HEALTH INSURANCE, HOSPITALS, OR BOTH?  
EVIDENCE FROM THE UNITED MINE WORKERS’ HEALTH CARE PROGRAMS IN APPALACHIA*  

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Abstract  

Should the government subsidize health insurance, health care facilities, or both? The United States has subsidized both for many decades, targeting under-served populations and geographic areas. We study these questions in the first rigorous quantitative analysis of two major natural experiments in Appalachian coal country. In the early 1950s, the United Mine Workers of America (UMWA) coal mining union began to provide free health insurance to coal miners and their families. A few years later, the UWMA opened ten new state-of-the-art hospitals in Appalachia. These interventions give us the unique opportunity to separately identify (i) the effect of health insurance from (ii) the combined effect of the insurance plus new hospitals for the same place, time, and population. To do so, we use difference-in-differences at the county-year level. We find that the health insurance had large effects on pregnant women and infants. A woman’s probability of delivering her baby in a hospital increased from 60 percent to over 90 percent. The probability of her infant dying before the age of one decreased from 36 to 9 per 1,000. For the new hospitals, crowd-out was low. Adding UMWA hospitals increased hospital beds by more than 50 percent. Health care workers more than doubled.  

JEL Codes: I18, I13, N32, O15, R58  

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Introduction

A key question in health care policy is whether to subsidize health insurance, health care facilities, or both. Subsidizing health insurance may make health care less expensive, but people may still have to travel long distances to visit the doctor if more doctors do not enter the market. Subsidizing new health facilities may successfully bring more doctors into a community, but some people may not go to the doctor if it is still expensive to do so. Subsidizing both health insurance and health care facilities may be complementary, especially in poor communities where there are few health facilities. On the other hand, these subsidies may instead crowd out existing private health facilities with no net gain in health care access.

The United States government has spent billions of dollars on both types of policies for over a half century, targeting underserved areas and populations as a part of a broader effort to reduce poverty. These policies include Medicare (subsidized insurance for the elderly), Medicaid (subsidized insurance for the poor), the Hill-Burton Act (subsidized hospital construction in underserved areas), and Community Health Centers (CHCs). Recently, Medicaid coverage has been expanded by increasing the maximum income needed to qualify for the subsidized insurance. Though these insurance and health facilities policies may be complementary, the government has largely implemented them separately – in different places and times and for different populations. Therefore, there is little evidence on the question of how such policies may (or may not) complement each other.

This paper presents the first rigorous quantitative analysis of a unique series of large health care natural experiments in Appalachian coal country in the 1950s. Run by the United Mine Workers of America (UMWA) coal mining union, the interventions give us the unique opportunity to examine the impact of health insurance separately from the combined impact of health facilities and insurance for the same place, time, and population. Beginning in 1950, the UMWA provided free hospital insurance to coal miners and their families. Six years later, the UMWA opened ten state-of-the-art hospitals in Appalachia. We use difference-in-differences to evaluate the impact of both programs using a rich variety of county-year level data on health care utilization, health inputs, and health outcomes primarily from the U.S. Vital Statistics and the American Hospital Association’s annual surveys. Because the insurance pre-dated the hospitals, we can separately identify (i) the pure effects of the insurance and (ii) the combined effects of
the insurance plus the top quality hospitals. Moreover, we improve upon the existing literature on health care interventions by using county-level variation in exposure to the UMWA insurance as proxied by the coal employment to working age population ratio.

Appalachia is a chronically poor rural area that suffers from worse health outcomes than the rest of the United States. Recently, Appalachia has gained attention for its worsening health outcomes relative to the rest of the country (Singh, Kogan and Slifkin 2017) and its increasing poverty rates as coal prices fall (Appalachian Regional Commission, NORC 2018). In the 1940s, prior to the UMWA’s health care interventions, Appalachians were less likely to deliver their babies in a hospital, had more infants die before the age of one, and had access to fewer hospitals compared to the rest of the United States. Infant mortality rates were roughly equivalent to those of modern day India (UN Inter-agency Group for Child Mortality Estimation 2018).

