1975, overall beds per capita increased from 2.1 per thousand people to 5.4 per thousand, and share of admission in public hospital increased from 27% to 54%. Both the overall availability of hospital beds and the expansion of public hospitals might have contributed to the decrease in the black-white health gap.[2]

In this paper, I study the effect of expansion of public hospitals on the narrowing racial IMR gap. Using county level data from 1951 to 1975, I find that places with 100% increase in public hospital expenditure had 1.7-5.2 per thousand decrease in the racial health gap. I use the allocation of Hill-Burton funds across counties to instrument for the increase in public and private hospital expenditures, and the effect becomes much larger. Overall, the increase in public hospital resources accounted for 13-42% of overall decrease in racial IMR gap from 1950s to 1975. The paper shows that this specific government intervention in the hospital industry benefited the disadvantaged race group even more than the general population.

The paper is related to several strands of literature. First, it contributes to the general discussion of the racial health gap in the U.S.. Komlos et al. [2016] evaluates the racial difference in health in the long-run perspective. They find that the rapid improvement in black life expectancy between 1940 and 1960 were due to rising income and racial convergence in both income and education attainment, and the 1965-1980 improvement was mainly due to desegregation of southern hospitals in the Civil Rights era. Glied et al. [2011] summarizes the socio-economic factors that contribute to health, and discusses the black-white health disparity due to racial bias, difficulties in patient-provider communication, residential segregation, and the legacy of history. Second, the paper is closely related to the discussion of cause of decline in racial health gap. Almond et al. [2006] highlights the important role of the Civil Rights Act, which forced hospitals that received federal fundings to eliminate discriminative practices. Alsan and Wanamaker [2016] shows that mistreatment of black people in the healthcare system undermined the trust of black patients, and in response to the disclosure of the Tuskegee Syphilis Study, life expectancy of black men fell by up to 1.4 years. Almond et al. [2011] studies the effect of introduction of the Food Stamp Program on infant health, and they find that the income increase was larger for African American mothers. Third, the paper is related to the evaluation of Hill-Burton program. Chung et al. [2016] shows that the Act had a lasting effect on the hospital industry in the U.S., by increasing the overall availability of beds, and equalizing the medical resources across counties.

[2]Numbers here are by the author's calculation. Please refer to the data section for details about data source.

However, to my knowledge, this paper is the first to discuss the role of public hospitals and Hill-Burton Act in the racial health convergence.

The paper is organized as follows. Section I demonstrate the background of racial segregation, racial health convergence, and details of Hill-Burton Act. Section II talks about the data used. Section III shows the empirical results. The last section concludes.

1 Background: racial segregation, black-white health gap, and Hill-Burton Act

1.1 Racial segregation and the black-white health gap

U.S. was very segregated in the healthcare sector in the 20th century, especially before the 1965 Civil Rights Act. Hospitals and medical societies were predominantly run by white people, and racial discrimination existed in all aspects of the healthcare sector. It was difficult for the black to find institutions to receive professional medical training[3], and even if they were lucky enough to finish education, they were not allowed to practice in most white hospitals. For the ones that did get positions in hospitals, they had limited admitting privileges and usually have to work under the supervision of white physicians.[4] Black patients were denied admission in white hospitals, admitted on segregated basis, and placed in wards with worse conditions.[5] "By the end of 1932 there was one Black hospital for every 107, 127 Blacks or one hospital bed for every 999 Blacks. For Whites the ratio was one hospital for every 18,737 Whites or one bed for every 110 Whites. For each Black physician only 1.1 hospital beds were available, in contrast to 6.7 beds for every White physician."[6] Racial segregation was even worse in the South, and the situation was compounded by the fact that the South had lower income, education level, and lots of rural areas with no hospitals at all.

The racial segregation greatly limited access to care for black patients. "In 1930, a Black man was injured in an automobile accident near Huntsville, Alabama. After being taken to Huntsville, he was advised that no hospital facilities were available for Blacks and the closest available care was ten miles away in Athens, Alabama. The victim died en route."[7] Regarding infant births, in 1941, only one third of all births took place in hospitals in the South, while the rate for the northerners was three quarters. Not being able to be admitted into hospitals, and sometimes with no hospitals at all, rural black mothers and infants benefited very little from modern hospital technologies. [8]

[3] Page 16, Rice and Jones [1994].
[4] Page 29, Gamble [1995].
[5] Page 29, Rice and Jones [1994].
[6] Page 27, Rice and Jones [1994].
[7] Page 29, Rice and Jones [1994].
[8] Page 44, Thomas [2011]

Among all hospitals, proprietary facilities that were run relying on patient fees were the most expensive and exclusive for black patients. "(In the South,) the small size, racial segregation, private ownership, and heavy reliance on patient fees that characterized most southern hospitals compounded a region wide crisis in healthcare access." [9]

1.2 Hill-Burton Act and racial health convergence

The healthcare crisis was likely to be lessened by the construction and renovation of health facilities funded by the Hill-Burton Act. The Hospital Survey and Construction Act, also known as the Hill-Burton Act in 1946 was the first big federal government intervention in the healthcare sector. The intent of the Act was to use federal funds to build a modernized and equal healthcare system across the U.S., with the the target of achieving 4.5 beds per thousand population across the country, irrespective of the initial condition. The Act spanned until 1975, when it was amended and became the Title XVI of the Public Health Service Act. With the need-based fund allocation formula, the Act favored the southern states, where beds per capita were the lowest. Also, the Act did not allow for discrimination based on race, but allowed for "separate-but-equal" treatment, meaning that as long as the blacks and whites had equal number of beds per capita, they were able to be placed and treated separately.

The Hill-Burton Act funded two types of facilities: voluntary non-profit and publicly owned. In total there were 10,748 projects funded from 1947 to 1971, and with 51% of them for voluntary non-profit hospitals, and 49% of them for publicly owned facilities. Total funds approved were $3.82 billion from the federal government, and state and local funds that matched the federal funds were $9.1 billions. Most hospitals funded admitted all races, in either segregated form or integrated form (Table 1). About 30% of the funds were used to build new facilities, and 70% for additions, alterations and replacements of existing facilities (Table 2).

[Table 1 about here.]

[Table 2 about here.]

The allocation formula of the funds followed a two-step procedure: first, funds were distributed across different states, using per capita income and population size as input parameters, to allocate more funds to states with lower income; then, states surveyed hospital beds across counties, and proposed a plan prioritizing counties based on whether or not a county was rural, its population, and bed need. Within states, the funding allocation followed a rotation rule: counties that received funding in one year would be moved to the bottom of the priority list in the following year. State and local government needed to provide approximately two times the Hill-Burton funds to match the grant, and economic viability of the facilities were also considered in the allocation process.

