

HEALTH INSURANCE AND HOSPITAL SUPPLY: EVIDENCE FROM 1950S COAL COUNTRY*

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Abstract

The United States government spends billions on public health insurance and has funded a number of programs to build health care facilities. However, the government runs these two types of programs separately: in different places, at different times, and for different populations. We explore whether access to both health insurance and hospitals can improve health outcomes and access to health care. We analyze a coal mining union health insurance program in 1950s Appalachia with and without a complementary hospital construction program. Our results show that the union insurance alone increased hospital births and reduced infant mortality. Once the union hospitals opened, however, the insurance and the hospitals together substantially increased the net amount of hospital beds and health care employees, with limited crowd-out of existing private hospitals. Our results suggest that hospitals can complement health insurance in underserved areas.

JEL Codes: I18, I13, H51

* The findings, conclusions, views, and opinions are those of the authors and do not necessarily represent the views of the U.S. Department of the Treasury, the Federal Reserve Board of Governors or its research staff, or the United States government. We thank Jacob Bastian, Prashant Bharadwaj, Marianne Bitler, Christopher Bollinger, Tiffany Chou, Seth Gitter, Anne Hall, Hilary Hoynes, Carl Kitchens, Ilyana Kuziemko, Itahi Lurie, Claudia Sahm, Jim Siodla, Bryan Stuart, Marianne Wanamaker, Tara Watson, Mike Zabek, James Ziliak, the staff of Treasury's Office of Economic Policy, the staff of the Federal Reserve's Consumer and Community Research Section, and seminar participants at George Mason University, Towson University, and the University of Kentucky for their helpful comments. We are grateful to Heidi Williams for generously sharing the Hill-Burton project registry data, and Amy Finkelstein and Martin Gaynor for generously sharing the American Hospital Associations (AHA) Annual Survey data from 1948 to 1975. Amy Finkelstein's efforts to create the AHA data and Heidi Williams's efforts to create the Hill-Burton project registry were supported by a grant from the National Institute on Aging of the National Institute of Health (P30-AG012810). We also thank Zoya Alam, Jason Claman, Rebecca Landau, and Cecilia Pastrone who provided research assistance. Any and all errors are our own.

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Introduction

The United States government plays a large role in the health care sector through public health insurance and subsidized hospitals. However, the government has carried out these public health care programs separately: in different places, at different times, and for different populations. This separation has largely neglected the potential for health insurance and hospitals to complement each other. Specifically, public insurance may lower the cost of health care, but people may still have trouble accessing care if they live in an area without many hospitals to treat them. As a result, building new hospitals may make subsidized health insurance more effective in underserved areas. However, subsidizing hospitals may displace, or crowd out, existing private hospitals, which would reduce the potential for the hospitals to complement the insurance.

Our paper explores the effects of subsidized insurance programs with and without a complementary hospital construction program in an underserved area. To study this question, we analyze two health care interventions in 1950s Appalachian coal country using data on health care utilization (hospital birth rates and hospital admissions), hospital outcomes (beds and employees), and health outcomes (infant and overall mortality rates). In 1950, the United Mine Workers of America (UMWA), a major coal mining union, began providing hospital care insurance to its members and their families. For pregnant women in coal mining families, the union insurance covered comprehensive pregnancy-related hospital care for the first time.¹ In 1956, the union opened ten new hospitals in the area, primarily to serve those with the union hospital care insurance. Because the insurance pre-dated the hospitals, we can analyze the impact of the insurance before and after the hospitals opened. In recent times, 36 states, including seven Appalachian states, have expanded public insurance through Medicaid (KFF 2020).² Therefore, whether subsidized health care is less effective in areas with fewer hospitals to treat new patients continues to be an important issue in health care policy.

¹ Improvements in pregnancy-related care in U.S. hospitals by the early 1930s made giving birth substantially safer by the time of the union health insurance (Albanesi and Olivetti 2016). Medicaid, the U.S. public insurance program for households with low income, did not start covering pregnant women aside from those making extremely low income until 1987 (Currie and Gruber 1996).

² For consistency with the results presented below, we consider a state to be in Appalachia if the state has at least one county in Appalachia as defined by the Appalachian Regional Commission's (ARC) 1967 definition of Appalachian counties. The seven Appalachian states that have expanded Medicaid are Kentucky, Maryland, New York, Ohio, Pennsylvania, Virginia, and West Virginia.

Before the union health care interventions, Appalachia had limited access to health care compared with the rest of the United States. Appalachians had access to 1.5 hospital beds per thousand, well below a federal designation for underserved areas of 4.5 per thousand (Chung, Gaynor and Richards-Shubik 2017). At the time, only 65 percent of infants in Appalachia were born in hospitals, compared to nearly 85 percent in the rest of the United States.³ To this day, the differences between Appalachia and the rest of the United States persist, as disparities in infant mortality rates have widened in Appalachia despite government programs designed to incentivize doctors to live in rural areas with doctor shortages (Falcettoni 2019, Singh, Kogan and Slifkin 2017).

By studying the complementary effects of subsidized hospital care insurance and hospitals, we contribute to our understanding of public health insurance programs in three ways. First, we provide causal evidence on a subsidized health insurance program with and without a complementary supply-side expansion of new hospitals. There is already a large literature on U.S. public health insurance programs.⁴ However, only limited evidence exists on whether building health care facilities improves the effectiveness of health insurance programs in underserved areas (Bailey and Goodman-Bacon (2015) is one exception). Second, we present the first causal analysis of these subsidized union health care programs. Our work complements existing studies that conduct descriptive and qualitative analysis of the programs.⁵ Third, we improve upon studies of the introduction of public health insurance programs in the United States by using a county-level proxy for health insurance eligibility instead of state or Census sub-region.⁶ As a result, our approach reduces the measurement error in the analysis.

We use a difference-in-differences approach across counties and over time to separately identify (i) the initial effects of the hospital insurance and (ii) the complementary effect of new hospitals in areas with high concentrations of people eligible for the union hospital insurance.⁷

³ U.S. Vital Statistics and authors' calculations.

⁴ The literature on Medicaid documents increased prenatal care and reductions in infant mortality and low birthweight births (Gruber 1997 provides a review of the literature on Medicaid). For Medicare, Finkelstein 2007 finds large increases in hospital admissions and supply-side responses through increased hospital beds. More recent papers in this literature include Finkelstein (2007) Finkelstien, Taubman, Wright (2012), Currie and Gruber (1996), and Goodman-Bacon (2018)

⁵ (Krajcinovic 1997, R. Mulcahy 1996, R. Mulcahy 1993, R. P. Mulcahy 2000, J. E. Ploss 1982, J. E. Ploss 1981)

⁶ (Finkelstein 2007, Goodman-Bacon 2018)

⁷ The counties where the union built hospitals had high levels of insured people, but, as long as the trends in outcomes in these counties would have been parallel in the absence of the hospitals, the impact of the hospitals in high insurance areas is identified. This assumption is likely to hold if the initial impact of the insurance is a level

Because the insurance pre-dated the hospitals, we can measure the impacts of the insurance separately with and without the hospitals.⁸ We use county-year level data in the 399 counties in Appalachia, including measures of health care utilization, hospitals, and health outcomes from the U.S. Vital Statistics and the American Hospital Association.⁹ In particular, since the insurance provided comprehensive coverage for hospital pregnancy care, the Vital Statistics allow us to measure its effects on pregnancy-related outcomes such as hospital birth rates and infant mortality, with and without the union hospitals. We identify the effects of the two interventions using two different measures of exposure at the county level. For the hospital insurance intervention, we use differences across counties in the rates of mining employment as a share of the population 14 years and older in the first year of the program (1950).¹⁰ The higher the share of mining employment, the more people have the mining union hospital care insurance. For the complementary hospital intervention, we use a county-level indicator for the presence of a union hospital.¹¹

Without the subsidized hospitals, we find that the insurance increased health care utilization and improved health outcomes. Hospital birth rates increased by 3 percent for the average Appalachian county with 3 percent of its adult population employed in mining. Among counties with mining employment in the 95th percentile or above, the union insurance increased hospital birth rates by an average of 23 percent. Infant mortality rates fell by 2 percent for the average county. This reduction is around 25 percent of the overall gap in infant mortality rates between Appalachia and the rest of the United States. We find no statistically significant evidence of a private market supply-side response to the insurance, such as an increase in

shift rather than an effect that grows or shrinks over time, which we can observe. Additionally, our difference-in-differences differs from a so-called “staggered rollout” design, which may need to account for the variation in treatment timing according to (Goodman-Bacon 2019)

⁸ While it may be of interest to separately identify the “pure” effects of hospitals from the combined effects of the insurance and the hospitals (in other words, a triple difference specification), we cannot do so given our setting. The hospitals opened in ten counties with a high concentration of health insurance coverage, and there is not enough variation to separately identify the “pure” effects of the hospitals. The analysis is also not powered enough to estimate heterogeneous treatment effects of the insurance by pre-existing hospital capacity.

⁹ Vital Stats data from Bailey, Clay, Fishback et al (2016). We use the county-level definition of Appalachia as designated by the federal Appalachian Regional Commission (ARC) in 1967. County-level data generously provided by James Ziliak.

¹⁰ In 1947, the Department of the Interior estimated that over 90 percent of miners were members of the United Mine Workers of America (UMWA) or the smaller Progressive Mine Workers of America (PMWA). The PMWA provided insurance benefits through a similar arrangement as the UMWA (R. P. Mulcahy 2000), and the timing was nearly identical to the UMWA.

¹¹ Using distance to hospitals is problematic: Appalachia is mountainous and roads at this time were extremely poor.

hospital beds in private hospitals.

With the insurance in place, the new hospitals had a large and lasting impact on health care infrastructure, suggesting that existing private hospitals were not enough to meet demand. In counties with new hospitals, beds increased 83 percent, on net, and these effects persist nearly ten years later. Full-time equivalent hospital employees more than doubled, from two per 1,000 to over five per 1,000. Moreover, the associated crowd out rate for hospitals is much lower than a separate federal subsidized hospital program in the same time period (the Hill-Burton program) that did not complement any existing insurance programs.¹² We cannot reject the null of no further improvements in hospital births, admissions, or infant mortality.¹³

Our analysis is robust to a variety of alternative specifications and explanations. First, we analyze pre-trends with event study specifications of our difference-in-differences regressions. Our results are robust to accounting for other contemporaneous government programs such as county-level funding from the Hill-Burton hospital construction program and counties receiving funding from the Tennessee Valley Authority. In addition, to ensure that the creation of Medicare and Medicaid did not confound our results, we intentionally end our sample in 1965, one year before these programs began providing benefits. Finally, we provide evidence that the Second Great Migration of African-Americans out of the South likely does not bias our results, nor did mining wages rise more rapidly than overall wages during our sample period.

Compared to the most similar study, Bailey and Goodman-Bacon (2015), our results extend our knowledge and complement their findings in several ways. First, we can examine the impact of reducing the cost of health care through subsidized insurance with and without building more health care facilities. Bailey and Goodman-Bacon (2015) examine the War on Poverty's Community Health Centers (CHCs). CHCs provided both additional health facilities and reduced cost primary care at the same time. Therefore, the two effects cannot be separated. Second, our study examines hospital care programs, rather than primary care programs. Third, we can test whether the subsidized hospitals crowded out existing private hospitals.

¹² UMWA's hospitals had a crowd rate of 0.30 compared to a statistically higher rate for Hill-Burton of 0.70 found by Chung, Gaynor, and Richards-Shubik's (2017) analysis of the Hill-Burton Act hospital construction program.

¹³ Our results do not rule out positive effects on other measures of health utilization or health status we cannot measure using mortality and hospital admissions data. It is also possible that the hospitals had little additional impact on health.

The rest of the paper proceeds as follows. First, we provide details on the health conditions in Appalachia before the union health care programs and information on the programs themselves. We then describe the two main data sources followed by the difference-in-differences identification strategy. Next, we present results on the impacts of both programs followed by the conclusion.

I. Historical Context and the Union Health Programs

Before the United Mine Workers of America (UMWA) health care programs, coal miners in Appalachia and their families had limited access to quality health care.¹⁴ They received primary care through company doctors and local hospitals, some of which had minimal pre-payment hospitalization plans. Company doctors were typically poorly trained and primarily concerned with minimizing worker compensation claims for the coal companies (Krajcinovic 1997). The pre-payment hospitalization plans acted like a very limited insurance plan. However, miners had difficulty determining whether certain treatments were covered and how much they had to pay out of pocket (U.S. Department of Interior 1947).¹⁵ The plans did not cover the treatment of contagious diseases or injuries related to car crashes (J. E. Ploss 1982, U.S. Department of Interior 1947). Moreover, neither the company doctor nor the hospitalization plans covered obstetric care or pre- and postnatal care (U.S. Department of Interior 1947). Even if the hospitalization plans were clear as to what was covered, most hospitals in the Appalachian region lacked basic facilities, such as surgical rooms, delivery rooms, clinical laboratories, or X-ray facilities (U.S. Department of Interior 1947).¹⁶

At the time, the government played only a limited role in health care. Medicare and Medicaid had not yet been established (these programs began providing benefits in 1966), and state and local governments primarily provided medical care through public health clinics and

¹⁴ We define counties as being part of the ARC 1967 definition of Appalachian counties. Appalachia is a rural area in the Eastern United States where historically communities have large shares of families living in poverty who suffer from poorer health and coal serves as the economic base in many areas (Black, McKinnish and Sanders 2005, Bollinger, Ziliak and Troske 2011, Cowen, et al. 2012, Islam, Minier and Ziliak 2015).

¹⁵ Other studies have noted that there was a greater share of for-profit hospitals in coal mining areas, particularly in Central Appalachia, than in the rest of the country (Hamilton 1962). While for-profit hospitals are not necessarily worse than non-profit hospitals, it appears that these hospitals provided a lower quality of service, with many hospital beds in coal mining areas being of unacceptable quality.

¹⁶ These deficiencies in health care are particularly noteworthy given that coal mining is a dangerous job. Between 1944 and 1948, almost 235,000 coal miners were killed or injured while working in the mines (Draper 1950). Moreover, coal miners died at about twice the rate as the average working male population (Enterline 1964).

workers' compensation. Public health clinics largely provided care for tuberculosis and venereal diseases (U.S. Department of Interior 1947). State workers' compensation benefits were limited and only provided care after a waiting period (Krajcinovic 1997).

The only major federal health care program was the Federal Hospital Survey and Construction Act of 1946, better known as the Hill-Burton Act. The Hill-Burton Act was passed to improve access to health facilities in areas with high levels of need, particularly in the South (Chung, Gaynor and Richards-Shubik 2017). Under the Hill-Burton Act, the federal government provided matching grants for up to one-third of the total cost to build or expand hospital facilities in areas that lacked a sufficient number of beds – defined as fewer than 4.5 beds per 1,000 (Chung, Gaynor and Richards-Shubik 2017).

The Hill-Burton program did little to alleviate the conditions in Central Appalachia, where the UMWA's programs were most heavily concentrated. By 1960, Central Appalachia had received only limited funding and additional beds as a result of the Hill-Burton Act, shown in panels (b) of Figures A.2 and A.3 (R. P. Mulcahy 2000).¹⁷ The average county in Central Appalachia had received approximately 0.7 Hill-Burton funded beds per 1,000 by 1960. Nationally, by 1960, the average county had received approximately 1.6 beds per 1,000 funded by the Hill-Burton program. Compared with the rest of the country, Central Appalachia appears as a "hole" for Hill-Burton funding, even by 1960 (Figures A.4(b) and A.5(b)).

Our health and health care outcome measures are considerably worse before the UMWA health care interventions. Table 1 presents summary statistics for our full sample (1946 to 1965), and Table 2 presents the same statistics for 1948, pre-UMWA interventions.¹⁸ On the utilization side, the share of births in a hospital for the average Appalachian county for our full sample is relatively high compared to the pre-period – 82 percent on average (Table 1). Finally, we look at summary statistics to show that health and health care measures before the union programs were worse overall than during the full sample. Before the UMWA programs, in the average county in Appalachia only around 60 percent of births were delivered in a hospital (Table 2) compared to

¹⁷ In Kentucky, the doctors owned many of the hospitals, which were for-profit hospitals, in coal mining areas. The doctors who owned the for-profit hospitals in coal mining areas were able to prevent the local governments from providing funds to secure Hill-Burton funding (J. E. Ploss 1981, 77). In West Virginia, the district leadership of UMWA union agreed to join with a local association to secure Hill-Burton funds. However, the international UMWA prevented the district leadership from entering into such an agreement (R. P. Mulcahy 2000, 44-45).