We find that both UMWA interventions had large effects on Appalachian communities, but on different aspects of the health care market and health outcomes. For the insurance program, we find the most dramatic effects for pregnant women and infants, as the UMWA insurance provided women with coverage for pregnancy-related hospital care for the first time. During this time, though hospital birth rates were on the rise in the US, in rural areas like Appalachia only around 60 percent of births were in a hospital. The UMWA insurance increased the probability that a woman in an insured household delivered in a hospital by 52 percentage points. In other words, estimates suggest that all insured households chose to deliver their babies in a hospital. Infant mortality rates for mining households fell from 36 to 9 deaths per 1,000 births: infants born into mining households were 74 percent less likely to die before the age of one. The effect of the UMWA program on infant mortality is larger than that associated with the initial rollout and subsequent expansions of Medicaid (Currie and Gruber 1996, Goodman-Bacon 2018), though infant mortality levels had already fallen substantially by the time these Medicaid programs took effect.

In addition, we also find that the UMWA insurance increased overall hospital admissions by around four percent for the average county. However, we find little evidence of a supply-side response to the insurance (increased hospitals and doctors), though these estimates are noisy and we cannot rule out large effects.

1 Author calculations from US Vital Statistics and American Hospital Association data.
For the hospital program, we find the most dramatic effects on the supply side of the health care market. If the existing hospital facilities were able to accommodate the increased number of people admitted to the hospital due to the insurance program, then we would not expect the UMWA hospital program to have much of an effect. In other words, we would expect the UMWA hospitals to crowd out existing hospitals. Instead, we find large effects of the UMWA hospitals on the supply side of the market. In counties where the UMWA hospitals were built, hospital beds increased 62 percent on net, and these effects persist over time. Full-time equivalent hospital employees more than doubled, from two per 1,000 to over four per 1,000. Consistent with a higher level of equilibrium hospital supply, we find an additional increase in hospital admissions of 15 percent. We also find that the new UMWA hospitals were associated with lower crowd-out than was associated with the federally sponsored hospital building program, the Hill-Burton program (Chung, Gaynor and Richards-Shubik 2017).

In addition to testing for parallel trends, we address other empirical concerns that may affect our results. Our results are robust to controlling for the only other major national health care program at the time, the Hill-Burton program. We show that during the 1950s, the Hill-Burton program provided little assistance in Appalachia, despite being targeted toward underserved areas. We also show 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 the time period. Our results are also robust to accounting for spending from the Tennessee Valley Authority, which led to increases in employment in agriculture and manufacturing during our sample period (Kline and Moretti 2014). Finally, our results are likely unaffected by the War on Poverty programs, namely the creation of Medicare and Medicaid, because we intentionally end our sample in 1965 to avoid introducing the confounding affects associated with these programs, which began providing benefits in 1966.

Our study contributes to a broad literature on the impact of health care interventions. Studies examining the effects of programs such as Medicare, Medicaid, and the Hill-Burton program generally find an increase in the supply of health care services and improvements in health outcomes (Almond, Chay and Greenstone 2006, Bailey and Goodman-Bacon 2015, Chung, Gaynor and Richards-Shubik 2017, Currie and Gruber 1996, Finkelstein 2007, Goodman-Bacon 2018). Though our paper analyzes an area in the US, given the health and living conditions in Appalachia at the time, our results may also inform the development
literature on health care interventions in poor areas outside the US. 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, the programs in Appalachia generally had high take up, but the limited health care supply was a key factor in the UMWA’s decision to build new hospitals in coal country.

I. Historical Context and the UMWA Health Programs

1. Health in the Appalachian Coal Fields before the UMWA Programs

Appalachia is a rural area in the Eastern United States with chronic poverty, poor health, lower service provision, and concentrated coal mining (Black, McKinnish and Sanders 2005, Bollinger, Ziliak and Troske 2011, Cowen, et al. 2012, Islam, Minier and Ziliak 2015). The Appalachian Region gained notoriety as part of the War on Poverty. In the 1960s, the federal government established the Appalachian Regional Commission, a massive economic development program targeted to a set of 399 defined counties that fall in the Appalachian Region (Figure 1). Within these 399 counties, there are three sub-regions: Northern, Central, and Southern Appalachia. Though there is mining scattered throughout Appalachia, in the early 1950s, mining was heavily concentrated in Central Appalachia (Figure 1).