[9] Page 35 and Page 159, Thomas [2011]

As a result, the middle income counties were helped most, not the poorest ones. Another policy was that facilities that received the funds were required to provide a "reasonable volume" of free care to local residents, and it might help the low income population as long as a facility nearby was funded.[10]

The Hill-Burton program had a big impact on the overall capacity of the hospital industry in U.S.. Chung et al. [2016] finds that it accounted for a net increase of over 70,000 beds nationwide, which was about 17% of the total hospital beds growth in the U.S. in 1948-1975. Also, due to the need-based allocation rule, differences in healthcare resources decreased between counties of different income level, rural and urban ones, and the South and the rest of country. In Figure 1, the first map shows the distribution of beds per thousand people in 1951. West coast and northeastern counties had the highest values, while southern states like Mississippi and Tennessee had the lowest. The second map shows the overall distribution of per capita Hill-Burton funds from 1947-1971, and the counties that initially had fewer hospital beds received more Hill-Burton funds. Overall increase in hospital beds and more equalized distribution might helped the southern states especially.

[Figure 1 about here.]

The program also affected the distribution of hospital resources between public and non-public facilities. In Figure 2, publicly owned hospitals are defined as public hospital, and all other hospitals as private hospitals, and the values are averaged across 559 counties that reported black and white infant mortality separately, and had at least one public hospital. We can see that in these counties from 1951 to 1975, per capita expenditure in public hospitals (green cubic line) followed trends of per capita expenditure in private hospitals closely (orange diamond line), despite starting at just half as high as the private one in 1951. In these counties, Hill-Burton funds for public facilities (blue circle line) were higher than funds for private ones (red triangle line). As far as these counties are concerned, share of public hospital expenditures over all hospital expenditures increased from 30% in 1951 to over 45% in 1975;[11] during the same time period, the racial gap in IMR decreased from over 20 per thousand to almost 10 per thousand. (Figure 3.)

[Figure 2 about here.]

[Figure 3 about here.]

In terms of reducing racial segregation, the program were not entirely successful due to the "separate-but-equal" principle. Nevertheless, as discuss in the previous paragraphs, access to care for black was very likely to increase:

[10] (See details of the allotment rule in Chung et al. [2016] and https://www.hrsa.gov/gethealthcare/affordable/hillburton/hillburton.pdf)

[11] Also, it is shown in Chung et al. [2016], increase in public hospitals and non-profit hospitals partially crowded out private hospitals.

"Deluxe Jim Crow hospitals resembled the pattern of hospital segregation practice in many northern cities, except that Hill-Burton enabled southern blacks to be cared for new, updated facilities instead of in the basements of deteriorating city hospitals."[12]

2 Data

The main outcome of interest is infant mortality rate by race. The county level mortality data from 1959 to 1975 is from Multiple Cause of Death (MCD) files, constructed by Bailey and Goodman-Bacon [2015]. The 1948-1958 data is constructed from the Vital Statistics of the United States.[13] Out of about 3000 counties in the two datasets, 883 out of them reported mortality by white and non-white breakdown in 1975, and 940 of them in 1951. The ones with total infant deaths only are usually the ones with too small black populations.

Information about hospitals are from American Hospital Association's (AHA) Annual Survey of Hospitals. The Survey was published annually in August from 1948-1975, expect 1954, summarizing information of U.S. hospitals registered in the AHA. The Survey reports capacity and utilization information on hospital-year level, including total expenditure, payroll expenditure, hospital beds, and admission. It also contains the information on type of control of hospitals: proprietary, non-profit, federal government and local government (state or city government). I group proprietary and non-profit hospitals into "private hospital", and the later two into "public hospital". Also, I keep only the hospitals with type of stay as short, to exclude rehabilitation facilities and other long-term care facilities, which should have little effects on infant mortalities. Overall I have 3,619 hospitals in total in 1951, 2,895 as private hospitals and 744 as public ones; in 1975 there are 4,829 hospitals in total, 3,296 as private ones, and 1,533 as public ones. In 1951, there were 2,043 counties with one or more hospitals, and the number rose to 2,523 in 1975.

Hill-Burton funding information is from printed version of Hill-Burton Project Register (July 1, 1947 - June 30, 1971), published by U.S. Department of Health, Education and Welfare. It lists all projects approved during the time period, with name of facility, location of the project (city and county), control type (non-profit or different kinds of government controlled), category (general hospital, tuberculosis hospitals, and others), beds provided, total estimated cost and Hill-Burton funds, and initial approval time. The Hill-Burton Act indeed extended until 1975, but I will only use the information until 1971 due to the data constraint. I keep the projects in general hospitals, public health centers and outpatient facilities only, since these projects might be most closely related to infant health. Overall there are 2,390 counties that received the Hill-Burton funds at some point, and 7,920 projects approved (3,944 non-profit ones and

[12] Page 175, Thomas [2011].

[13] The data was entered and constructed by Adriana Lleras-Muney and Seth Richards-Shubik.

3,976 government-run ones).

Other county characteristics are from U.S. County and City Data Book, 1947-1977. The data has county level variables in 1950, 1960 and 1970, including total population, black population, population density, 10-year population growth rate, urban population, median family income, median years of education for people aged 25 and above, percent of people with years of education fewer than 5 years and aged 25 and above, and the percentage with more than 12 years of education.

For all variables related to price level, I adjust the value to 1960 $ values using GDP implicit price deflator.[14]

3 Empirical results

3.1 Baseline county characteristics: are counties with hospitals of different types of control different?

First let's take a look at the characteristics of 936 counties that reported infant mortality rate by race in 1951.[15] In Table 3, there are four columns: the first column includes 345 counties with no hospitals, the second column includes 108 counties with only public hospitals, the third column for 344 counties with only private hospitals, and the forth column include 139 counties with both private and public hospitals. For each variable, there are two rows: the first row reports the mean value while the second row reports the standard deviation.

Compare the four columns, we see that the counties with no hospitals had the highest shares of black population (36.9%), were least urban (13%), poorest (median family income $1,900), least education (median of 7.4 years of schooling for adults aged 25 or above), least populated (total population mean 22,000), and had the lowest 10-year population growth rate (average -0.8%). The counties with both private and public hospitals had the lowest black share (21.3%), and were better off in all socio-economic measures. The counties with only public hospitals or private hospitals lie in between, with the ones with private only better off. In terms of difference of black and white infant mortality rate, the counties with no hospitals had the highest racial health gap (black IMR was larger than the white IMR by 23 per thousand), and counties with public hospital only and with both private and public hospitals had the lowest gap (19.4 per thousand and 19.8 per thousand, respectively.)