¹⁸ Because not all variables are available for the same number of years, there are different numbers of observations for different variables depending on data availability.

over 80 percent in the full sample (Table 1). Hospital admissions are around 85 per thousand people in the full sample, but only around 53 per thousand before the UMWA programs were established. On the facilities supply side, the average Appalachian county had around 1.4 hospitals with 2 hospital beds per 1,000 in the full sample. In the pre-program period, these figures are only 1.2 hospitals and 1.5 beds per 1,000. The federal Hill-Burton hospital infrastructure program set a goal target of 4.5 beds per 1,000 at the time, considerably higher than the average county in Appalachia.

The infant mortality rate in mid-century Appalachia was slightly higher than in the rest of the United States. Before the interventions, in 1948, the average Appalachian county had an infant mortality rate of 36 per 1,000 births (Table 2). The U.S. national infant mortality rate in 1948 was 34 per 1,000 births.¹⁹ By contrast, by 2015, the U.S. national rate had fallen to 5.9 per 1,000 (Centers for Disease Control 2015).

1. The United Mine Workers of America Health Care Interventions

To improve health care in the coal fields, the UMWA launched two massive health programs in the 1950s. These programs were very much targeted to Appalachia, as the region had the highest concentration of coal employment in the country (Figure A.1). First, following the coal miners' strike of 1946, the UMWA secured the establishment of a fund to provide non-wage benefits to all miners, financed by a per-ton royalty fee on coal production as part of a collective bargaining agreement facilitated by the U.S. government (Krajcinovic 1997).²⁰ These benefits included retirement, disability, and a free health insurance program for miners and their dependents. Second, in the mid-1950s, the UMWA, dissatisfied with the quality of hospitals and doctors in Appalachia, used its funds to build ten state-of-the-art hospitals in the area. To support its hospitals, the UMWA attracted top medical talent to the area to staff the hospitals.

(a) The UMWA Health Insurance Program (Demand Side)

The UMWA started its hospital care insurance program in June 1950, covering all union miners, working and retired, plus their dependents. The insurance required no out-of-pocket

¹⁹ Authors' calculations from U.S. Vital Statistics data. The national average, however, masks large disparities between white and black infant mortality as documented in Almond, Chay, and Greenstone (2006).

²⁰ Health care had become a particularly prominent issue for miners as progress in the medical industry bypassed coal mining communities (Krajcinovic 1997). For a broader discussion of the 1946 UMWA strike, the nationalization of the mines, and subsequent creation of the miners' health insurance program, see Krajcinovic (1997) and Mulcahy (2000).

costs – beneficiaries paid no copayments, deductibles, or premiums. Compared with the hospital pre-payment plans miners were used to, the insurance was cheaper and provided more comprehensive coverage (Krajcinovic 1997). Importantly, the UMWA insurance program fully covered obstetric care for pregnant women, typically not covered under the previous plans. The full coverage of obstetrics care was a particularly salient innovation at the time. As late as the mid-1970s, health insurance provided only limited coverage of childbirth (Gruber 1994).

Before 1950, in the first nine months of 1949, the UMWA rolled out an initial insurance plan that was short-lived and chaotic, suffering from overcharging and abuses (Krajcinovic 1997). This initial version of the insurance that paid providers directly on a fee-for-service basis was quickly ended. (Krajcinovic 1997, J. E. Ploss 1982). In an event-study specification of our analysis, we show that this “false start” initial program had little to no impact on outcomes. It was only in 1950, when the insurance program began again with more robust controls for quality of care, that we see sustained increases in hospital care and declines in infant mortality.

(b) The UMWA Hospital Program (Supply Side)

Soon after the hospital insurance plan was established, the UMWA realized it had made a poor assumption about the supply-side response to its insurance program. To the UWMA’s surprise, the draw of a large set of patients with a well-functioning, centrally managed insurance program was not enough to attract an additional supply of quality hospitals and doctors to an isolated, rural area like Appalachia (J. E. Ploss 1982, 87, Draper 1958).

As a result, the UMWA developed a supply-side plan that we refer to as the “hospital program” – building a network of ten state-of-the-art hospitals and attracting top medical talent to the area (Krajcinovic 1997). The union hospitals directly accepted the union hospital insurance. These hospitals opened between December 1955 and May 1956 (Figure 2) in various population centers in Central Appalachia, costing around \$34 million in 1955, equivalent to around \$350 million in today’s dollars (Architectural Forum 1956, Meyer 1961). The union paid physicians a steady salary instead of the typical fee-for-service (Krajcinovic 1997). The hospitals were open to all, and, as a result, represented an increase in available hospital services for all residents (Krajcinovic 1997).

A key feature of these hospitals was their location: the UMWA built them in places where larger shares of people had recently become eligible for the UMWA’s insurance. As we describe in the next section, we use this feature of the UMWA’s program to expand our

understanding of complementary effects of placing hospitals in areas where people can afford to use them. We also describe how we support the identifying assumption necessary to estimate the impact of the hospitals (parallel trends in our outcomes in the absence of the hospitals). As Figure 2 shows, all counties where UMWA hospitals opened had high shares of mining employment. In counties without UMWA hospitals, most counties had little to no mining employment, but there still exist some counties without UMWA hospitals where the amount of mining employment was similar to counties with UMWA hospitals.

II. Data and Methodology

1. Data

To examine the effect of the two UMWA health care interventions on health and health care outcomes, we use data from two main sources: county-year level U.S. Vital Statistics administrative data and county-year level American Hospitals Association (AHA) survey data from 1946 through 1965 for all 399 counties in Appalachia.²¹ For our outcome variables, our health care utilization measures include the fraction of births in a hospital, or hospital birth rate (Vital Statistics, 1946 to 1965, Bailey, Clay, Fishback et al (2016)), and overall hospital admissions (AHA, 1948 to 1965). To measure effects on hospital capacity, we use data on the number of hospital beds per 1,000 (AHA, 1948 to 1965) and full-time equivalent hospital employees per 1,000 (AHA, 1951 to 1965). Finally, we examine the effects on health outcomes with Vital Statistics data on infant mortality under the age of one per 1,000 births (1946 to 1965) and overall mortality rates per 1,000 (1946 to 1965).

We choose the time frame of our analysis to increase the representativeness of the sample and to avoid confounding effects of the War on Poverty. As in other work, we choose 1946 as the starting year for our series of analyses (Troland and Figinski 2019). In doing so, we begin our sample in 1946 to mark the beginning of the post-war period, when prime-age men returned to the labor force and children were born to a more representative group of families. For the end year, we choose 1965, the first year of the War on Poverty programs, to avoid any confounding effects of other future programs (most notably Medicare and Medicaid). Including years through

²¹ We focus on the 399 Appalachian counties because the UMWA interventions were specifically targeted to Appalachian coal miners. When we use the AHA data, we linearly interpolate the data for each hospital for 1954 because there was no AHA survey in 1954. Interpolating the AHA data in this way is consistent with Chung, Gaynor and Richards-Shubik (2017).

1965 also allows us to examine a time when the UMWA scaled back benefits.²² Because we have two interventions (insurance and hospitals), we divide the years 1946 to 1965 into three separate periods according to when the UMWA rolled out each intervention. The next section describes this in more detail.

We use two county-level variables to measure each Appalachian county's exposure to the insurance and the hospitals. For the hospital insurance, we use the fraction of workers employed in mining as a share of the population age 14 and older at the county level in 1950 from the U.S. County and City Data Book (United States Department of Commerce. Census. 2012). For the union hospitals, we use a binary indicator for whether a particular county contained one of the ten UMWA hospitals using information from Krajcinovic (1997). At this time, the average Appalachian county had 3 percent of the population employed in mining (Table 1). Some counties had zero mining employment, while in others miners made up 20 percent of the population 14 and older. The fraction of workers employed in mining was particularly concentrated in Central Appalachia (Figure 1).²³

2. *Methodology – Difference-in-Differences*

First, we describe the specifications we use to estimate the effects of introducing hospital insurance coverage and union hospitals to Appalachia. Second, we explain the interpretation of the coefficients of interest and the identification assumptions. Finally, we discuss a theoretical framework to explain the results we expect to see for the impact of the two union programs.

(a) *Specification and Variables*

We use a difference-in-differences approach to estimate the impact of the two UMWA programs on health care and health outcomes in Appalachia. Our setup is different from many difference-in-differences designs. A common setup is a “staggered rollout” design, where

²² In the late 1950s, the UMWA programs began to run into financial trouble and began to cut services. The price of coal had declined, meaning there was less revenue for the UMWA Health and Retirement Programs (Krajcinovic 1997). At the same time the costs of providing health insurance and operating the hospitals increased substantially (Krajcinovic 1997, R. P. Mulcahy 2000). As a result, beginning in 1960, the UMWA began reducing eligibility for benefits. First, medical benefits were eliminated for miners who had been unemployed for more than a year (Muncy 2009). Two years later, in 1962, benefits were eliminated for miners working for coal companies who had not made their royalty payments (Krajcinovic 1997, Muncy 2009). Nearly 20 percent of beneficiaries lost their benefits because of these reforms, most of whom resided in Central Appalachia (Krajcinovic 1997).

²³ Figure A.1 in the Appendix provides the fraction of mining employment in 1950 for each county in the country. The same pattern emerges – mining employment is concentrated in Central Appalachia.

observations get the same intervention at different times.²⁴ In our case, we have two *different* interventions at two different times, but observations receive each intervention at roughly the *same* time. Moreover, there are overlapping pre- and post- periods for the two interventions.

There are the three distinct time periods for our difference-in-difference approach (Figure 3). Our sample begins in 1946 and the hospital insurance program started in 1950. Therefore, the pre-period for the hospital insurance program is 1946 to 1949. We end the post period for the insurance program in 1955, because starting in 1956, the hospitals opened in the areas with the highest shares of people eligible for UMWA insurance to complement the insurance. For the hospitals, the pre-period is 1951 to 1955, and the post- period is 1956 to 1965.

To account for the timing of the interventions, we estimate two separate regressions over different time periods, one for the insurance intervention and one for the hospital intervention. We estimate the following two equations:

$$y_{ct} = \alpha_c + \alpha_t + \beta_1 post_{1t} * ME_c + \Gamma X_{ct} + e_{tc}, 1946 \leq t \leq 1955 \quad (1)$$

$$y_{ct} = \alpha_c + \alpha_t + \beta_2 post_{2t} * H_c + \theta X_{ct} + u_{tc}, 1951 \leq t \leq 1965, \quad (2)$$

where y_{ct} is the outcome variable for county c in year t . We also run event-study specifications of (1) and (2) in which we interact each of the intervention variables with indicators for each year.²⁵

Our outcomes y_{ct} include a number of health and health care outcomes. We measure effects on hospital birth rates, hospital admissions per 1,000, infant mortality per 1,000 births, overall mortality per 1,000, hospital beds per 1,000, and full-time equivalent (FTE) hospital employees per 1,000).

For the insurance intervention (equation 1), we interact two variables to estimate the causal effect of the insurance program (β_1). First, $post_{1t}$ is an indicator for the post-intervention period for the insurance program and is set equal to one for all years 1950 and later.²⁶ Second, ME_c is the 1950 county-level mining employment as a share of the total population age 14 and

²⁴ A staggered rollout design may need to account for the variation in treatment timing according to (Goodman-Bacon 2019).

²⁵ This specification is sometimes referred to as an event study in the difference-in-differences literature, though it is distinct from an event study in a time series analysis.

²⁶ As previously noted, while the insurance was available for the first nine months of 1949, we view this period as a “false start.” In a more flexible specification of (1), we find no impact of the program in 1949.

older. This measure is a proxy for the share of the population (miners and dependents) eligible for insurance. The more mining employment a county has, the more people are eligible for UMWA hospital insurance. This measure improves upon existing literature on the initial effects of public insurance because it has a finer level of geographic variation (the county).²⁷

One potential issue is that the union insurance was only available to union coal miners, and we do not observe union membership. At the time, less than 10 percent of coal miners in Appalachia were non-union (U.S. Department of Interior 1947).²⁸ Our measure counts some miners as insured who are not actually insured. If this measurement error is uncorrelated with our outcome measures, then it should bias our results toward zero. Instead, union membership may be correlated with the mining employment to population share. The most likely scenario is that union membership is positively correlated with mining employment: counties with high levels of mining employment also have high rates of union membership. In this case, mining employment share is a good proxy for union employment share and, therefore, insurance eligibility share, and our estimates are measuring the impact of the insurance. We view the opposite scenario as unlikely, that union membership is negatively correlated with true eligibility.

For the hospitals (equation 2), we interact two different variables to estimate the causal effect. First, $post_{2t}$ is an indicator equal to one for all years 1956 and later.²⁹ Second, H_c is a county-level indicator for a union hospital. The level of treatment for the hospital program is the county. Though the primary intended beneficiaries of the UMWA hospitals were miners who already had UMWA insurance, the UMWA hospitals also accepted non-miner beneficiary

²⁷ For example, Finkelstein (2007) studies the initial rollout of Medicare and uses the percentage of the population age 65 and older without Blue Cross hospital insurance in each Census sub-region to estimate the effects of the introduction of Medicare on county level outcomes. Bacon-Goodman (2018) studies the initial rollout of Medicaid and uses the percentage eligible for cash welfare at the state level, a proxy for Medicaid eligibility in the early years of the program.

²⁸ In 1947, the Department of the Interior “estimated that a present all but a minor percentage (less than 10 percent) of the miners in the bituminous-coal industry are members of either the United Mine Workers of America or of the smaller Progressive Mine Workers of America” (XVII). Moreover, while the Progressive Mine Workers of America (PMWA) were distinct from the UMWA, the PMWA provided medical benefits through a similar arrangement as the UMWA (R. P. Mulcahy 2000). That is, the PMWA received a tonnage royalty, which was tied to the UMWA tonnage royalty, from the coal producers that funded an independently run health benefits program (R. P. Mulcahy 2000). The timing of the PMWA’s implementation was nearly identical to the UMWA.

²⁹ Evidence from Meyers (1961) and the AHA data indicates that three of the hospitals opened in December of 1955. Given that we are using annualized data, however, coding all the hospitals as opening in 1956 introduces less measurement error than separately setting the $post_{2t}$ indicator equal to one for all years 1955 and later for counties where hospitals opened in 1955. Nevertheless, our results are quantitatively identical to setting the $post_{2t}$ indicator to one in 1955 and later for the three counties where the hospitals opened in 1955. Our results are also robust to using Goodman-Bacon’s (2019) staggered difference-in-differences. Additionally, consistent with Goodman-Bacon’s (2019) guidance, we report the event study analysis below.

patients.³⁰ As a result, all residents of the county gained access to additional hospital facilities once the UMWA hospitals were opened.

In theory, the two natural experiments would allow us to estimate three separate effects: (i) the effect of union insurance without the union hospitals, (ii) the effect of union hospitals without union insurance, and (iii) the complementary effect of building hospitals in areas where people have health insurance. In equation (1), β_1 does in practice estimate (i).³¹ In equation (2), we could in theory estimate (ii) and (iii) with a triple difference specification: $\widetilde{\beta}_2 post_{2t} * H_c$ to estimate (ii) and $\widetilde{\gamma}_2 post_{2t} * H_c * ME_c$ to estimate (iii). Because the UMWA built ten hospitals, we cannot separately identify (ii) from (iii) because there is not enough power.

We instead estimate two separate effects. In equation (1), we estimate the effects of the hospital insurance with β_1 . In equation (2), we estimate β_2 , the complementary effect of building hospitals in areas where people have health insurance. Going back to the triple difference specification, we can think of β_2 as the sum of $\widetilde{\beta}_2 + \widetilde{\gamma}_2$ for a specific set of counties where a large share of the residents already had insurance.³²

In both (1) and (2), we include a number of control variables to account for variation in our outcomes that is not due to the union health care interventions. First, we include county fixed effects, α_c , to control for baseline pre-UMWA program county characteristics such as the number of hospitals, the number of physicians, or household income. Second, we include year fixed effects, α_t , to control for region-wide shocks within year. Third, we control for observable time-varying characteristics of the counties in X_{ct} . Specifically, we include controls for county population, fertility rates (births to female population), the number of hospital beds added by the Hill-Burton program in each county-year during this time period, and an indicator for when a Hill-Burton project was approved in a given county-year.³³ Finally, in (1), we also include a variable interacting $post_{1t} * total_births_{ct}$. In other work, we find that when women get access

³⁰ There is evidence that approximately 20 percent of patients at the hospitals were not UMWA beneficiaries (R. P. Mulcahy 2000).

³¹ β_1 does not estimate the “pure” effect of insurance alone without any hospitals, because though Appalachia had low levels of hospital beds at this time, there were still private hospitals that operated in the region. The regression is not powered enough to estimate heterogeneous treatment effects of the insurance by pre-existing hospital capacity.

³² To see this, suppose instead the union had viewed the hospitals as substitutes for insurance and built them in areas with little to no insured miners. Then, we would not be able estimate complementary effects of hospitals, and instead only be able to recover the “pure” effect of the hospitals ($\widetilde{\beta}_2$).

³³ We do not control for county-level household median income from the decennial census, because post-treatment, income may be endogenous to receiving health insurance. However, county fixed effects control for differences pre-existing levels of county-level median household income.

to UMWA insurance, they have fewer children, likely because more children are expected to survive into adulthood (“quality-quantity” tradeoff) (Troland and Figinski 2019). We include this interaction term to control for these differential fertility effects.

To correct for differences in the county-year error term and improve precision, we estimate (1) and (2) using Weighted Least Squares (WLS), following guidance in Solon, Haider, and Wooldridge (2015). We weight by county-level population in regressions with the following outcome variables: hospital admissions per 1,000, overall mortality per 1,000, hospital admissions per 1,000, and hospital FTEs per 1,000. We weight by county-level births in regressions estimating effects on hospital birth rates and infant mortality. We cluster our standard errors at the county level.³⁴

(b) Identification Assumptions

To identify β_1 and β_2 , we rely on two key identification assumptions, one for each parameter. For β_1 , the assumption is parallel trends in our outcome variables in low mining and high mining employment counties in the counterfactual world with no union insurance. For β_2 , the assumption is parallel trends in our outcome variables in hospital counties and non-hospital counties in the counterfactual world with no union hospitals. Union hospital counties had higher *levels* of insured people compared to the average county in our sample, but as long as the trends in these counties would have been parallel in the absence of the hospitals, β_2 is identified. To support the plausibility of parallel trends, we examine whether there are differential pre-trends in each regression in their respective pre-periods. To do so, we run event-study specifications of (1) and (2) in which we interact each of the treatment variables with indicators for each year.

However, due to the timing and location of the hospitals, for parallel trends to hold for the hospitals, we must do an additional check. The post period for the insurance is the pre-period for the hospitals (Figure 3). Counties that eventually got hospitals were in fact differentially affected by the insurance compared to counties that did not. These differential effects could violate parallel trends for identifying β_2 . However, violating parallel trends is not a given. Instead, it depends on the nature of the impact of the insurance over time. In particular, it

³⁴ Following Solon, Haider, and Wooldridge (2015), we run a modified Breusch-Pagan test as a standard heteroskedasticity diagnostic and reject the null of constant variance of the county-year error terms. We also compare OLS to WLS specifications. WLS specifications have smaller standard errors, suggesting population-driven heteroskedasticity in the error terms. Results available upon request.

depends on the slope of the insurance effect over time. If the impact of the insurance is a level shift, meaning the effect of the insurance does not grow or shrink over time, then parallel trends are likely to hold. Because we have annual data, we can examine the shape of the insurance effect over time. When we run (1), the insurance program regression, as an event study, we can measure the year-by-year differential effects between high insurance (high mining employment) and low insurance (low mining employment) counties using the coefficients in the event study regression. If these coefficients grow over time, then parallel trends are likely violated for identifying the casual effect of the hospitals.

As an example, we describe the impacts of hospital birth rates. If we run (1), we expect $\beta_1 > 0$ for 1951 to 1955 (an increase in hospital birth rates post-insurance). With an event-study version of (1), we can identify year-by-year effects of the insurance in the post-period of 1951 to 1955, which is the pre-period for identifying β_2 . The event-study specification measures differences in hospital birth rates between high and low insurance counties over time. Parallel trends for identifying β_2 are likely to hold if the slope of these event-study coefficients is flat rather than growing or shrinking over time. In other words, if hospital birth rates jump up to a higher but constant level in high insurance counties in the post-insurance but pre-hospitals period, then parallel trends for β_2 are likely to hold. If, instead, hospital birth rates jump to a higher level and then continue to rise in high mining counties relative to low mining counties, parallel trends are unlikely to hold.

(c) Theoretical Framework and Expected Empirical Results

We discuss the expected results of our empirical analysis using the theoretical framework of a market for hospital care. For the impact of the insurance intervention (β_1), we test whether the program caused an increase in the equilibrium quantity of hospital care in affected Appalachian counties. Giving people subsidized insurance lowers the price of health care. We expect that providing union coal miners and their dependents with free hospital insurance will increase demand for hospital care, or a shift to the right in the demand curve for hospital care services. This increased demand would result in an increase in both the equilibrium quantity of hospital care demanded and supplied in the market. As a result, we expect to see an increase in hospital birth rates and admissions and a corresponding increase in full time equivalent employees and hospital beds ($\beta_1 > 0$).

If increased hospital care is improving people's health, we also expect to see an improvement in health outcomes. At the time of the interventions, hospitals had just recently gained the technology to deliver life-saving antibiotics to reduce infant mortality (Almond, Chay and Greenstone 2006, Thomasson and Treber 2007).³⁵ We are less likely to find a decline in overall mortality given the state of medical technology and the overwhelming amount of deaths due to heart disease.³⁶ The additional care provided to adult miners is unlikely to have been able to prevent deaths from heart disease. However, because miners had access to hospital services such as rehabilitation after mining injuries, the UMWA insurance may have improved health outcomes for adults in ways we cannot measure with mortality data.

For the hospital intervention (β_2), we test whether building new hospitals in high insurance places further increased the equilibrium quantity of health care in these areas. It could be that the union hospitals simply crowded out existing private hospitals and doctors. If the supply side of the market had responded adequately to meet the new demand from the insurance by increasing hospital capacity, we would expect $\beta_2 \approx 0$, or full crowd-out of existing hospitals. However, if the union hospitals responded to a true need for more hospital capacity, then we would expect $\beta_2 > 0$ for hospital beds and FTEs. If $\beta_2 > 0$, then the hospital intervention shifted the hospital care supply curve to the right. As a result, we expect to see an additional increase in the quantity of hospital care supplied and demanded.

Therefore, if β_2 is greater than zero and significant for measures of hospital capacity, we might also expect $\beta_2 > 0$ for our health care utilization outcomes (increase in quantity demanded as a result of the shift to the right in the hospital supply). Finally, if the new hospitals and health care employees were in fact better at preventing deaths, we would expect further declines in infant and overall mortality rates, or $\beta_2 < 0$.

III. Results

We find the strongest effects of the insurance program on measures of hospital utilization and infant mortality. For the hospital program, we find the strongest effects on hospital capacity

³⁵ These drugs were most effective at preventing death in the postnatal period, between 1 to 12 months after birth (Almond, Chay and Greenstone 2006). UMWA-insured mothers gave birth to insured babies, who could be brought to the hospital and treated for infectious diseases that contributed to infant death.

³⁶ Age-adjusted death rates from heart disease have decreased from a peak of 307.4 per 100,000 in 1950 to 134.6 per 100,000 in 1990 (Centers for Disease Control 1999).

beds and FTEs. We discuss our results separately by intervention: first union hospital insurance, then union hospitals.

1. *Effects of the Demand-Side UMWA Hospital Insurance Program*

We first discuss results from the first union health care intervention: hospital insurance for union coal miners, working and retired, and their dependents. The first row of Table 3 shows estimates for β_1 , our difference-in-differences estimator for the impact of the insurance program (the coefficient on Post Ins x Mining EPop share 1950), from equation (1). These estimates measure the average impact of a county going from zero employment in mining and no insurance coverage to all workers employed in mining and eligible for insurance (minus non-union miners). We also show that, for a version of the hospital birth rate regression, with certain assumptions, β_1 can be interpreted as a household-level treatment effect.

In the left-hand side graphs of Figure 4, 5, and 6, we examine whether counties with high population shares of mining employment trended differently than those with low shares before 1950, when the hospital insurance program began. We normalize the year 1948 to zero.³⁷

(a) Utilization: Hospital Births and Admissions

In theory, once people enroll in subsidized health insurance, we expect increased hospital utilization. Consistent with this theory, we find large utilization effects of the insurance for pregnant women, who received free hospital obstetric care for the first time. Table 3, row (1), column (1) shows that the union insurance increased the fraction of births in a hospital. The coefficient can be interpreted as the effect of UMWA insurance on our outcomes when our treatment variable increases from zero to one. In other words, the treatment effect for a county in our sample going from zero mining employment (and no one eligible for insurance) to all individuals in the county age 14 and older working in mining (and all individuals eligible for insurance). The estimated coefficient of 0.660 suggests that for the average county with 3 percent of its population age 14 and older employed in mining, hospital birth rates increase by around 0.02, or a percent increase of 3 percent.³⁸ For counties with very high shares of mining

³⁷ Typically, one would normalize the last pre-treatment year (1949) to zero. However, in 1949 the UMWA rolled out its chaotic “false start” initial insurance program covering all medical care that lasted only nine months. The long running hospital insurance started in 1950, and it is not until 1950 that we see sustained and significant impacts of the insurance program.

³⁸ To calculate the effect size, we multiply the estimated coefficient (0.66) by the average share of the population in mining employment (0.03) and divide the product by the pre-treatment share of hospital births in 1948 (0.61).

employment (in 95th percentile and above), hospital birth rates increase by 15 percent or more (10 percentage points).

In Figure 4, panel (a), the left graph shows little evidence of pre-trends. However, there is a small spike in 1949, indicating that slightly more women in high insurance counties delivered their babies in a hospital during the UMWA's short-lived initial program. This difference goes away the following year before jumping and staying at a relatively stable but elevated level from 1952 to 1955. The slope of the coefficients is relatively constant starting in 1952, which supports the assumption of parallel trends for estimating causal effects of the hospitals.

We run an alternate specification of (1) to calculate a back-of-the envelope measure of a household-level impact of the insurance. In other words, a measure of the probability a woman in an insured household gives birth in a hospital. We rely on a number of assumptions to calculate this household-level effect (we provide additional detail in Appendix A). The key assumption comes from the fact that we do not observe the number of mining households in a given county that also had a birth in 1950. Instead, we rely on a proxy. Birth rates among mining households were 2.7 percentage points higher than non-mining households in 1950, according to data from the 1950 decennial census 1 percent sample (Ruggles, et al. 2019). We take the average share of households with a birth in 1950 in the Vital Statistics data, and we scale it up by 2.7 percentage point to account for the higher birth rate in mining households.

In this alternate specification, we find that the insurance increases the probability of delivering in a hospital by 3 percentage points for the average mining household. Column (6) of Table 3 shows the results of this alternative specification. The point estimate of three percentage points is a percent increase of 5 percent, going from a probability of 0.61 before the UMWA insurance to a probability of 0.64.

We find more suggestive evidence that the insurance increased overall hospital admissions, which could reflect some combination of increased admissions of pregnant women and other types of patients. Table 3, row (1), column (2) presents the results of running (1) with hospital admissions per 1,000 people on the left hand side. The coefficient of 65.56 from column (2) indicates that for the average Appalachian county, the insurance induces an increase of around 2 additional admissions per thousand people (significant at the ten percent level).³⁹ This

³⁹ To calculate this number, we take the average county mining employment to working age population share (3 percent) and multiply it by the estimated coefficient (61.09).

represents a percentage increase of around 4 percent from a pre-intervention average of around 53 admissions per thousand. Figure 4, panel (b), left graph shows results of a version of the regression in Table 3, row (1) column (1) with indicators for each year multiplied by the mining employment to population age 14 and over share. There is no evidence of pre-trends in Figure 4. However, the data on hospital admissions begin in 1948, reducing the number of pre-intervention years to one in fixed effects specifications.

The average treatment effects on hospital admissions are smaller than those associated with the introduction of Medicare, a much larger subsidized insurance program that covered people 65 and older (Finkelstein 2007). Finkelstein (2007) finds that Medicare increased hospital admissions by 46 percent, on average, much higher than our point estimate of four percent. However, Medicare was a larger intervention covering nearly an additional 7.5 percent of Americans.⁴⁰ Therefore, it is unsurprising that our average treatment effects on hospital admissions are smaller than those associated with the introduction of Medicare.

(b) Health Outcomes: Infant and Overall Mortality

We find that the insurance reduces infant mortality. Table 3, row (1), column (3) shows for the average Appalachia county, going from zero people working in mining to 100 percent of people working in mining, UMWA insurance reduces infant mortality by around 21 per thousand. For the average Appalachian county with three percent of the population age 14 and older employed in mining, the insurance reduces the infant mortality rate by around 0.66 per thousand, or a percentage decline of around two percent.. Figure 5, panel (a), left graph shows that the yearly estimates of the effect on infant mortality are noisier, and that in 1947 there is some evidence of pre-trends. However, there is a clear decline in 1950 for counties with higher population shares of mining employment. These counties have increasingly lower rates of infant mortality as time goes on, which means that the parallel trends assumption for the complementary impact of the hospitals in high insurance counties on infant mortality may be violated.

In comparison to the literature, our results are in line with previous studies of the Medicaid program (Currie and Gruber 1996, Goodman-Bacon, Public Insurance and Mortality:

⁴⁰ To calculate the additional 7.5 percent figure, we use information from Finkelstein (2007) – ten percent of the population was elderly times 75 percent who became insured.

Evidence from Medicaid Implementation 2018). However, unlike the UMWA insurance, Medicaid also provided coverage for primary care in addition to hospital care. Currie and Gruber (1996) find that, for a state with the average increase in Medicaid eligibility of 0.30, Medicaid reduced infant mortality by around 1 deaths per 1,000 births, from a base of around 10 deaths per 1,000 births. Bacon-Goodman (2018) finds similar results for Medicaid's initial rollout, though the declines were larger in percentage terms.

Finally, we do not find evidence of reductions in overall mortality. Overall mortality includes all deaths, infant and older. Infant deaths are around 9 percent of total deaths in our sample, so even if the program provided no reductions in mortality for non-infants, we might still expect to see some effects for overall mortality, entirely driven by the observed reductions in infant mortality. However, as Table 3, row (1), column (4) shows, our estimates are noisy, and we cannot rule out large negative or positive effects. While we find no effects on overall mortality, our results cannot be interpreted to conclude the insurance had no effect on health outcomes. It is possible that the UMWA insurance improved the health outcomes of adult miners along dimensions which are not well measured by reductions in mortality, such as enhanced mobility from physical rehabilitation for which we lack data to estimate the effect.

(c) Health Care Capacity: Hospital Beds

In section III.1.a, we find that the insurance program increased hospital births and overall hospital admissions, even though many eligible people lived far from a quality hospital. These results point to increased demand for hospital care, and, as a result, an increase in the equilibrium amount of hospital care. Therefore, we might expect to see corresponding increases in measures of hospital care supply to meet this new demand. We analyze this response using the number of hospital beds per 1,000. Row (1), column (5) of Table 3 shows results for the impact of the insurance program on hospital beds per 1,000. We find no clear evidence of increased hospital beds. However, we cannot rule out large effects, as the standard errors are large.

Though our paper analyzes an area in the U.S., given the health and living conditions in Appalachia at the time, our results may also inform the development literature on health care interventions in underserved areas outside the U.S. Programs such as subsidized insurance and incentivized doctor visits in developing countries, such as in Kenya and Indonesia, often suffer from problems such as low take-up and limited supply side response (Chemin 2017, Triyana 2016, Wagstaff, et al. 2007). In comparison, our results do suggest that the programs in

Appalachia generally had high take up. However, like some of these health insurance programs in developing countries, the UMWA's concerns about the supply side of hospital care was a key factor in the decision to build new hospitals in coal country.

2. *Effects of the UMWA Supply-Side Hospital Program*

We now turn to results on the UMWA's second intervention, the union hospitals. Our results measure a type of local average treatment effect (LATE), answering the following policy-relevant question: What happens when hospitals are built in areas where large shares of the population can afford to use them? As with the insurance program results, across each table, each column has a different set of controls. To test for pre-trends, we turn to the right graphs of Figures 4 through 6. These figures represent an event-study version of equation (2), displaying coefficients for the hospital intervention multiplied by indicators for each year. The year before the intervention (1955) is normalized to zero.

(a) Impacts on Hospital Capacity: Hospital Beds and FTEs

We find stark increases in hospital beds in counties with UMWA hospitals. Table 4, row (1), columns (5) and (6) estimate equation (2) with the total number of hospital beds and full-time equivalent hospital employees as dependent variables, respectively. For the average county with a UMWA hospital, there was an increase of around 1.6 beds per thousand people (column 5). This represents a percent increase of around 80 percent for counties with UMWA hospitals.⁴¹ Figure 6, panel (a) right graph, shows a large, clear, persistent jump in the number of beds post-1956. We also find no evidence of differential pre-trends between counties where the UMWA built hospitals and counties where they did not. Even though we see no pre-trends in the top-right graph, to be cautious, we note that in the left graph, the point estimates suggest evidence of a steady and growing increase in beds in high insurance counties before the hospitals opened in 1956. However, these increases are noisy and much smaller in magnitude than those in the right graph. This is especially true considering results in the left graph must be scaled down: the estimates are for a county with 100 percent of its population age 14 and older employed in mining. The highest mining employment county had around 30 percent of the population employed in mining.

⁴¹ The relevant pre-treatment mean in this case is 1.94 beds per thousand, the average number of beds in treatment counties in 1951-1955, the years after the insurance program but before the hospitals were completed.