[Table 3 about here.]

Overall, I find that in these (mostly) southern counties, availability of hospital was highly correlated with local economic conditions. Also, from the discussion above, the racial IMR gap suggests that availability of public hospital

[14] https://fred.stlouisfed.org/series/GDPDEF.

[15] Most of these counties locate in the southern states, see Figure 4.

might be beneficially for the black people. In the following sections, I will control theses socio-economic variables to account for county differences, and will investigate how public hospital resources affected the health of black people.

3.2 Expansion of public hospitals and the narrowing racial health gap: OLS regression.

How did the expansion of public hospitals contribute to the narrowing racial IMR gap? I will start with a panel regression on county-year level. In Equation (1), $DIMR_{ct}$ is black IMR minus white IMR in county c and year t, and $Log(exp)_{ct}^{public}$ means log of total expenditure in public hospitals, which is the main regressor. I choose total expenditure here because it was most directly related with the grant[16]; I also restrict the sample to county-year with positive public hospital expenditure to measure the intensive margin of the treatment instead of the extensive margin (the effect of having better funded public hospitals, not the effect of having a new public hospital in places with no public hospitals at all, which can be quite different). I also control for log of total expenditure in private hospitals, other county characteristics mentioned in the previous section, county fixed effects and year fixed effects.

$$DIMR_{ct} = \alpha_0 + \alpha_1 Log(exp)_{ct}^{public} + \alpha_2 Log(exp)_{ct}^{private} + X_{ct}\Gamma + I_c + I_t + \epsilon_{ct} \quad (1)$$

Another important concern is the effect of the Civil Rights Act in 1965. As pointed out in Almond et al. [2006], the Civil Rights Act contributed significantly to the racial health convergence by forcing hospital to desegregate. The Act prohibited racial discrimination and segregation in institutions that received federal fundings, and the new Medicare program had elimination of discrimination as prerequisite for payment eligibility. Also, as shown in Figure 3, there was a trend break in racial IMR difference around year 1965. Thus, in addition to the model with year fixed effect, I also estimate a model with trend break in 1965. In Equation (2), I control for year t, and a post indicator variable that is equal to one when after 1965, and the interaction of number of years after 1965 and the post indicator.

$$\begin{aligned} DIMR_{ct} =& \alpha_0 + \alpha_1 Log(exp)_{ct}^{public} + \alpha_2 Log(exp)_{ct}^{private} + X_{ct}\Gamma + I_c \\ &+ \beta_1 t + \beta_2 I(t > 1965) + \beta_3 (t - 1965) * I(t > 1965) + \epsilon_{ct} \end{aligned} \quad (2)$$

Regression results are shown in Table 3.4.2. Column (1)-(3) use the year fixed effect specification, while Column (4)-(6) use the trend break specification. All columns have year fixed effects (or trend break controls), share of black population, share of urban population, median family income and log total

[16] I use payroll expenditure instead of total expenditure in the robustness check part. Results are similar.

population. Column (1) and (4) are without county fixed effects, and Column (2) and (5) add county fixed effects. Column (3) and (6) add log of private hospital expenditures, education level, and 10-year population growth rate.

In all columns, counties that were less populated, with higher percentage of black population and more urban areas had higher IMR differences, but the effect is not significant. In Column (1), we see that cross-sectionally, places with 100% larger public hospital expenditures had 0.12 per thousand lower infant mortality rate gap; the effect is small and insignificant. When adding county fixed effects in Column (2), the effect becomes larger and more significant. After adding private hospital expenditure, education controls and 10-year population growth rate, the effect of public hospital expenditure becomes even larger and more significant. This suggests that counties with higher public hospital expenditures were also likely to have higher private hospital expenditures, but the two had opposite effects on the black and white IMR difference: counties with 100% larger public expenditure had 1.66 per thousand lower IMR gap, and the ones with 100% larger private expenditure had 0.19 per thousand higher IMR gap, though not significant. Column (4)-(6) tell a similar story.

[Table 4 about here.]

The OLS regression results in Table 3.4.2 indicates that bigger public hospitals were correlated with smaller racial health difference, both cross-sectionally and in the panel data where I use year fixed effects and county fixed effects to control for unobserved year and county characteristics. However, if there were other time-variant variables that were correlated with public and private hospital expenditures, and also affected the IMR difference, the estimates will be biased. For example, it was possible that counties with increasing public hospital sizes also had more of other poverty-alleviation programs, such as increasing female literacy rate, making more transfer to indigent families. If the black population were poorer and more illiterate at that time, then both public hospitals and the programs could help the black population more and decrease the IMR gap. In this case, the OLS estimate overstates the effect of growing public hospitals. However, if higher investment in public hospitals could be correlated with smaller sizes of welfare programs, then the OLS estimate understates the effect of growing public hospital.

In order to address these endogeneity concerns, I will use the Hill-Burton program funding to instrument for the hospital expenditures in the next section.

3.3 Hill-Burton funds and the growing public hospitals: IV regression.

The Hill-Burton funds helped both public and non-profit hospitals to expand far beyond what the local governments were willing to do by themselves. "(Yet) capital improvements to health facilities were one of state and local governments' greatest needs and expenses."[17] Also, due to the state and local grant-matching

[17] Page 180, Thomas [2011]

policies, the ones that received higher Hill-Burtons funds were the ones that were able to support the construction and maintenance of the facilities originally, then it was unlikely that receiving the funds affected the expenditure on other welfare programs (especially if the welfare program schedule was decided not by the county level government, but state or federal government). In addition, most of the big welfare programs in the War on Poverty initiative[18] happened after 1965 nationwide, and year fixed effects or year trend should take care of these changes.