We find large increases in the number of hospital FTEs. Table 4, column (6), shows an increase of around 3 FTEs per thousand, more than double the employees compared to a pre-intervention mean of around 2 per thousand.⁴² Figure 6, panel (b) shows a sharp increase in FTEs with no evidence of differential pre-intervention trends.

The increases in hospital beds and FTEs suggest a complementarity between the union insurance and the union hospitals. We further explore this complementarity by directly comparing our results to the Hill-Burton hospital construction program in Chung, Gaynor, and Richards-Shubik (2017). The Hill-Burton program was a contemporary of the UMWA's programs, but it did not explicitly target counties where large shares of people already had health insurance. Moreover, it began well before the US public insurance programs expanded health insurance coverage on a widespread basis. Therefore, the scope for complementarities between Hill-Burton hospitals and insurance was limited. Another key difference is that, unlike the Hill-Burton program, the UMWA program actively recruited quality doctors and paid them a salary rather than fee-for-service. Differences between the impacts of the UMWA program and the Hill-Burton program are likely driven by complementarities between the insurance and the hospitals.⁴³

We directly compare our findings to the Hill-Burton program by running a specification that measures the impact of the UMWA hospitals on a “per new bed” basis. In Figure 7, we run an event-study version of (2) with a different measure of intervention for the hospital program, similar to a specification used to analyze Hill-Burton in Chung, Gaynor, and Richards-Shubik (2017). Instead of using an indicator for whether a county got a hospital, we instead use the number of *additional* hospital beds in the new UMWA hospitals in a given county (not the total number of hospital beds, only the new beds in the new UMWA hospitals). The right-hand side is the same as in Table 4 column (5), total beds in a given county (UMWA beds plus other existing hospital beds in each county).

⁴² Note that we cannot analyze effects on FTEs for the insurance program since the FTE data start in 1951, the year after the insurance program began.

⁴³ As described earlier, the federal Hill-Burton Act was passed to improve access to health facilities in areas with high levels of need, particularly in the South (Chung, Gaynor and Richards-Shubik 2017), and was run by the states. The program existed at the same time as the UMWA programs (though it lasted longer, running from 1948 to 1971) and was much larger than the UMWA program. For most of the years of the Hill-Burton program there were no public insurance programs to complement the Hill-Burton hospitals. However, unlike UMWA, by targeting underserved areas, the program likely incentivized states to build in areas with lower, rather than higher, shares of people with insurance, as households in underserved areas may not have been able to afford comprehensive private coverage.

We find that the union hospitals had far lower crowd-out rates than the Hill-Burton program. To compare the two programs, we take a conservative approach and look at results a few years after the hospitals opened, giving the market more time to adjust to the new UMWA hospital entry. If we look at results for 1959, after the hospitals had been open for four years, we find that for every additional new UMWA hospital bed, total hospital beds increase by around 0.70, or a crowd-out rate of 0.30. This rate is significantly higher than that found in a comparable time frame by Chung, Gaynor, and Richards-Shubik (2017).⁴⁴

(b) Health Care Utilization and Health Outcomes

We do not find evidence of additional effects on health care utilization. Table 4, column (2) row (3) presents results for the impact of the hospital intervention on admissions per thousand, which is positive but statistically insignificant. The UMWA hospitals increased hospital admissions by 18 additional admissions per 1,000, or a percent increase of around 15 percent for the average county. Table 4, column (1) row (3) shows statistically significant increases in hospital births. However, these results do not hold up to state-year trends (Table A.2). Our results are noisy, and we cannot rule out large positive or large negative effects.

We also do not find evidence of further improvements in health outcomes. While the point estimates in Table 4, column (3) row (3) show statistically significant declines in infant mortality, the right graph in Figure 5 panel (a) shows pre-trends, which is not surprising given that the declines in infant mortality caused by the insurance were increasing in magnitude over time (panel (a), left graph). Finally, while Table 4, column (4) row (3) shows that the hospitals may have reduced overall mortality, the right graph of Figure 5, panel (b) shows some evidence of pre-trends.

These results do not rule out positive effects on health care utilization or other measures of health status. Mortality is a relatively coarse measure of health status that may not capture the marginal improvements in health care provided by the union hospitals. For example, the union hospitals provided state-of-the-art specialists in rehabilitation care for injured coal miners. Better measures of health status such as mobility would likely show further improvements once the hospitals opened. It may be that the marginal improvement in maternal and infant care at the

⁴⁴ Chung, Gaynor, and Richards-Shubik (2017) do not have the date that the Hill-Burton hospitals opened, only the date that each project got approved for funding. Assuming around two years of construction time, we compare our estimates to those after six years in the analysis of Hill-Burton. Results are similar for years five through seven.

union hospitals was not large enough to detect additional improvements in hospital births or infant mortality.

3. *Robustness Checks and Additional Tests*

We address a number of alternative explanations for our results. First, we show that unobserved state-year time trends have little effect on the qualitative discussion of the results above (Tables A.1 and A.2). Second, we investigate coal wages compared to overall non-farm wages during our sample and find little evidence for increased coal income as a driver for the observed improvements in health care outcomes. If coal wages were growing much faster than wages for other occupations during the 1950s, then higher wage growth would be correlated with the insurance intervention as measured by the coal employment to working age population ratio. Assuming health care is a normal good, coal miner households may simply be getting paid more and consuming more health care as a result. Our observed increases in hospital care from the UMWA insurance may not be due to health insurance at all but instead simply an income effect due to higher coal wages. Figure 8 plots real hourly wages for all non-farm workers and real hourly coal wages from 1947 to 1965 (U.S. Department of Labor, Bureau of Labor Statistics 1991). While coal wages are higher, on average, the trends in the two series are similar. It would be worrisome if there was a differential trend break in 1950 for mining wages compared to non-mining wages. Therefore, it is unlikely that the effects we observe are income effects rather than direct effects of the health insurance.

Third, we address potential effects of the Second Great Migration. Though the 1940s and 1950s were a historic period of migration for African Americans from southern rural areas to northern cities, it is unlikely that this movement could cause the observed improvements in health care that we attribute to the union health care programs (Boustan 2009, Collins and Wanamaker 2014, Collins and Wanamaker 2015, Smith and Welch 1989). If African Americans were migrating out of mining counties, there could be differential effects driven by outmigration rather than the UMWA health programs. More African American families were living in poverty than white families at this time, so outmigration would tend to make the overall population richer on average, and therefore demand more health care (Collins and Wanamaker 2015, Smith and Welch 1989). Alternatively, there could be more African American out-migration in the control counties (non-mining/UMWA hospital). If this is the case, the control

counties would be getting differentially higher income, on average, which would attenuate our treatment effects rather than augment them. However, unlike other areas in the American South, there were very few African Americans in Appalachia, and even fewer in areas with high levels of coal mining, our intervention areas. The average U.S. county had a nonwhite population of around 11 percent in 1950, while the average Appalachian county in the 90th percentile of coal employment to population had a nonwhite population of just 3.5 percent.

Fourth, other programs, such as the Tennessee Valley Authority (TVA) and the War on Poverty programs, also likely have little impact on our results. The TVA funded a series of large investments in the Tennessee valley region, which some evidence suggests led to an increase in both agricultural and manufacturing employment in region (Kline and Moretti 2014).⁴⁵ During the time frame of our analysis, TVA increased and then sharply decreased funding to counties in the region. The increase coincided with the UMWA's insurance program, and the decrease happened three years after the UMWA hospitals opened. The increase in income associated with high employment levels could increase health care utilization and health outcomes, and the decrease could have the opposite effect. 111 counties are part of both the TVA and Appalachia. Of these 111 counties, only 26 counties had mining employment as a share of the population greater than one percent. As a result, the TVA counties in our sample primarily serve as control counties in our analysis. For the insurance program TVA would likely bias our results to zero, since the control counties would be getting richer as a result of the program (just as is the case if there was differential out-migration by African Americans in our control counties). For the hospitals, the opposite is true, but we do not observe any differential changes in our estimates starting in 1959, when TVA began to cut funding. Nevertheless, we conduct our analysis excluding the TVA counties. Our findings, reported in Tables A.3 and A.4, are robust to excluding these counties from the analysis.

Finally, to address any confounding effects of the War on Poverty programs, we end our sample period in 1965. Medicare and Medicaid did not begin providing benefits until 1966 (Goodman-Bacon 2018). Similarly, Medicare did not begin providing benefits until 1966. Other programs, such as the funding of the Appalachian Development Highway System, did not begin

⁴⁵ There is other evidence which suggests the TVA may not have increased agricultural and manufacturing employment and may have increased malaria rates, potentially offsetting nearly a quarter of the fiscal stimulus generated by the TVA (Kitchens 2013, Kitchens 2014).

until 1965 (Jaworski and Kitchens 2016). Alternatively, because some of the War on Poverty programs such as the Area Redevelopment Act of 1961 and the Food Stamp Program began before 1965, our results are robust to excluding years after 1959 (results available upon request).

IV. Conclusion

We examine the impacts of a union hospital care insurance program with and without a complementary hospital construction program. Without the hospitals, the insurance program increased hospital births and reduced infant mortality. The program reduced infant mortality by 0.02 per 1,000 births, equal to around 30 percent of the overall gap in infant mortality between the U.S. and Appalachia. However, we do not find statistically significant increases in the supply of hospitals or health care workers to treat newly insured union patients. Once the union hospitals opened, the supply of hospital beds and health care workers increased substantially. We, however, do not find statistically significant improvements in health care utilization or mortality after the hospitals opened.

Our findings suggest a role for complementary effects of hospitals in areas with a large insured population. The union hospitals substantially increased the net number of hospital beds and health care workers. These effects suggest that existing private hospitals did not adequately meet demand for hospital care. Moreover, crowd-out rates were much lower compared to a similar hospital construction program that did not complement any existing insurance program. However, with our data, we do not find statistically significant evidence that mortality, both infant and overall, improved as a result. Therefore, we cannot conclude that the hospitals made the insurance more effective at preventing deaths. It is possible that the hospitals improved outcomes along other dimensions that we cannot measure with our data, such as mobility or even financial security. It is also possible that there were no further improvements. As policymakers look to expand public health insurance in underserved areas, further research with other data on health outcomes and household finance can improve our understanding of complementarities between insurance and hospitals.

APPENDIX

A. Methodology Appendix

We interpret our results for hospital births rates as household level probabilities by running an alternate specification of (1). To generate this specification, we start with the simple case where mining employment is randomly assigned across households in the population. If we had household level data on occupation and births, we would run the following regression for the sample of households with women who gave birth in each given year:

$$hosp_birth_{hct} = \alpha + \gamma mining1950_{hc} + v_{ict} \quad (3) \text{ for } h \text{ with a birth in year } t,$$

where $hosp_birth_{hct}$ is an indicator for whether a given birth in a given household h was in a hospital in county c year t . $mining1950_{hct}$ is an indicator for whether the household that had a birth is also a mining household in 1950 when the program launched. We can aggregate (3) to the county level, and we have

$$hosp_birth_{ct} = \alpha + \gamma mining1950_c + n_{ict}$$

where $hosp_birth_{ct}$ is total hospital births in county c year t , and $mining1950_{ct}$ is total households that were both mining households in 1950 *and* had a child in county c year t (recall that being a mining household in 1950 is simply a proxy for treatment, as we assume miners stay on the UMWA insurance once they become eligible). We can divide both sides of the equation by $total_births_{ct}$ to get:

$$\frac{hosp_birth_{ct}}{total_births_{ct}} = \frac{\alpha}{total_births_{ct}} + \gamma \frac{mining1950_c}{total_births_{ct}} + \frac{n_{ict}}{total_births_{ct}} \quad (3')$$

We must assume one birth per household per year, then $total_births_c$ is equal to the number of households that had a child in a given county-year. We also assume one miner per household. With these assumptions, we can interpret the numerator $mining1950_{ct}$ as total mining households that had a child in a given county-year. The term $\frac{mining1950_c}{total_births_{ct}} = \frac{total_mining_hh_withbirth1950_c}{total_hh_withbirth1950_c}$ is then share of eligible households among all households that had a child in a given year. In our main regression (1), we have $ME_c = \frac{total_mining_workers1950_c}{population_over141950_c}$. For this exercise, we again assume one miner per household, meaning that $total_mining_workers_c = total_mining_households_c$.

We use the county level data to arrive at calculation of $\frac{total_mining_hh_withbirth1950_c}{total_hh_withbirth1950_c}$. We already have the denominator, $total_hh_withbirth_{ct} = total_births_{ct}$, in the county-level data. We are missing the numerator, the number of mining households also had a child in a given year. Instead, we have total mining households (regardless of whether they had a child). To calculate a measure of the numerator, we scale total mining households down by the average county-level birth rate across all households in 1950. We then adjust that number up 2.7 percentage points for each county. Our adjustment is derived from the 1% sample of the 1950 decennial census (Ruggles, et al. 2019). Specifically, we calculate that in the 1% sample of the 1950 decennial census white males between the ages of 16 and 59 working in coal mining and living in a state with at least one county in Appalachia (Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia) are 2.7 percentage points more likely to have a child under the age of one, a proxy for a birth in the year 1950, than white males working in an industry that is not coal mining and living in a state with at least one county in Appalachia. Given our other assumptions, we can refer to our estimate from the 1% sample of the 1950 census as the estimate for mining households.

$$\begin{aligned}
 & total_mining_hh_withbirth1950_c \\
 &= total_mining_households_{ct} * \frac{total_mining_hh_withbirth1950_c}{total_mining_households_{ct}} \\
 \text{We proxy for } & \frac{total_mining_hh_withbirth1950_c}{total_mining_households_{ct}} \text{ with } \frac{total_hh_withbirth1950_c}{total_hh_1950_c} + 0.027 \\
 & \frac{total_mining_households1950_c \times (\frac{total_hh_withbirth1950_c}{total_hh_1950_c} + 0.027)}{total_hh_withbirth1950_c}
 \end{aligned}$$

We apply this calculation to our difference-in-differences specification by running a version of (1) with a different treatment variable. Instead of mining employment as a share of population 14+ ($ME_c = \frac{total_mining_workers_c}{population_over14_c}$), we use the above proxy for the share of mining households that had a birth in 1950, or the share of births in households that gained insurance in

$$1950 \left(\frac{total_mining_households1950_c \times (\frac{total_hh_withbirth1950_c}{total_hh_1950_c} + 0.027)}{total_hh_withbirth1950_c} \right).$$

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Table 1: Summary Statistics – Full Sample (1946-1965)

	Number of Observations (1)	Mean (2)	Standard Deviation (3)	Minimum (4)	Maximum (5)
Fraction Births in Hospital	7,980	0.816	0.214	0.0380	1
Infant Mortality per 1000 Births	7,980	30.30	11.44	0	100
Adult Mortality per 1000	7,980	9.216	1.995	3.254	21.30
Population	7,980	44,188	93,915	2,875	1,628,587
Number of Hospitals	7,161	1.394	1.990	0	27
County Real Median Household Income (in 2016\$)	7,980	35,752	16,125	5,467	84,627
Mining Employment-to-Population Share 1950	7,980	0.0311	0.0526	0	0.282
Hospital County (Indicator)	7,980	0.0251	0.156	0	1
Births per Female Population	7,980	0.111	0.0184	0.0490	0.235
First Year Hill-Burton	6,840	1,954	6.122	1,947	1,971
Hill Burton Beds/1000	7,980	0.934	1.457	0	10.52
Admissions/1000	6,989	84.40	84.17	0	1,053
Beds/1000	7,134	2.215	2.190	0	23.00
Hospital Full-Time Equivalent Employees per 1000	5,819	3.048	3.550	0	54.20
Doctors(MDs)/1000	1,197	0.599	0.368	0	5.081

Sources: Authors' calculation using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, the Bureau of Health Professionals Area Resource File, and the American Hospital Association Annual Survey.

Table 2: Summary Statistics Pre-Insurance Intervention (1948)

	Mean	Standard Deviation	Minimum	Maximum
	(1)	(2)	(3)	(4)
Fraction Births in Hospital	0.614	0.232	0.0795	0.995
Infant Mortality per 1,000 Births	36.38	11.97	0	71.21
Adult Mortality per 1,000	8.712	2.155	3.615	21.30
Population	43,374	89,474	3,515	1,494,497
Number of Hospitals	1.190	1.963	0	25
County Real Median Household Income (in 2016\$)	18,336	7,082	5,467	36,071
Hospital County (Indicator)	0.0251	0.157	0	1
Mining Employment-to-Population Share (Decade)	0.0276	0.0464	0	0.298
Births per Female Pop	0.120	0.0197	0.0778	0.190
Admissions per 1,000	53.15	66.35	0	525.9
Beds per 1,000	1.460	1.745	0	12.90

Sources: Authors' calculation using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, the Bureau of Health Professionals Area Resource File, and the American Hospital Association Annual Survey. The number of observations for each variable is 399, except for Admissions per 1,000, which has 393 observations due to missing observations.