In Equation (3), I use log of cumulated Hill-Burton funds for public and private hospitals 3 years ago to instrument log of public hospital expenditures. I use cumulated 3-year lag because in Chung et al. [2016], the authors show that Hill-Burton funds had persistent effects on the hospital size that lasted for 20 years and more, and the effect started to show 3 years after the funds was approved. The rationale here is that when the fund was approved, need-based allocation formula generated a negative correlation between the current hospital expenditure and approved funds, but after several years when the construction took place, the Hill-Burton funds contributed to the hospital expansion. I also add $Diff_{ct}$ which represents the gap between the target of 4.5 beds per thousand and current beds per thousand if the difference is positive; otherwise it is coded as 0. I use this variable to represent the how much the county was "in need", and it should have an effect on the overall likelihood of receiving the Hill-Burton fund beyond the cumulative 3-year lag. In addition, I control for percent of population aged 65 or above, since this variable represents some part of local demand for hospital resources, but should not affect the racial infant mortality gap directly. [19]

$$\begin{aligned} Log(exp)^{public}_{ct} = \delta^1_0 + \delta^1_1 Log(fund)^{public}_{ct-3} + \delta^1_2 Log(fund)^{private}_{ct-3} + \delta^1_3 Diff_{ct} \\ +\delta^1_4 PctPop^{65+} + X_{ct}\Phi^1 + I_c + I_t + \xi_{ct} \end{aligned} \tag{3}$$

$$\begin{aligned} Log(exp)^{private}_{ct} = \delta^2_0 + \delta^2_1 Log(fund)^{public}_{ct-3} + \delta^2_2 Log(fund)^{private}_{ct-3} + \delta^2_3 Diff_{ct} \\ +\delta^2_4 PctPop^{65+} + X_{ct}\Phi^2 + I_c + I_t + \xi_{ct} \end{aligned} \tag{4}$$

Table 5 shows the first-stage regression as in Equation (3) and (4). Column (1) and Column (2) are for public hospitals, and the later two columns are for private hospitals. Column (1) and (3) use year fixed effects, and Column (2) and (4) use year trend with 1965 trend break. We see that 1% increase in lagged Hill-Burton funds in public hospitals increased the current expenditure in public hospitals by about 0.01 %, while the increase in lagged Hill-Burton funds in

[18] Including the Economic Opportunity Act of 1964, Food Stamp Act of 1964, Elementary and Secondary Education Act of 1965, and Social Security Act 1965.

[19] Further test for exclusion restriction in Appendix B.

private hospitals had no effect on public hospitals. Vice versa, the private funds helped the private hospitals, but not the public ones. The counties with fewer number of beds per capita had lower expenditure in hospitals. Interestingly, counties that have higher share of elderly people were richer in public hospital resources, but poorer in private hospital resources.

Overall, F-statistics are all above 10, and the main instruments (Hill-Burton funds) have expected signs. There is no evidence on weak first-stages. [20]

[Table 5 about here.]

Table 6 shows the second-stage regressions. Column (1) and (3) are OLS regression results, same as in Column (3) and (6) in Table 3.4.2. Column (2) and (4) instrument the expenditure in private and public hospitals with lagged cumulative Hill-Burton funds, beds in need and percentage of elderly population. After instrumenting, the effect of public and private hospitals both become bigger, though the private hospital effect remains insignificant. 100% increase in expenditure of public hospitals resulted in 4.69-5.17 per thousand decrease in overall racial infant mortality gap. In addition, urban counties experienced less decrease, indicating that the racial health convergence came mainly in the more rural areas. From 1951 to 1975, the mean increase in expenditure in public hospitals was about 120%, and this means that the contribution to racial IMR convergence was 5.6-6.2 per thousand. From 1950s to 1975, the decline in IMR gap was about 15 per thousand, so the expansion of public hospitals accounted for 37-42% of the total decline if we use the 2SLS estimates, and 13-14% if we use the OLS estimates.

[Table 6 about here.]

Overall, the result shows that public hospitals indeed played an important role in improving the health of black people relative to the whites.

3.4 Robustness check.

3.4.1 Are southern counties affected differentially from northern counties?

As discussed in the previous sections, it is likely that southern counties were the ones that benefited the most from the program. In this section, I divide the sample into southern v.s. non-southern counties, where southern counties are the ones in Virginia, Tennessee, Arkansas, Louisiana, North Carolina, South Caroline, Mississippi, Alabama, Georgia, Florida, Texas, Oklahoma, West Virginia, Kentucky, Maryland, Delaware, and Missouri.

[20] I try to drop "beds in need" variable in the first stages, and the results for Hill-Burton funds are similar, but the second stage coefficient become even bigger. I keep this variable to report conservative results.

As shown in Table 7 and Table 8, in southern counties, public hospital expenditure had almost the same effects as in the whole sample, while in non-southern counties there was basically no effect (if any, it was the private hospitals that helped). The result further reinforces the main results.

[Table 7 about here.]

[Table 8 about here.]

3.4.2 Measure of hospital size: payroll expenditure instead of total expenditure.

There are also concerns about how to measure hospital industry sizes. In the main regression, I use total expenditure, because total expenditure was should be most closely related to the Hill-Burton funds. Here I use payroll expenditure instead, but the results are basically the same. Thus the main results are robust to the measure I use for hospital sizes.

[Table 9 about here.]

4 Conclusion

In a specific time period of racial discrimination and racial segregation, the structure of the healthcare sector mattered for the health of the disadvantaged race group, in addition to the total healthcare resources. As the first large-scale federal government intervention in the hospital industry, the Hill-Burton Program coordinated resources from the federal and local governments to build an improved hospital system nationwide. Although not entirely immune from racial segregation clauses, the expansion of public hospitals benefited the black people disproportionally. This further highlights the importance of access to care on health improvement, and might shed light upon the cause of and solution to the racial health gap issue still existing in the U.S. today.

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Table 1: Types of facilities aided by Hill-Burton in the United States, 1947-1971

Type	Number of projects	Hill-Burton Funding
Teaching hospitals	2,223 (20.7%)	$1.1 billion (29.7%)
Public-owned	5,280 (49.1%)	$1.5 billion (41%)
All race admitted (segregated and integrated)	10,644 (99%)	
All-white	84	
All-black	20	
Inpatient	9,670 (90%)	$3.3 billion
General	5,787 (73%)	$2.6 billion
Long-term	1,733 (16%)	$523.1 million
Mental		$78.5 million
Tuberculosis		$27.7 million
Outpatient	1,078	$453.2 million
Total hospital projects	10,748	$3.75 billion
Health centers	1,281	$99.7 million
Total projects	12,029	$3.82 billion

*Source: U.S. Congress, Senate, Committee on Labor and Public Welfare. Table is from Thomas [2011], Page 178.

Table 2: Types of construction by Hill-Burton in the United States, 1947-1971

Type	Projects		Hill-Burton Funding	
	Number	Percent	Amount (billion $)	Percent
New facilities	3,594	33.4	$1.1	29.1
Additions, alterations, and replacements	7,154	66.6	$2.6	70.9

*Source: Hill-Burton Project Register, 1947-1971, Page 21.