Table 3: Effect of UMWA Insurance Program on Various Health Outcomes (Sample Period: 1946-1955)

	Hospital Births	Admissions	Infant Mortality	Overall Mortality	Beds	Hospital Births
	(1)	(2)	(3)	(4)	(5)	(6)
Post Insurance x Mining EPop Share 1950	0.660*** (0.0796)	65.56* (36.39)	-21.45*** (4.818)	-0.369 (0.651)	0.287 (0.464)	
Post Insurance x Household Mining Share 1950						0.0308* (0.0162)
Mean dependent variable in 1948	0.61	53.15	36.38	8.71	1.46	0.61
Mean mining Employment-to-Population Share in 1950	0.031	0.031	0.031	0.031	0.031	
Mean mining share of households in 1950						0.092
Observations	3,990	3,138	3,990	3,990	3,192	3,990

Notes: Asterisks denote levels of significance: 1% (***) level of significance; 5% (**) level of significance; and 10% (*) level of significance. Each column represents a separate regression. The dependent variable of each regression is indicated by the column heading – (1) hospital births per 1,000, (2) admission per 1,000, (3) infant mortality per 1,000 births, (4) overall mortality per 1,000, (5) hospital beds per 1,000, and (6) hospital births per 1,000. Controls in each regression include county population, county fertility rate (births to female population), an indicator for whether the year was after the county first received Hill-Burton funding, the number of additional beds the county received that were funded by Hill-Burton, county fixed effects, and year fixed effects. In addition, each regression includes an interaction between the post indicator (equal to one for years 1950 and later) and the total number of births to control for the fact that after the creation of the United Mine Workers of America (UMWA) insurance, women had fewer children, likely because more children are expected to survive into adulthood. The variable of interest in each regression, except column (6), is the interaction of the indicator after the insurance was implemented (equal to one for years 1950 and later) and the 1950 county-level mining employment as a share of total population age 14 and older. In column (6), the variable of interest is the mining employment of the county divided by the total number of households in the county. The sample is limited to years 1946 to 1955, with 1955 being the last year in the sample because, in 1956, the UMWA hospitals opened. In columns (2) and (5), the sample size is reduced because the dependent variables are drawn from the American Hospital Association's (AHA) annual survey, which does not begin until 1948. Additional observations are lost in column (5) due to missing data on the number of beds in the AHA data. To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. Columns (1), (3), and (6) are weighted by county-level births. Columns (2), (4), and (5) are weighted by county-level population. The mean of the 1950 county-level mining employment as a share of total population age 14 and older and the mean of the dependent variable are unweighted.

Source: Authors' calculations using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, Hill-Burton Project Register, and the American Hospital Association Annual Survey.

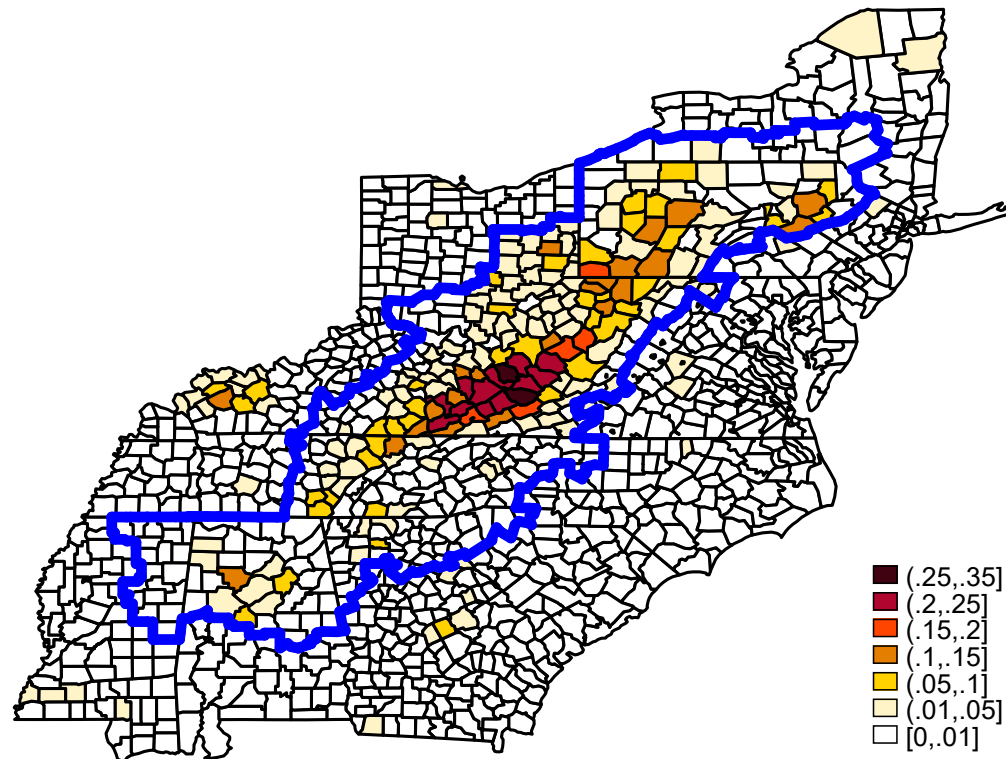
Table 4: Effect of UMWA Hospitals on Various Outcomes (Sample Period: 1951-1965)

	Hospital Births	Admissions	Infant Mortality	Overall Mortality	Beds	FTEs
	(1)	(2)	(3)	(4)	(5)	(6)
Post Hosp. x Hosp. County (Indicator)	0.0660*** (0.0199)	10.52 (9.623)	-5.629*** (1.948)	0.266 (0.164)	1.609*** (0.261)	3.080*** (0.534)
Mean dependent variable (average 1951-1955)	0.80	71.75	30.76	8.69	1.94	2.07
Share of counties with a UMWA hospital	0.025	0.025	0.025	0.025	0.025	0.025
Observations	5,985	5,813	5,985	5,985	5,937	5,819

Notes: Asterisks denote levels of significance: 1% (***) level of significance; 5% (**) level of significance; and 10% (*) level of significance. Each column represents a separate regression. The dependent variable of each regression is indicated by the column heading – (1) hospital births per 1,000, (2) admission per 1,000, (3) infant mortality per 1,000 births, (4) overall mortality per 1,000, (5) hospital beds per 1,000, and (6) full-time equivalent (FTEs) per 1,000. Controls in each regression include county population, county fertility rate (births to female population), an indicator for whether the year was after the county first received Hill-Burton funding, the number of additional beds the county received that were funded by Hill-Burton, county fixed effects, and year fixed effects. The variable of interest in each regression is the interaction of the indicator after the United Mine Workers of America (UMWA) hospital opened (equal to one for years 1956 and later) and an indicator for whether a UMWA hospital opened in the county. The sample is limited to years 1951 to 1965. In columns (2) and (5), the sample size is reduced because the dependent variables are drawn from the American Hospital Association's (AHA) annual survey and the data are missing for these county-year observations. The AHA hospital survey data does not include data on FTEs until 1951, reducing the sample size in column (6). To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. Columns (1) and (3) are weighted by county-level births. Columns (2), (4), (5), and (6) are weighted by county-level population. The mean of the dependent variable and share of counties with a UMWA hospital are unweighted.

Source: Authors' calculations using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, Hill-Burton Project Register, and the American Hospital Association Annual Survey.

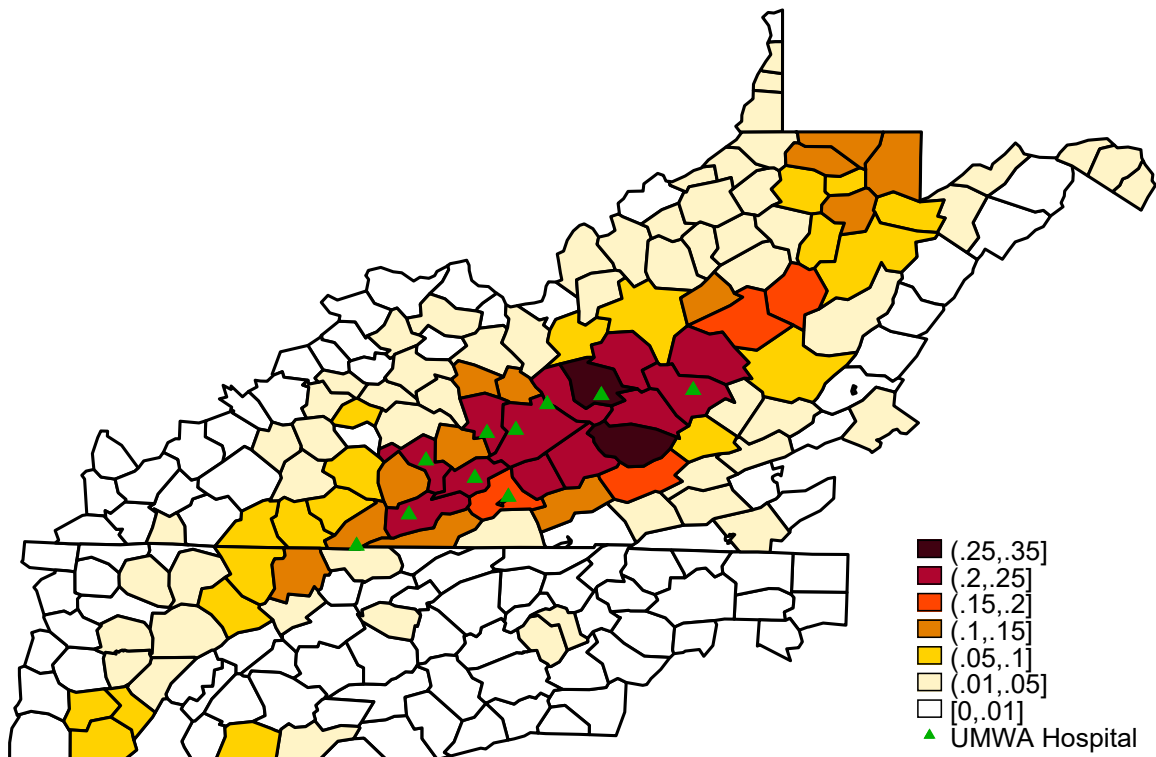
Figure 1: County Mining Employment in 1950 as a Share of Population Age 14 and Older in the Appalachian Region



Notes: The counties within the blue bolded line are considered Appalachia. Counties are defined as part of Appalachia using the Appalachian Regional Commission's (ARC) 1967 definition of Appalachian counties. Only states with at least one county in Appalachia are included in the figure. The fraction of mining employment in each county is calculated as the fraction of individuals employed in mining divided by total county population age 14 and older.

Source: Authors' calculations using data from the United States County and City Data Book Consolidated File and data from the ARC 1967 provided by James Ziliak.

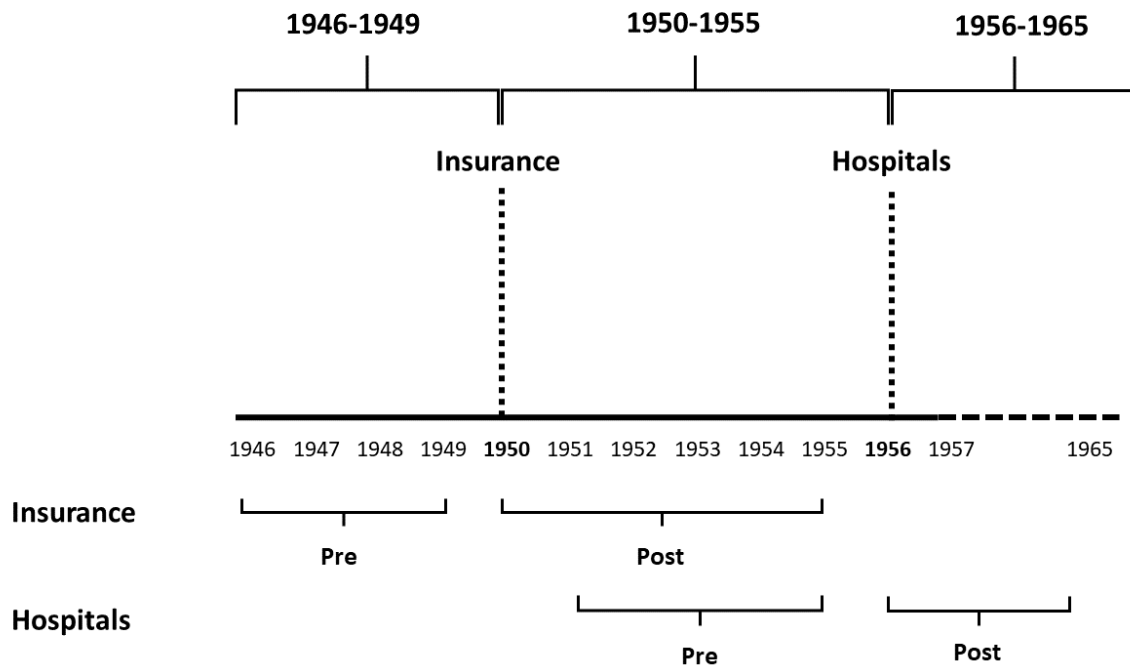
Figure 2: Locations of the United Mine Workers Hospitals and the County Mining Employment as a Share of Population Age 14 and Older in Central Appalachia



Notes: Only Appalachia counties in states in Central Appalachia are included. The United Mine Workers of America (UMWA) opened ten state-of-the-art hospitals in central Appalachia in 1956, known as the Miners' Memorial Hospitals, indicated by the green triangles in the map. The UMWA hospitals were opened in ten counties with a high concentration of health insurance coverage. While these hospitals were run by the UMWA, the hospitals served both miners and non-miners.

Source: Authors' calculations using data from the United States County and City Data Book Consolidated File and hospital location based on Ford et al. (1962).

Figure 3: Timeline of Interventions

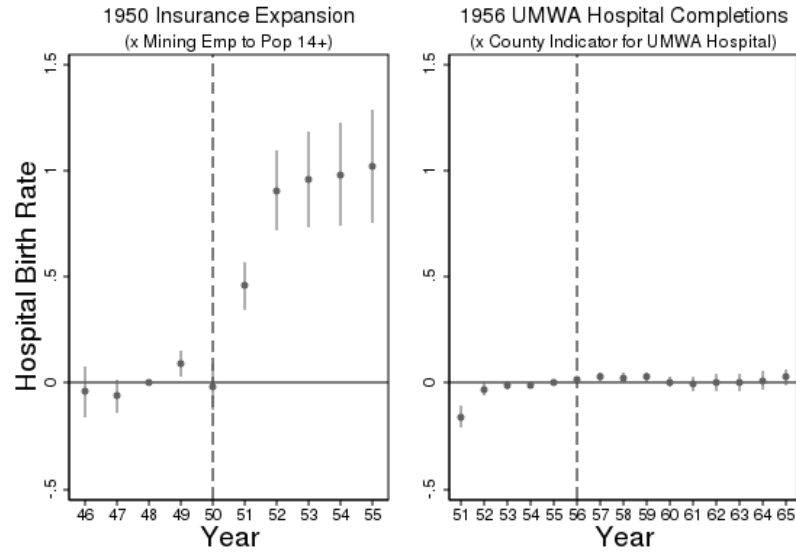


Notes: The United Mine Workers of America (UMWA) began providing free hospital care insurance in June 1950 and opened ten state-of-the-art hospitals in central Appalachia in late 1955 and 1956. We chose 1946 as the starting year of our analysis period because 1946 marks the beginning of the post-World War II period. We chose 1965 as the last year in our analysis period to avoid confounding effects from the introduction of Medicare and Medicaid in 1966.

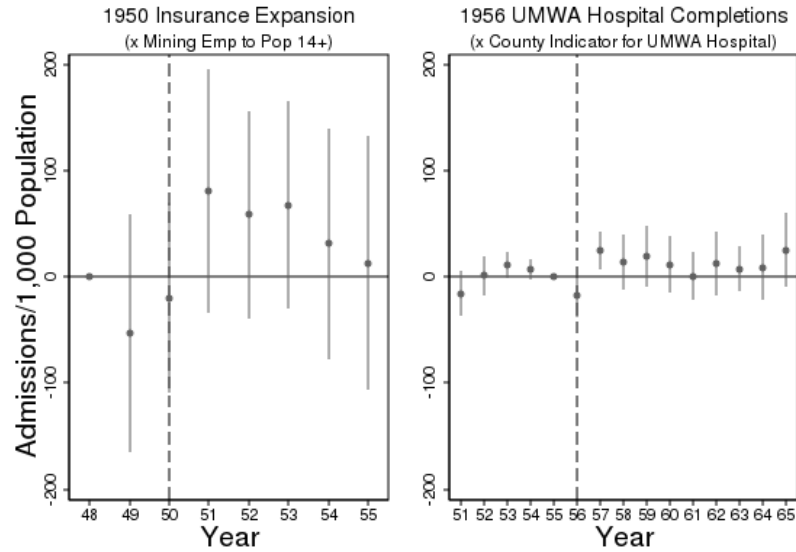
Source: Authors' illustration.