Table 3: Characteristics of counties in 1951, by hospital types

Type	No hospital	Only public hospitals	Only private hospitals	Both private and public
	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)
IMR, white	27.5	28.6	28.7	28.2
(death per thousand live births)	(18.7)	(12.8)	(12.1)	(9.1)
IMR, non-white	50.5	48.0	50.1	48.0
(death per thousand live births)	(29.1)	(25.1)	(22.8)	(22.9)
IMR, difference	23.0	19.4	21.4	19.8
(non-white minus white)	(32.1)	(26.6)	(24.8)	(21.1)
% black population	36.9	32.6	30.0	21.3
	(17.9)	(18.5)	(16.9)	(14.8)
% urban population	13.0	30.4	32.3	63.0
	(23.2)	(20.8)	(24.6)	(25.5)
Total population	22.0	31.5	59.6	314.8
(thousand)	(71)	(41.9)	(116.8)	(604.1)
Median family income	1.9	2.2	2.4	3.4
(thousand, in 1960 $)	(0.8)	(0.8)	(1.0)	(1.1)
Median years of schooling	7.4	7.8	7.9	9.3
(among people aged 25+)	(1.1)	(1.1)	(1.3)	(1.5)
% with less than 5 years of schooling	27.4	25.1	23.5	16.1
(among people aged 25+)	(9.6)	(9.4)	(10.8)	(8.8)
% with more than 12 years of schooling	17.3	19.2	21.4	31.1
(among people aged 25+)	(7.7)	(7.7)	(9.3)	(11.1)
Population growth rate	–0.8	5.8	5.4	26.9
(decadal growth rate)	(23.8)	(25.6)	(20.8)	(32)
Number of counties	345	108	344	139

Table 4: Did expansions of public hospitals narrow the black-white health gap? Counties (1951-1975)

IMR_{nw}- IMR_w	(1)	(2)	(3)	(4)	(5)	(6)
Log(exp. in public hospitals)	-0.12	-1.00*	-1.66***	-0.16	-1.07*	-1.77***
	(0.62)	(0.58)	(0.61)	(0.62)	(0.57)	(0.59)
Log(exp. in private hospitals)			0.19			0.21
			(0.36)			(0.37)
% black	0.07	0.08	0.06	0.07	0.08	0.00
	(0.05)	(0.14)	(0.16)	(0.04)	(0.14)	(0.17)
% urban	0.02	0.10	0.12	0.02	0.09	0.10
	(0.03)	(0.09)	(0.10)	(0.03)	(0.10)	(0.11)
Median family income	-1.42	0.28	-0.19	-1.40*	-0.81	-0.85
	(0.87)	(1.00)	(1.04)	(0.71)	(0.51)	(0.61)
Median years of schooling			0.78			0.69
(age>25)			(1.50)			(1.57)
% <5 years of schooling			0.22			0.28
(age>25)			(0.32)			(0.29)
% >=12 years of schooling			0.08			0.02
(age>25)			(0.21)			(0.19)
10-year pop. growth rate			-0.01			-0.01
			(0.02)			(0.02)
Log(population)	-0.26	-2.66	-2.15	-0.23	-1.68	-1.61
	(0.83)	(2.89)	(3.43)	(0.80)	(2.91)	(3.67)
I(year>1965)				-2.64**	-2.10**	-1.91*
				(1.02)	(0.99)	(1.06)
Year trend				0.36*	0.29*	0.38**
				(0.20)	(0.17)	(0.19)
Post 1965 trend				-1.08***	-1.13***	-1.15***
				(0.25)	(0.24)	(0.28)
Constant	22.32***	45.39	20.16	-677.89*	-527.33	-792.65*
	(6.70)	(30.06)	(40.53)	(396.76)	(344.61)	(432.31)
Year FE	Yes	Yes	Yes	No	No	No
County FE	No	Yes	Yes	No	Yes	Yes
Observations	8,151	8,151	7,471	8,151	8,151	7,471
R-squared	0.06	0.21	0.21	0.05	0.21	0.21

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at state level. Column (1)-(3) control for year fixed effects, and Column (4)-(6) control for overall year trend and trend break after 1965. Only Column (1) and (4) do not control for county fixed effects. Column (3) and (6) add additional controls such as log(expenditure in private hospitals).

Table 5: Hill-Burton funds and expansion of hospitals, first stage

	(1)	(2)	(3)	(4)
Instrumented variable:	Log(exp. in public hospitals)		Log(exp. in private hospitals)	
log(Hill-Burton funds in public hosp.)	0.008***	0.008***	-0.000	-0.000
cumulative, 3-year lag	(0.002)	(0.002)	(0.009)	(0.009)
log(Hill-Burton funds in private hosp.)	-0.002	-0.002	0.050***	0.050***
cumulative, 3-year lag	(0.003)	(0.003)	(0.017)	(0.017)
4.5 - beds per thousand	-0.17***	-0.18***	-0.33***	-0.33***
	(0.03)	(0.02)	(0.10)	(0.10)
% population aged 65+	0.02***	0.009	-0.05**	-0.04*
	(0.007)	(0.006)	(0.02)	(0.02)
Other controls in the main regression	Yes	Yes	Yes	Yes
Time control	Year FE	Year Trend	Year FE	Year trend
County FE	Yes	Yes	Yes	Yes
Observations	7,186	7,186	7,186	7,186
F-statistics	40.93	32.18	21.80	26.32
p-value	0.00	0.00	0.00	0.00

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered at state level. Column (1) and (3) are the first stage regressions for Column (2) in Table 6, and Column (2) and (3) are the first stage regressions for Column (4) in Table 6.

Table 6: Did expansions of public hospitals narrow the black-white health gap? 2SLS with Hill-Burton funds as instruments.

IMR_w- IMR_{nw}	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
Log(exp. in public hospitals)	-1.66***	-5.17**	-1.77***	-4.69**
	(0.61)	(2.02)	(0.59)	(1.97)
Log(exp. in private hospitals)	0.19	2.16	0.21	1.96
	(0.36)	(1.83)	(0.37)	(1.87)
% black	0.06	-0.03	0.00	-0.05
	(0.16)	(0.16)	(0.17)	(0.18)
% urban	0.12	0.15*	0.10	0.14*
	(0.10)	(0.08)	(0.11)	(0.08)
Median family income	-0.19	-0.50	-0.85	-0.86
	(1.04)	(0.98)	(0.61)	(0.63)
Median years of schooling	0.78	0.45	0.69	0.45
(age>25)	(1.50)	(1.41)	(1.57)	(1.52)
% <5 years of schooling	0.22	0.19	0.28	0.23
(age>25)	(0.32)	(0.35)	(0.29)	(0.33)
% >=12 years of schooling	0.08	0.06	0.02	0.03
(age>25)	(0.21)	(0.19)	(0.19)	(0.19)
10-year pop. growth rate	-0.01	-0.00	-0.01	-0.00
	(0.02)	(0.02)	(0.02)	(0.01)
Log(population)	-2.15	-2.93	-1.61	-2.63
	(3.43)	(2.64)	(3.67)	(2.61)
Constant	32.00	55.27*	-699.98*	-918.51**
	(33.22)	(31.03)	(346.85)	(370.27)
Time control	Year FE	Year FE	Year trend	Year trend
County FE	Yes	Yes	Yes	Yes
Observations	7,471	7,186	7,471	7,186
R-squared	0.21	0.21	0.21	0.20

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered at state level. Column (1) and (3) are the same OLS regressions as Column (3) and (6) in Table 3.4.2, and Column (2) and (4) are 2SLS results. Instrumented variables are log(exp. in public hospitals) and log(exp. in private hosp.), and instruments are log(cumulative Hill-Burton funds in public hospitals, 3 years ago), log(cumulative Hill-Burton funds in private hospitals, 3 years ago), difference between 4.5 beds per thousand and actual number of beds per thousand, and share of population older than 65.

Table 7: Public hospital expansion and black-white health gap, OLS and 2SLS, southern states

IMR_{nw}- IMR_w	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
Log(exp. in public hospitals)	-1.93***	-5.29**	-2.10***	-4.35**
	(0.61)	(2.07)	(0.60)	(2.01)
Log(exp. in private hospitals)	0.13	2.39	0.15	1.95
	(0.38)	(1.95)	(0.38)	(1.88)
% black	-0.04	-0.12	-0.07	-0.12
	(0.17)	(0.19)	(0.20)	(0.21)
% urban	0.12	0.17**	0.12	0.16*
	(0.11)	(0.08)	(0.11)	(0.09)
Median family income	-0.89	-0.76	-1.23*	-0.99
	(1.07)	(1.01)	(0.70)	(0.71)
Median years of schooling	0.99	0.90	1.01	1.00
(age>25)	(1.90)	(1.74)	(1.98)	(1.83)
% <5 years of schooling	0.21	0.20	0.25	0.24
(age>25)	(0.36)	(0.38)	(0.33)	(0.35)
% >=12 years of schooling	0.01	-0.03	-0.02	-0.06
(age>25)	(0.22)	(0.19)	(0.21)	(0.19)
10-year pop. growth rate	-0.01	-0.00	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)
Log(population)	-1.56	-2.57	-1.28	-2.35
	(3.63)	(2.47)	(3.92)	(2.58)
Constant	30.72	48.34**	-920.77**	-1,026.73***
	(34.17)	(23.30)	(363.51)	(376.72)
Time control	Year FE	Year FE	Year trend	Year trend
County FE	Yes	Yes	Yes	Yes
Observations	6,701	6,460	6,701	6,460
R-squared	0.20	0.19	0.19	0.19
F-stats, first stage	-	30, 22	-	25,22

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered at state level. Column (1) and (3) are the same OLS regressions as Column (3) and (6) in Table 3.4.2, and Column (2) and (4) are 2SLS results; just that the sample is restricted to southern counties.

Instrumented variables are log(exp. in public hospitals) and log(exp. in private hosp.), and instruments are log(cumulative Hill-Burton funds in public hospitals, 3 years ago), log(cumulative Hill-Burton funds in private hospitals, 3 years ago), difference between 4.5 beds per thousand and actual number of beds per thousand, and share of population older than 65.

Table 8: Public hospital expansion and black-white infant mortality rate gap, non-southern counties

IMR_{nw}- IMR_w	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
Log(exp. in public hospitals)	1.47	9.08	1.86	13.53
	(2.88)	(11.14)	(2.50)	(9.47)
Log(exp. in private hospitals)	2.53	-14.87*	2.98	-11.99
	(1.99)	(8.13)	(2.28)	(8.68)
% black	0.58	0.88**	0.27	0.29
	(0.50)	(0.40)	(0.40)	(0.31)
% urban	0.02	-0.06	-0.05	-0.12
	(0.17)	(0.12)	(0.18)	(0.15)
Median family income	3.28	3.03	1.27	-0.32
	(3.83)	(3.32)	(3.10)	(2.99)
Median years of schooling	3.42	2.97	2.76	2.02
(age>25)	(3.45)	(2.06)	(3.13)	(1.67)
% <5 years of schooling	1.86	2.20**	2.23	2.91*
(age>25)	(1.47)	(1.02)	(1.62)	(1.49)
% >=12 years of schooling	-0.02	0.78	-0.24	0.09
(age>25)	(0.84)	(0.50)	(0.64)	(0.35)
10-year pop. growth rate	0.01	-0.03	0.01	-0.01
	(0.03)	(0.02)	(0.03)	(0.02)
Log(population)	3.78	15.16	3.35	11.30
	(11.22)	(11.43)	(11.63)	(11.38)
Constant	-127.29	-234.52*	1,486.74	-259.13
	(169.01)	(132.49)	(1,254.21)	(995.33)
Time control	Year FE	Year FE	Year trend	Year trend
County FE	Yes	Yes	Yes	Yes
Observations	770	726	770	726
R-squared	0.46	0.35	0.45	0.33
F-stats, first stage		18,5		20,5

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered at state level. Column (1) and (3) are the same OLS regressions as Column (3) and (6) in Table 3.4.2, and Column (2) and (4) are 2SLS results; just that the sample is restricted to non-southern counties.
Instrumented variables are log(exp. in public hospitals) and log(exp. in private hosp.), and instruments are log(cumulative Hill-Burton funds in public hospitals, 3 years ago), log(cumulative Hill-Burton funds in private hospitals, 3 years ago), difference between 4.5 beds per thousand and actual number of beds per thousand, and share of population older than 65.

Table 9: Public hospital expansion and black-white infant mortality rate gap, payroll expenditure instead of total expenditure.