Figure 4: Effects of UMWA Programs on Health Care Utilization

(a) Share of Births In A Hospital (Hospital Births/Total Births)



(b) Hospital Admissions/1,000 Population

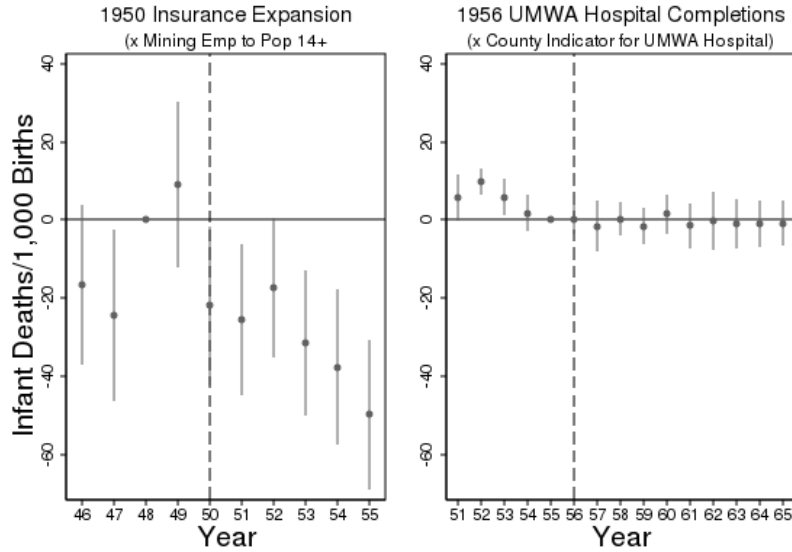


Notes: Each dot represents the coefficient from a county-year regression interacting a set of year fixed effects with treatment variable. The bars show the 95 percent confidence interval of the coefficient estimates. In the left figures, the sample includes years from 1946 to 1956 and the treatment variable is the fraction of mining employment of each county in 1950. In the right figures, the sample includes years from 1951 to 1965 and the treatment variable is a dummy variable for a UMWA hospital. The dashed lines indicate the year of the interventions – 1950 for the insurance intervention and 1956 for the completion of the hospitals. Standard errors are clustered at the county level. Control variables included in the regression are the number of births of residence in the county, the population of the county, and the fraction of mining employment in the county, year fixed effects (omitting 1948 in the right graph and 1955 in the left graph), and county fixed effects. In addition, the figures on the left include an interaction between the post indicator (equal to one for years 1950 and later) and the total number of births. To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. The analysis in (a) is weighted by county-level births and the analysis in (b) is weighted by county-level population.

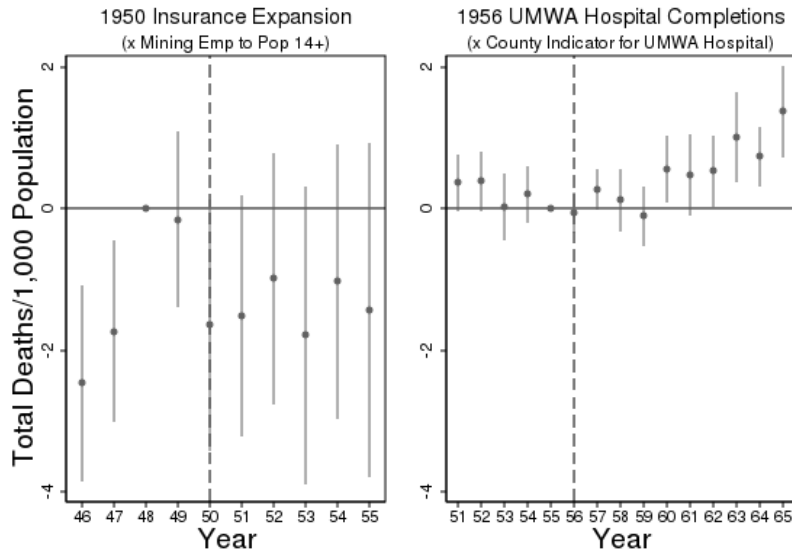
Source: Authors' calculation using data from the U.S. Vital Statistics, Hill-Burton Project Register, the American Hospital Association's annual survey, and the United States County and City Data Book Consolidated File.

Figure 5: Effects of UMWA Programs on Mortality

(a) Infant Mortality/1,000 Births



(b) Overall Mortality/1,000 Population

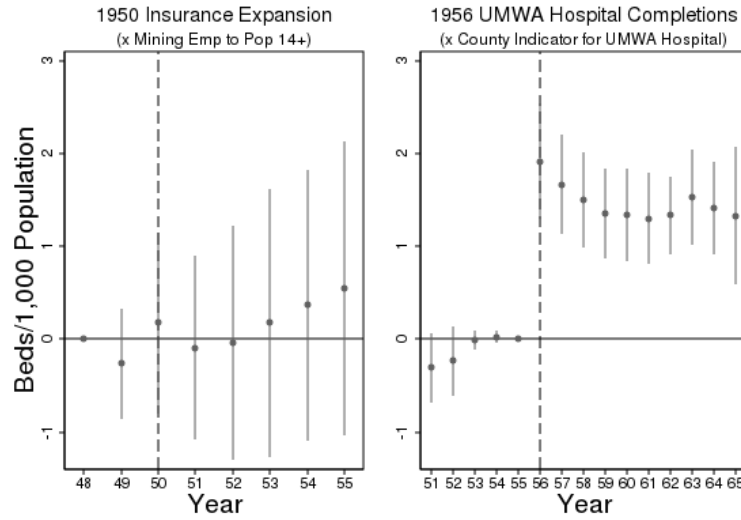


Notes: Each dot represents the coefficient from a county-year regression interacting a set of year fixed effects with each treatment variable. The bars show the 95 percent confidence interval of the coefficient estimates. In the left figures, the sample includes years 1946- 1956 and the treatment variable is the fraction of mining employment of each county in 1950. In the right figures, the sample includes years from 1951 to 1965 and the treatment variable is a dummy variable for a UMWA hospital. The dashed lines indicate the year of the interventions – 1950 for the insurance intervention and 1956 for the completion of the hospitals. Standard errors are clustered at the county level. Control variables included in the regression are the number of births of residents in the county, the population of the county, and the fraction of mining employment in the county, year fixed effects (omitting 1948 in the right graph and 1955 in the left graph), and county fixed effects. In addition, the figures on the left include an interaction between the post indicator (equal to one for years 1950 and later) and the total number of births. To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. The analysis in (a) is weighted by county-level births and the analysis in (b) is weighted by county-level population.

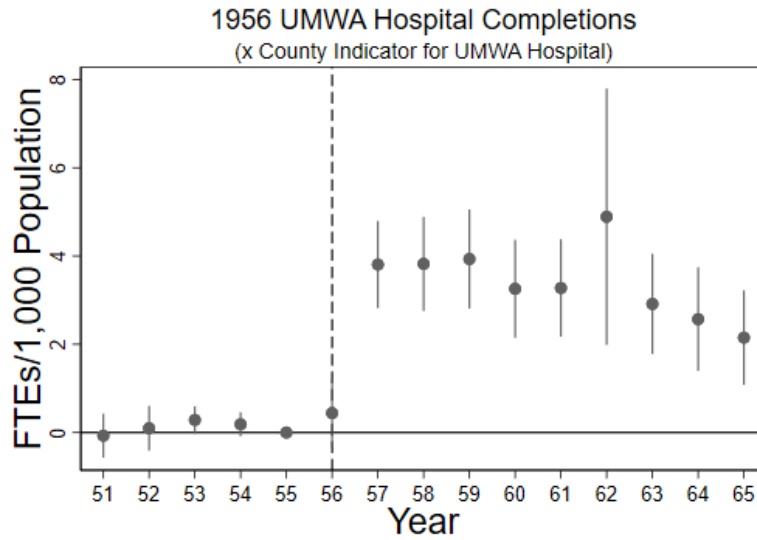
Source: Authors' calculation using data from the U.S. Vital Statistics, Hill-Burton Project Register, the American Hospital Association's annual survey, and the United States County and City Data Book Consolidated File.

Figure 6: Effects of UMWA Programs on Inputs to Hospital Supply

(a) Hospital Beds/1000

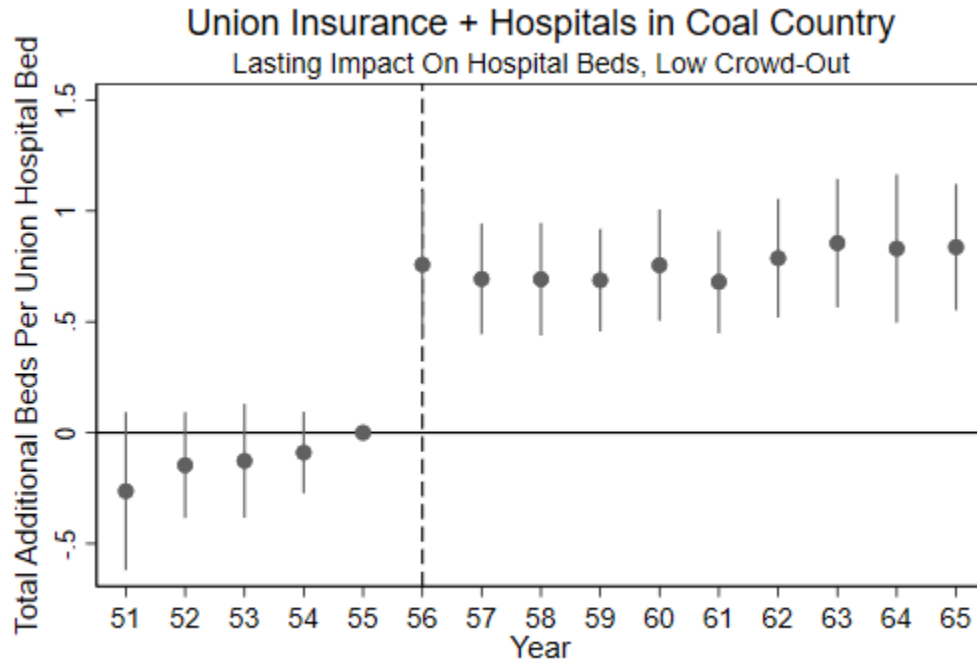


(b) Full-Time Equivalent Employees



Notes: Each dot represents the coefficient from a county-year regression interacting a set of year fixed effects with each treatment variable. The bars show the 95 percent confidence interval of the coefficient estimates. For the estimates of the effect of hospital beds per 1,000, the sample in the left figure of panel (a) includes all years prior to 1956 and the treatment variable is the fraction of mining employment of each county in 1950. In the right figure of panel (a), the sample includes years from 1951 to 1965 and the treatment variable is a dummy variable for a UMWA hospital. For the estimates of the effect on full-time equivalent employees (FTEs) in panel (b), the American Hospitals Association (AHA) hospital survey does not include data on FTEs until 1951. As a result, we cannot perform estimates for the effects of the insurance on FTEs. The dashed lines indicate the year of the interventions – 1950 for the insurance intervention and 1956 for the completion of the hospitals. Standard errors are clustered at the county level. Control variables included in the regression are the number of births of residence in the county, the population of the county, and the fraction of mining employment in the county, year fixed effects (omitting 1948 in the right graph and 1955 in the left graph for the hospital beds per 1,000, and omitting 1955), and county fixed effects. In addition, the left figure of panel (a) includes an interaction between the post indicator (equal to one for years 1950 and later) and the total number of births. To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. The analysis in (a) is weighted by county-level births and the analysis in (b) is weighted by county-level population. Source: Authors' calculation using data from the U.S. Vital Statistics, Hill-Burton Project Register, the American Hospital Association's annual survey, and the United States County and City Data Book Consolidated File.

Figure 7: Crowd-out Effects of UMWA Hospitals

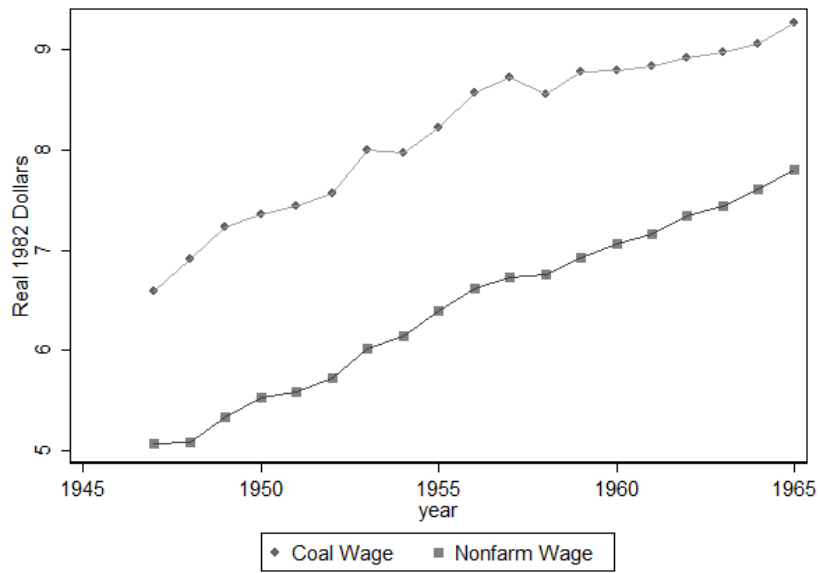


Figinski and Troland 2020. Health Insurance and Hospital Supply: Evidence from 1950s Coal Country.

Notes: Each dot represents the coefficient from a county-year regression interacting a set of year fixed effects with each treatment variable. The bars show the 95 percent confidence interval of the coefficient estimates. The sample includes years from 1951 to 1965. Instead of using an indicator for whether a county got a hospital, we instead use the number of additional hospital beds in the new UMWA hospitals in a given county (not the total number of hospital beds, only the new beds in the new UMWA hospitals). The right-hand side is the total beds in a given county (UMWA beds plus other existing hospital beds in each county). The dashed line indicates the year of the intervention –1956 for the completion of the hospitals. Standard errors are clustered at the county level. Control variables included in the regression are the number of births of residence in the county, the population of the county, and the fraction of mining employment in the county, year fixed effects (omitting 1955), and county fixed effects.

Source: Authors' calculation using data from the Hill-Burton Project Register, the American Hospital Association's annual survey, and the United States County and City Data Book Consolidated File.

Figure 8: Real Hourly Wages 1947-1965.



Source: Authors' calculation using data from U.S. Department of Labor, Bureau of Labor Statistics. 1991. "Employment, Hours, and Earnings, United States, 1909-1990 Volume 1."

Table A.1: Effect of UMWA Insurance Program on Various Outcomes Including State-Year Trends (Sample Period 1946-1955)

	Hospital Births (1)	Admissions (2)	Infant Mortality (3)	Overall Mortality (4)	Beds (5)
Post Ins. x Mining EPop Share 1950	0.650*** (0.0786)	100.3*** (38.18)	-17.26*** (6.116)	-0.352 (0.741)	0.552 (0.555)
Mean dependent variable in 1948	0.614	53.153	36.381	8.712	1.460
Mean mining EPop Share in 1950	0.031	0.031	0.031	0.031	0.031
Observations	3,990	3,138	3,990	3,990	3,192

Notes: Asterisks denote levels of significance: 1% (***) level of significance; 5% (**) level of significance; and 10% (*) level of significance. Each column represents a separate regression. The dependent variable of each regression is indicated by the column heading – (1) hospital births per 1,000, (2) admission per 1,000, (3) infant mortality per 1,000 births, (4) overall mortality per 1,000, and (5) hospital beds per 1,000. Controls in each regression include county population, county fertility rate (births to female population), an indicator for whether the year was after the county first received Hill-Burton funding, the number of additional beds the county received that were funded by Hill-Burton, county fixed effects, year fixed effects, and state-by-year time trends. In addition, each regression includes an interaction between the post indicator (equal to one for years 1950 and later) and the total number of births to control for the fact that, after the creation of the UMWA insurance, women had fewer children, likely because more children were expected to survive into adulthood. The variable of interest in each regression is the interaction of the indicator after the insurance was implemented (equal to one for years 1950 and later) and the 1950 county-level mining employment as a share of total population age 14 and older. The sample is limited to years 1946 to 1955, with 1955 being the last year in the sample because, in 1956, the UMWA hospitals opened. In columns (2) and (5), the sample size is reduced because the dependent variables are drawn from the American Hospital Association's (AHA) annual survey, which does not begin until 1948. Additional observations are lost in column (5) due to missing data on the number of beds in the AHA data. To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. Columns (1) and (3) are weighted by county-level births. Columns (2), (4), and (5) are weighted by county-level population. The mean of the 1950 county-level mining employment as a share of total population age 14 and older and the mean of the dependent variable are unweighted.

Source: Authors' calculations using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, and the American Hospital Association Annual Survey.

Table A.2: Effect of UMWA Hospitals on Various Outcomes Including State-Year Trends (Sample Period 1956-1965)

	Hospital Births (1)	Admissions (2)	Infant Mortality (3)	Overall Mortality (4)	FTEs (5)	Beds (6)
Post Hosp. x Hosp. County (Indicator)	-0.00153 (0.0261)	3.558 (10.75)	-3.748* (2.104)	-0.0214 (0.183)	3.007*** (0.577)	1.424*** (0.279)
Mean dependent variable in 1951	0.730	63.533	32.077	8.697	1.686	1.689
Share of counties with a UMWA hospital	0.025	0.025	0.025	0.025	0.025	0.025
Observations	5,985	5,813	5,985	5,985	5,819	5,937

Notes: Asterisks denote levels of significance: 1% (***) level of significance; 5% (**) level of significance; and 10% (*) level of significance. Each column represents a separate regression. The dependent variable of each regression is indicated by the column heading – (1) hospital births per 1,000, (2) admission per 1,000, (3) infant mortality per 1,000 births, (4) overall mortality per 1,000, (5) hospital beds per 1,000, and (6) full-time equivalent (FTEs) per 1,000. Controls in each regression include county population, county fertility rate (births to female population), an indicator for whether the year was after the county first received Hill-Burton funding, the number of additional beds the county received that were funded by Hill-Burton, county fixed effects, year fixed effects, and state-by-year time trends. The variable of interest in each regression is the interaction of the indicator after the United Mine Workers of America (UMWA) hospital opened (equal to one for years 1956 and later) and an indicator for whether a UMWA hospital opened in the county. The sample is limited to years 1951 to 1965. In columns (2) and (5), the sample size is reduced because the dependent variables are drawn from the American Hospital Association's (AHA) annual survey, and the data are missing for these county-year observations. The AHA hospital survey does not include data on FTEs until 1951, reducing the sample size in column (6). To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. Columns (1) and (3) are weighted by county-level births. Columns (2), (4), (5), and (6) are weighted by county-level population. The mean of the dependent variable and share of counties with a UMWA hospital are unweighted.

Source: Authors' calculations using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, and the American Hospital Association Annual Survey.

Table A.3: Effect of UMWA Insurance Program on Various Outcomes Excluding TVA Counties (Sample Period 1946-1955)

	Hospital Births (1)	Admissions (2)	Infant Mortality (3)	Overall Mortality (4)	Beds (5)
Post Ins. x Mining EPop Share 1950	0.694*** (0.0830)	91.78*** (35.13)	-18.69*** (4.751)	-0.223 (0.718)	0.200 (0.501)
Mean dependent variable in 1948	0.614	53.153	36.381	8.712	1.460
Mean mining EPop Share in 1950	0.031	0.031	0.031	0.031	0.031
Observations	2,880	2,263	2,880	2,880	2,304

Notes: Asterisks denote levels of significance: 1% (***) level of significance; 5% (**) level of significance; and 10% (*) level of significance. Each column represents a separate regression. The dependent variable of each regression is indicated by the column heading – (1) hospital births per 1,000, (2) admission per 1,000, (3) infant mortality per 1,000 births, (4) overall mortality per 1,000, and (5) hospital beds per 1,000. Controls in each regression include county population, county fertility rate (births to female population), an indicator for whether the year was after the county first received Hill-Burton funding, the number of additional beds the county received that were funded by Hill-Burton, county fixed effects and year fixed effects. In addition, each regression includes an interaction between the post indicator (equal to one for years 1950 and later) and the total number of births to control for the fact that after the creation of the United Mine Workers of America (UMWA) insurance, women had fewer children, likely because more children were expected to survive into adulthood. The variable of interest in each regression is the interaction of the indicator after the insurance was implemented (equal to one for years 1950 and later) and the 1950 county-level mining employment as a share of total population age 14 and older. The sample is limited to years 1946 to 1955, with 1955 being the last year in the sample because, in 1956, the UMWA hospitals opened. Counties that were part of the Tennessee Valley Authority, as defined by the Kline and Moretti (2013) replication file, are removed from the sample. In columns (2) and (5), the sample size is reduced because the dependent variables are drawn from the American Hospital Association's (AHA) annual survey, which does not begin until 1948. Additional observations are lost in column (5) due to missing data on the number of beds in the AHA data. To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. Columns (1) and (3) are weighted by county-level births. Columns (2), (4), and (5) are weighted by county-level population. The mean of the 1950 county-level mining employment as a share of total population age 14 and older and the mean of the dependent variable are unweighted.

Source: Authors' calculations using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, the American Hospital Association Annual Survey, and the Kline and Moretti (2013) replication file.

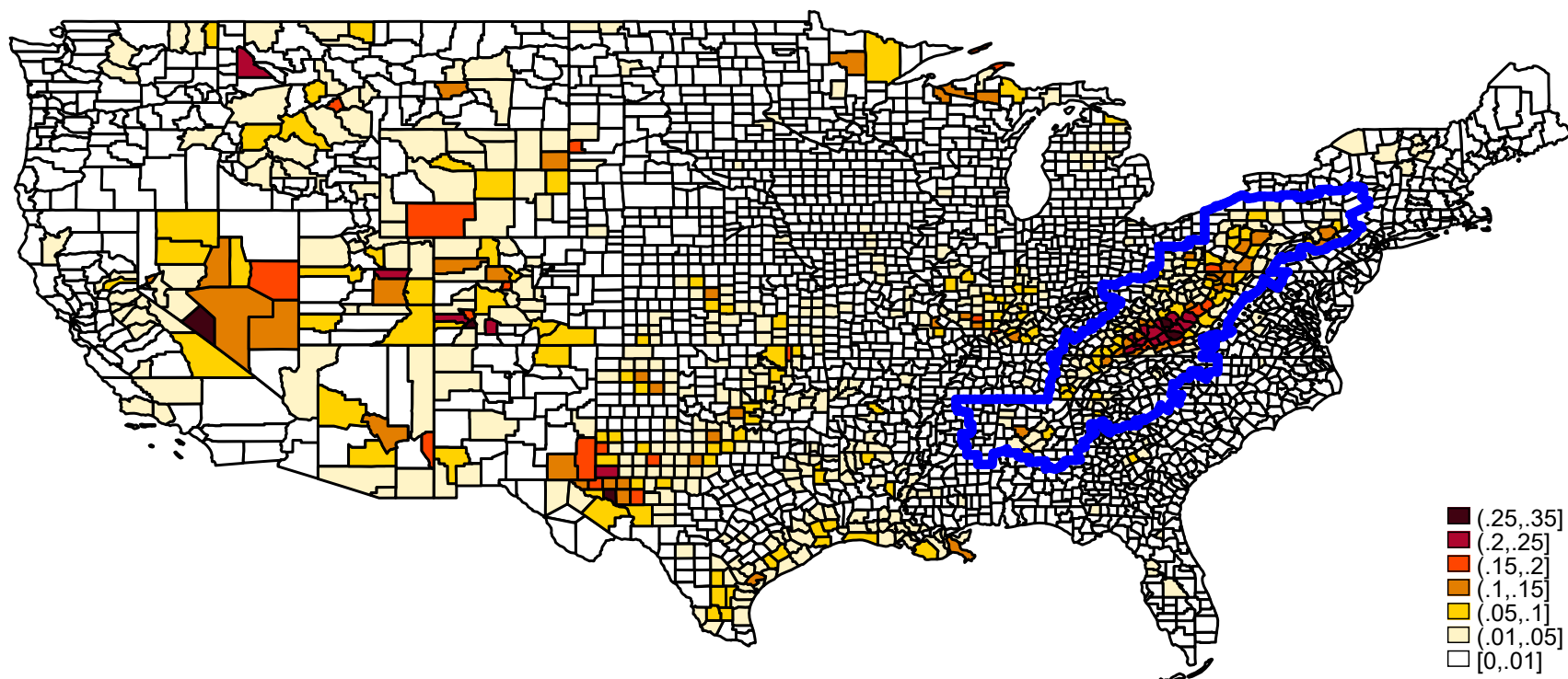
Table A.4: Effect of UMWA Hospitals on Various Outcomes Excluding TVA Counties (Sample Period 1956-1965)

	Hospital Births (1)	Admissions (2)	Infant Mortality (3)	Overall Mortality (4)	FTEs (5)	Beds (6)
Post Hosp. x Hosp. County (Indicator)	0.0676*** (0.0215)	10.59 (10.71)	-5.075** (1.999)	0.326* (0.176)	3.043*** (0.589)	1.619*** (0.289)
Mean dependent variable in 1951	0.730	63.533	32.077	8.697	1.686	1.689
Share of counties with a UMWA hospital	0.025	0.025	0.025	0.025	0.025	0.025
Observations	4,320	4,202	4,320	4,320	4,204	4,293

Notes: Asterisks denote levels of significance: 1% (***) level of significance; 5% (**) level of significance; and 10% (*) level of significance. Each column represents a separate regression. The dependent variable of each regression is indicated by the column heading – (1) hospital births per 1,000, (2) admission per 1,000, (3) infant mortality per 1,000 births, (4) overall mortality per 1,000, (5) hospital beds per 1,000, and (6) full-time equivalent (FTEs) per 1,000. Controls in each regression include county population, county fertility rate (births to female population), an indicator for whether the year was after the county first received Hill-Burton funding, the number of additional beds the county received that were funded by Hill-Burton, county fixed effects, and year fixed effects. The variable of interest in each regression is the interaction of the indicator after the United Mine Workers of America (UMWA) hospital opened (equal to one for years 1956 and later) and an indicator for whether a UMWA hospital opened in the county. The sample is limited to years 1951 to 1965. Counties that were part of the Tennessee Valley Authority, as defined by the Kline and Moretti (2013) replication file, are removed from the sample. In columns (2) and (5), the sample size is reduced because the dependent variables are drawn from the American Hospital Association's (AHA) annual survey, and the data are missing for these county-year observations. The AHA hospital survey data does not include data on FTEs until 1951, reducing the sample size in column (6). To correct for differences in the county-year error term and improve precision, we estimate the regressions using Weighted Least Squares. Columns (1) and (3) are weighted by county-level births. Columns (2), (4), (5), and (6) are weighted by county-level population. The mean of the dependent variable and share of counties with a UMWA hospital are unweighted.

Source: Authors' calculations using data from the U.S. Vital Statistics, the United States County and City Data Book Consolidated File, the American Hospital Association Annual Survey, and the Kline and Moretti (2013) replication file.

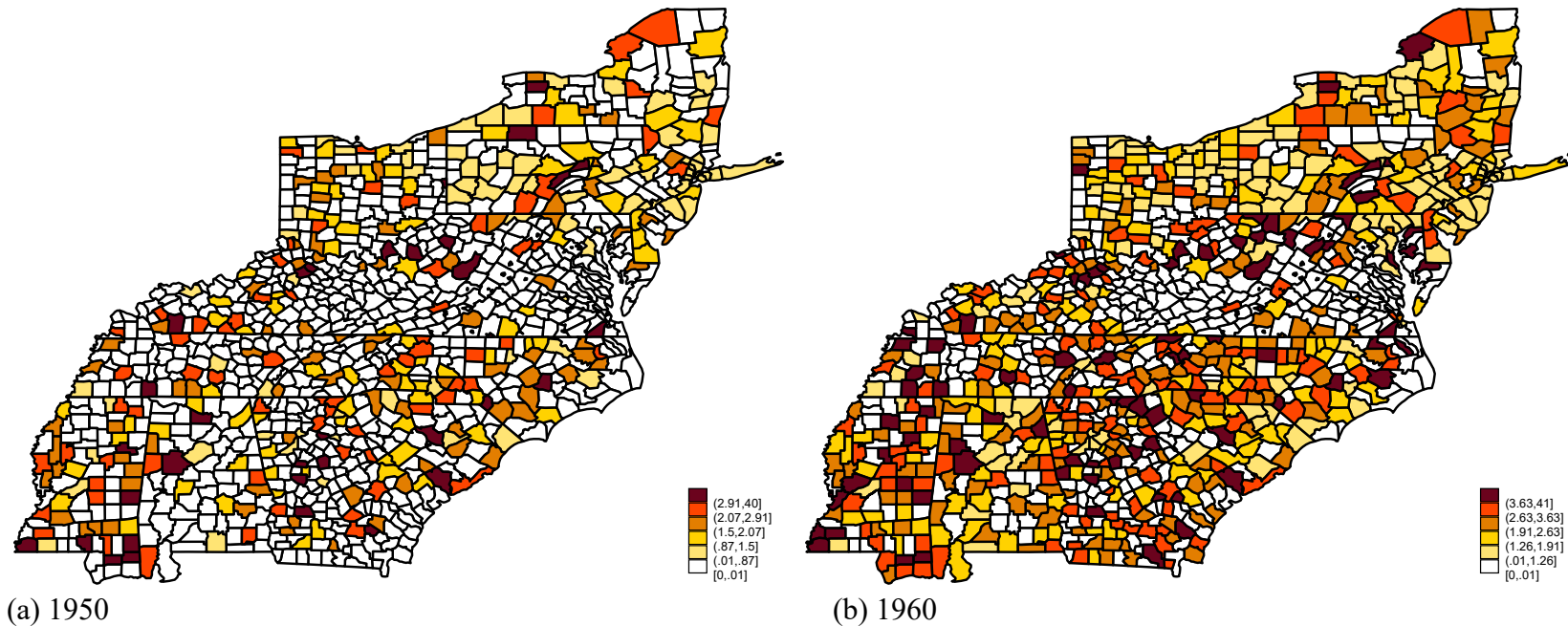
Figure A.1: County Mining Employment as a Share of Total Population Age 14 and Older by County, 1950



Notes: The counties within the blue bolded line are considered Appalachia. The fraction of mining employment in each county is calculated as the fraction of individuals employed in mining divided by total population age 14 and older.

Source: Authors' calculations using data from the United States County and City Data Book Consolidated File.

Figure A.2: Cumulative Hill-Burton Beds Provided per 1,000, 1950 and 1960



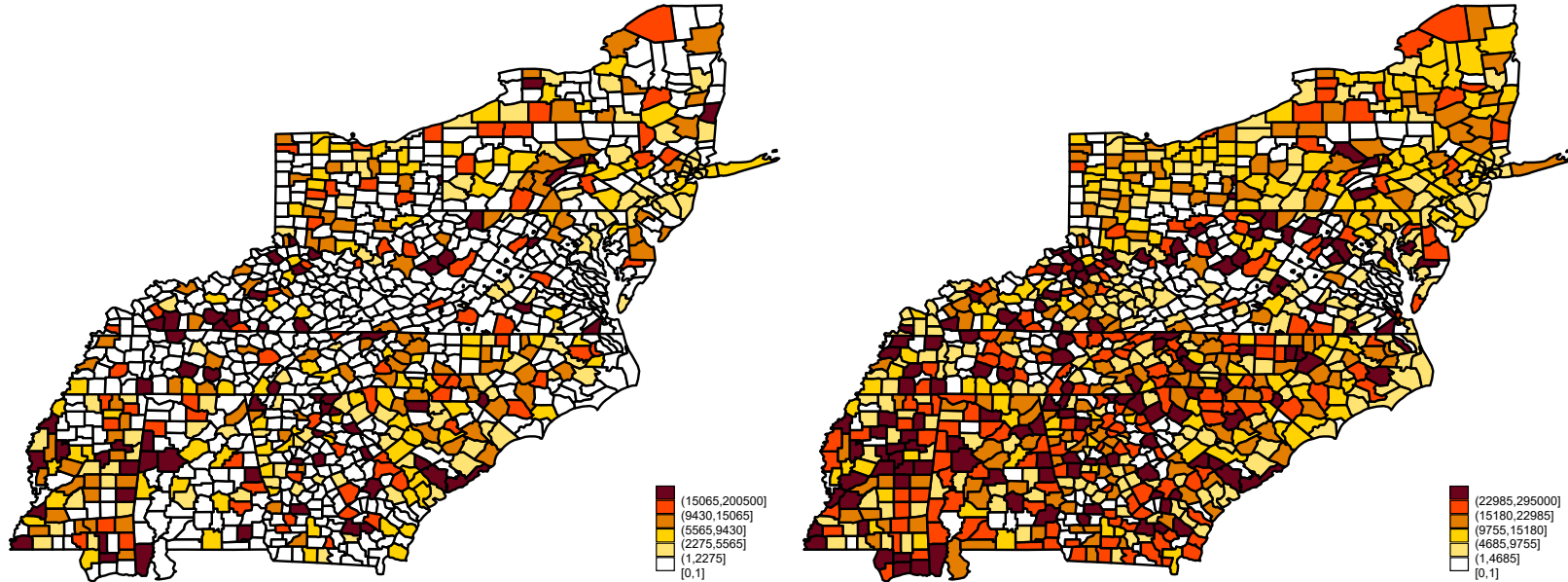
Notes: Maps include all states that contain at least one county in the Appalachian Regional Commission's list of counties in Appalachia. Hill-Burton provided beds are defined as the number of cumulative beds each project that received Hill-Burton funding provided. Because the Hill-Burton Project Register only provides data on when the project received initial approval from the Public Health Service Regional Offices, we define the year in which the Hill-Burton beds were provided as the year the project was approved. The number of cumulative Hill-Burton beds is divided by the population in county in the relevant year. The cutoffs are defined as the quintiles of those counties that received at least some Hill-Burton funding as of the relevant year.