IMR_{nw}- IMR_w	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
Log(exp. in public hospitals)	-0.88	-4.52***	-1.07*	-3.67**
	(0.56)	(1.73)	(0.54)	(1.78)
Log(exp. in private hospitals)	0.02	2.45	0.02	2.05
	(0.26)	(1.91)	(0.26)	(1.98)
% black	-0.03	-0.11	-0.06	-0.09
	(0.16)	(0.16)	(0.17)	(0.18)
% urban	0.10	0.13	0.09	0.12
	(0.10)	(0.09)	(0.11)	(0.09)
Median family income	-0.27	-0.93	-0.67	-0.87
	(1.24)	(0.99)	(0.79)	(0.66)
Median years of schooling	0.20	0.15	0.14	0.30
(age>25)	(1.42)	(1.50)	(1.50)	(1.61)
% <5 years of schooling	0.19	0.17	0.22	0.21
(age>25)	(0.30)	(0.35)	(0.28)	(0.33)
% >=12 years of schooling	0.06	0.04	0.03	0.03
(age>25)	(0.20)	(0.19)	(0.19)	(0.19)
10-year pop. growth rate	-0.01	-0.00	-0.01	-0.00
	(0.02)	(0.02)	(0.02)	(0.01)
Log(population)	-2.16	-3.43	-1.80	-3.34
	(3.81)	(2.53)	(3.87)	(2.53)
Constant	39.80	63.38*	-500.55	-780.57*
	(39.59)	(32.48)	(345.19)	(452.43)
Time control	Year FE	Year FE	Year trend	Year trend
County FE	Yes	Yes	Yes	Yes
Observations	7,639	7,025	7,639	7,025
R-squared	0.21	0.21	0.21	0.21
F-stats, first stage		40,22		41,28

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered at county level. Column (1) and (3) are the same OLS regressions as Column (3) and (6) in Table 3.4.2, and Column (2) and (4) are 2SLS results; just that total expenditure is replaced by payroll expenditure.
Instrumented variables are log(exp. in public hospitals) and log(exp. in private hosp.), and instruments are log(cumulative Hill-Burton funds in public hospitals, 3 years ago), log(cumulative Hill-Burton funds in private hospitals, 3 years ago), difference between 4.5 beds per thousand and actual number of beds per thousand, and share of population older than 65.

Figure 1: Distribution of beds per thousand people in 1951, and distribution of per capita Hill-Burton fund over 1947-1975

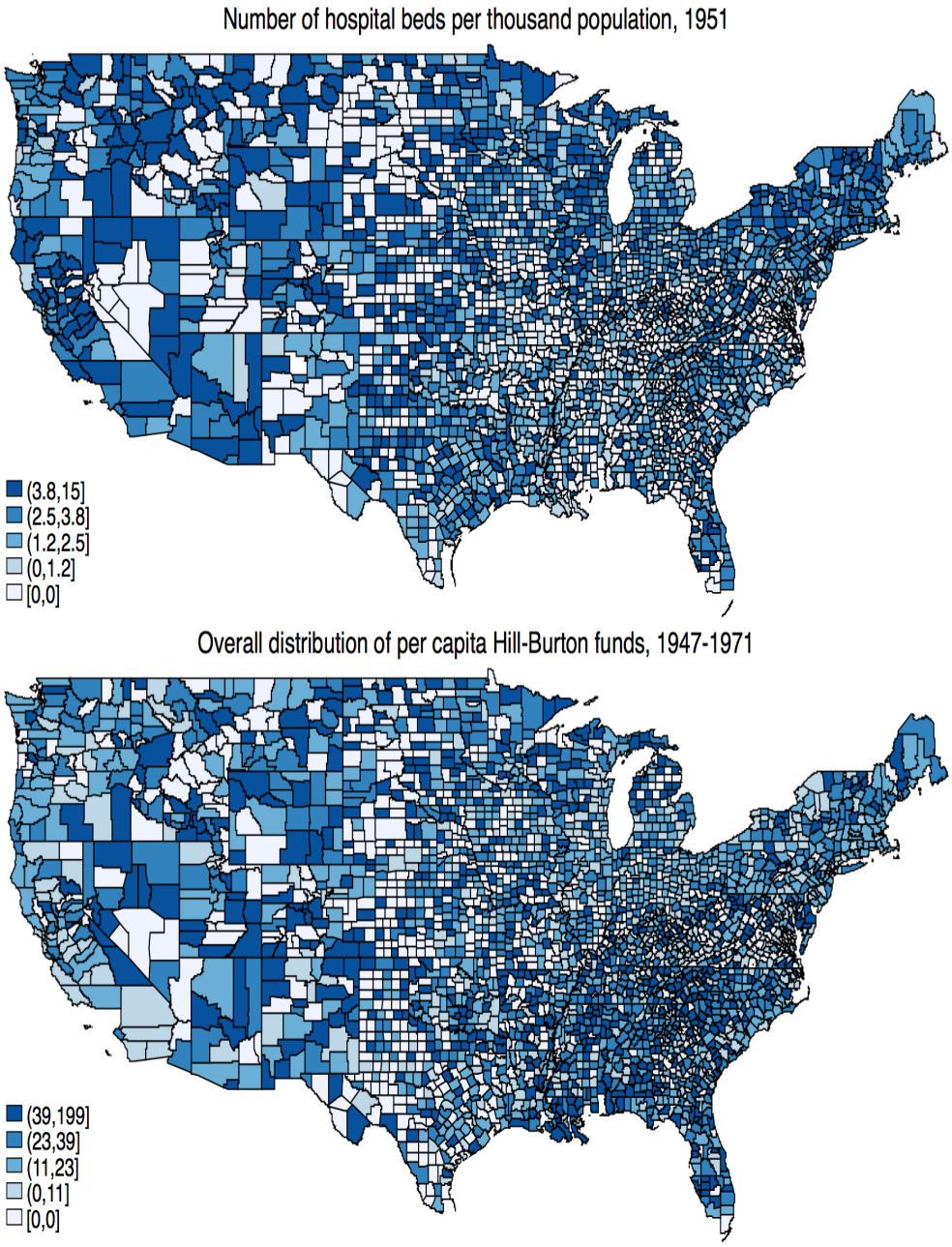


Figure 2: Trend of per capita Hill-Burton funds and hospital expenditure, public and private, 1951-1975, average across counties