Source: Authors' calculations using data from the Hill-Burton Project Register and the United States County and City Data Book Consolidated File.

Figure A.3: Cumulative Hill-Burton Funding per 1,000, 1950 and 1960

(a): Cumulative Hill-Burton Funds Received per 1,000, 1950

(b): Cumulative Hill-Burton Funds Received per 1,000, 1960

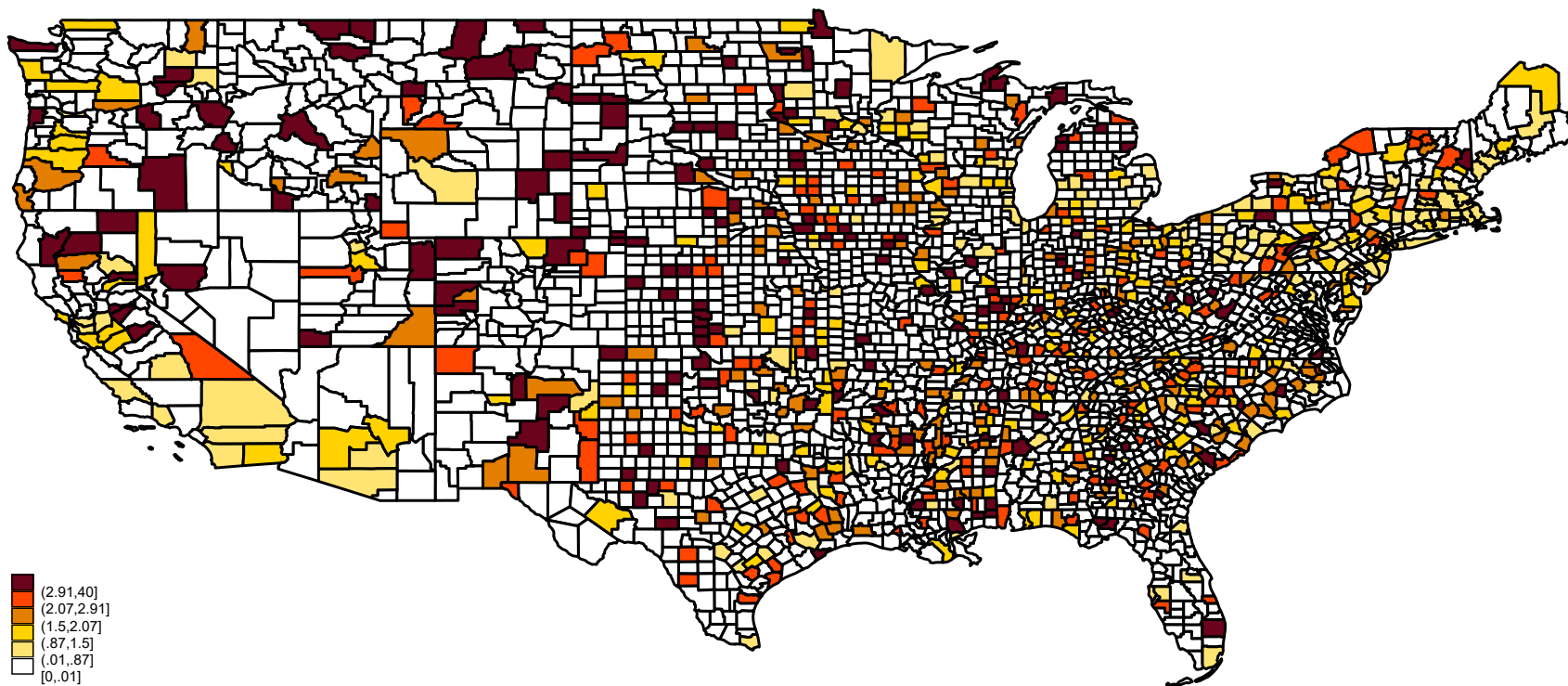


Notes: Hill-Burton provided funds are defined as total cumulative Hill-Burton funding each project received through the Hill-Burton program. Because the Hill-Burton Project Register only provides data on when the project received initial approval from the Public Health Service Regional Offices, we define the year in which the Hill-Burton funds were provided as the year the project was approved. The cumulative amount of Hill-Burton funding received is divided by the population in county in the relevant year. The cutoffs are defined as the quintiles of those counties that received at least some Hill-Burton funding as of the relevant year.

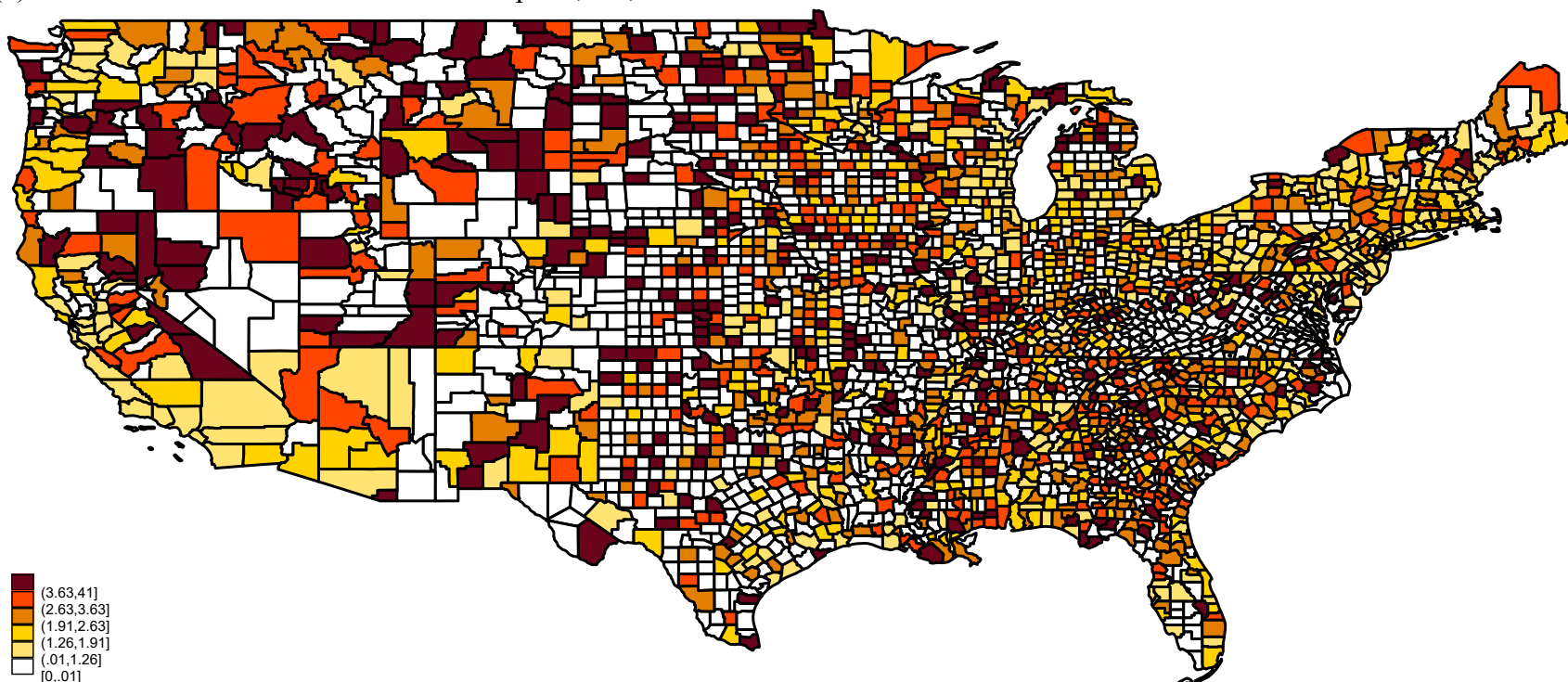
Source: Authors' calculations using data from the Hill-Burton Project Register and the United States County and City Data Book Consolidated File.

Figure A.4: Cumulative Hill-Burton Beds Provided per 1,000, 1950 and 1960

(a): Cumulative Hill-Burton Beds Provided per 1,000, 1950



(b): Cumulative Hill-Burton Beds Provided per 1,000, 1960

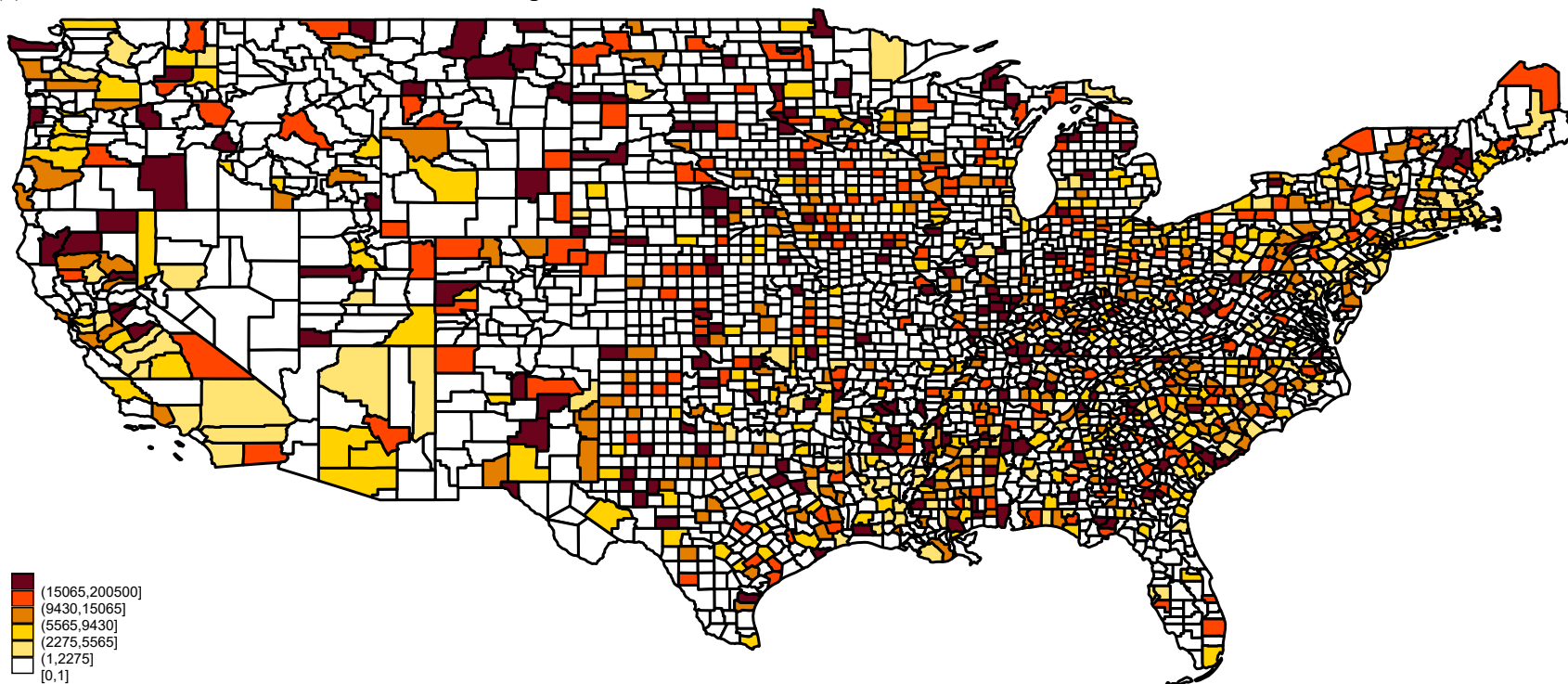


Notes: Hill-Burton provided beds are defined as the cumulative number of additional beds each project that received Hill-Burton funding provided. Because the Hill-Burton Project Register only provides data on when the project received initial approval from the Public Health Service Regional Offices, we define the year in which the Hill-Burton beds were provided as the year the project was approved. The number of Hill-Burton beds is divided by the population in county in the relevant year. The cutoffs are defined as the quintiles of those counties that received at least some Hill-Burton funding as of the relevant year.

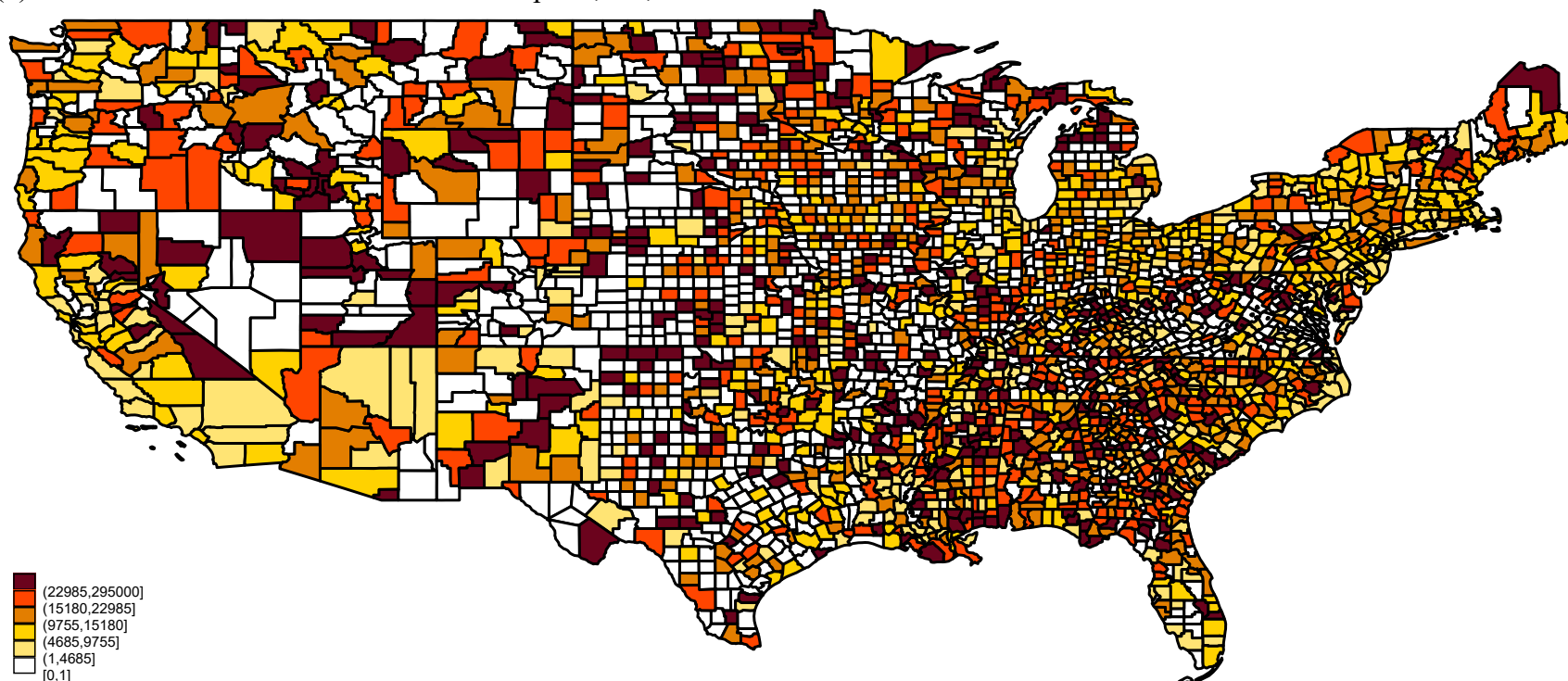
Source: Authors' calculations using data from the Hill-Burton Project Register and the United States County and City Data Book Consolidated File.

Figure A.5: Cumulative Hill-Burton Funding Provided per 1,000, 1950 and 1960

(a): Cumulative Hill-Burton Funds Received per 1,000, 1950



(b): Cumulative Hill-Burton Funds Received per 1,000, 1960



Notes: Hill-Burton provided funds are defined as total cumulative Hill-Burton funding each project received through the Hill-Burton program. Because the Hill-Burton Project Register only provides data on when the project received initial approval from the Public Health Service Regional Offices, we define the year in which the Hill-Burton funds were provided as the year the project was approved. The amount of Hill-Burton funding received is divided by the population in county in the relevant year. The cutoffs are defined as the quintiles of those counties that received at least some Hill-Burton funding as of the relevant year.

Source: Authors' calculations using data from the Hill-Burton Project Register and City Data Book Consolidated File.