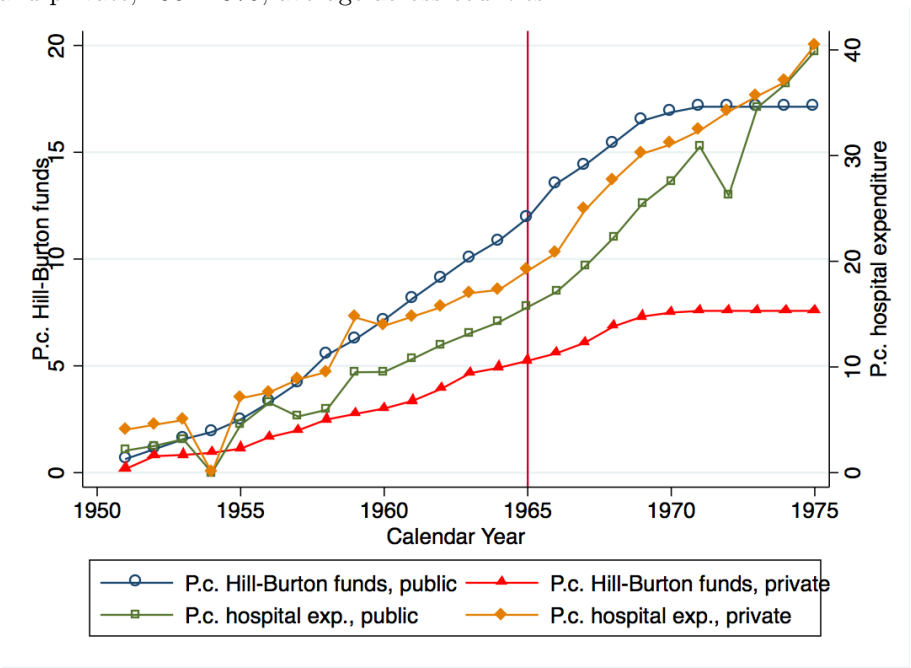
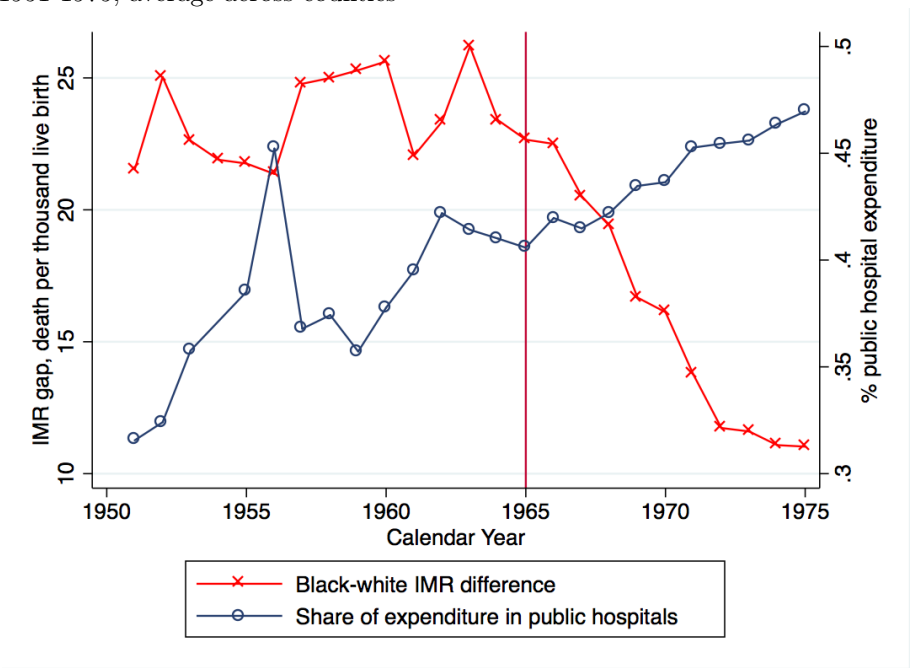


Figure 3: Trend of black-white IMR gap and % of public hospital expenditure, 1951-1975, average across counties



A Map of 936 counties that reported infant mortality rate for black and white separately in 1951.

[Figure 4 about here.]

B Test of exclusion restrictions

Here I will test the validity of the instruments that I use by adding the instruments directly into the OLS main specification (Equation (1)). From Table 10, we can see that adding the instrument into the main regression directly does not affect the coefficient estimates for log expenditure in public hospitals significantly, and coefficients for the instruments are not statistically significant. Thus, from this test, there is no evidence for violation of exclusion restrictions.

[Table 10 about here.]

Table 10: Does adding instruments in the main regression affect the results?

IMR_{nw}- IMR_w	(1)	(2)	(3)	(4)
Log(exp. in public hospitals)	-1.66***	-1.89**	-1.77***	-2.10**
	(0.61)	(0.88)	(0.59)	(0.88)
Log(exp. in private hospitals)	0.19	0.10	0.21	0.11
	(0.36)	(0.34)	(0.37)	(0.34)
% black	0.06	-0.02	0.00	0.01
	(0.16)	(0.17)	(0.17)	(0.18)
% urban	0.12	0.12	0.10	0.12
	(0.10)	(0.11)	(0.11)	(0.11)
Median family income	-0.19	-1.16	-0.85	-0.70
	(1.04)	(1.13)	(0.61)	(0.69)
Median years of schooling	0.78	0.50	0.69	0.68
(age>25)	(1.50)	(1.58)	(1.57)	(1.62)
% <5 years of schooling	0.22	0.30	0.28	0.30
(age>25)	(0.32)	(0.31)	(0.29)	(0.31)
% >=12 years of schooling	0.08	0.03	0.02	0.05
(age>25)	(0.21)	(0.21)	(0.19)	(0.19)
10-year pop. growth rate	-0.01	-0.01	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)
Log(population)	-2.15	-1.87	-1.61	-2.09
	(3.43)	(3.60)	(3.67)	(3.50)
log(Hill-Burton funds in public hosp.)		-0.04		-0.04
cumulative, 3-year lag		(0.07)		(0.07)
log(Hill-Burton funds in private hosp.)		0.03		0.02
cumulative, 3-year lag		(0.06)		(0.06)
4.5 - beds per thousand		-0.35		-0.32
		(0.89)		(0.89)
% population aged 65+		-0.55		-0.43
		(0.52)		(0.45)
Constant	32.00	43.58	-699.98*	-787.98**
	(33.22)	(33.40)	(346.85)	(352.30)
Observations	7,471	7,186	7,471	7,186
R-squared	0.21	0.21	0.21	0.21

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Stardard errors clustered at state level. Column (1) and (3) are the same as in Table 3.4.2, and Column (2) and (4) add the 4 instruments: lagged Hill-Burton public and private funds, beds in need and percentage of elderly population.

Figure 4: Black and white IMR gap in 1951, in 936 counties with IMR reported by race.