Before the UMWA health care programs in the 1950s (the pre-treatment period), coal miners in Appalachia and their families had very limited access to quality health care, and the government played a minor role in supporting care. Miners typically received health care from poorly trained “company doctors” (Krajcinovic 1997). These doctors were hired by coal mine operators without the input of the miners, but deductions from coal miners’ paychecks paid the company doctors’ salaries (Krajcinovic 1997). The services the company doctor provided were minimal – limited to primary care delivered in home and office visits (Krajcinovic 1997). Moreover, one study concludes that the company doctor “practices had become a dumping ground for the incompetent, the unfit, and the unqualified” (R. Mulcahy 1996, 39-40). There is also evidence that the coal mine operators used the company doctors as a means of minimizing

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2 We define counties as being part of Appalachia using the Appalachian Regional Commission’s (ARC) 1967 definition of Appalachian counties.
3 In addition, there is evidence that the coal mine operators paid the doctor a salary less than the total value of the deduction and kept the surplus (Krajcinovic 1997).
claims submitted to state workers’ compensation programs (U.S. Department of Interior 1947, J. E. Ploss 1982).

While many miners also had access to hospital care through pre-payment plans funded by a separate payroll deduction, these plans were plagued by similar deficiencies as the company doctor system. For instance, the hospitalization 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). The pre-payment hospitalization plans were also obscure, such that it was difficult to determine whether or not services necessary for treatment of serious conditions or illnesses were available without additional costs or whether the entire cost of these services was to be paid by the miners (U.S. Department of Interior 1947). Moreover, neither the company doctor nor the hospitalization plans covered obstetric care or pre- and post-natal 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).

At the time, government played only a limited role in increasing access to 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 workers’ compensation. The public health clinics largely provided care for tuberculosis and venereal diseases (U.S. Department of Interior 1947). Additionally, these public health clinics almost certainly lacked the ability or skills necessary to provide the specialized care many coal miners required. State workers’ compensation also had only a limited effect on the availability of health care in coal mining areas (Krajcinovic 1997). Workers’ compensation only provided for health care coverage in the case of an injury caused by the employer. Moreover, the health benefits available under workers’ compensation were limited and only provided after a waiting period (Krajcinovic 1997). Finally, as noted above, the company doctor system helped stifle coal miners’ access to the limited health benefits available through workers’ compensation (Krajcinovic 1997).

4 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.
The largest government health care intervention at the time, the federal government’s hospital building program under the Federal Hospital Survey and Construction Act of 1946, better known as the Hill-Burton Act, did little to alleviate the conditions in Central Appalachia, where the UMWA’s programs were most heavily concentrated. 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 less than 4.5 bed per capita (Chung, Gaynor and Richards-Shubik 2017). By 1960, however, due to a combination of private hospital political economy and the UMWA’s failure to secure Hill-Burton funding for its own hospitals, Central Appalachia had received only limited funding and additional beds as a result of the Hill-Burton Act, shown in Appendix Figure A2 and A3, panel (b) (R. P. Mulcahy 2000). The average county in Central Appalachia had received approximately 13 Hill-Burton funded beds by 1960. Nationally, by 1960, the average county had received approximately 71 beds funded by the Hill-Burton program. Compared to the rest of the country, Central Appalachia appears as a “hole” in terms of Hill-Burton funding, even by 1960 (Appendix Figure A4(b) and Figure A5(b)).

These deficiencies in health care are particularly noteworthy given that coal mining is a dangerous job. In the short term, coal miners can die or be permanently disabled from explosions and roof collapses inside the mines. Between 1944 and 1948, almost 235,000 coal miners had been 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). In the longer term, miners can suffer from black lung disease after breathing in the carbon material in the mines that coats the lungs. Approximately 77 percent of those who died of black lung between 1990 and 1999 worked in coal mines (Centers for Disease Control 2008). Given the limited access to health care and the health consequences of coal mining employment, in the 1940s, for many miners, better health care became more important than wage increases (Krajcinovic 1997).

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5 Mechanization of mining would increase these dangers of roof collapses and create a large amount of dust contributing to an increase in black lung (Krajcinovic 1997).
2. 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 1). First, following the coal miners’ strike of 1946, the UMWA had 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 US government (Krajcinovic 1997). 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 major free hospital care insurance program in June 1950. The program covered all union miners, working and retired, plus their dependents. The insurance was free —beneficiaries paid no copayments, deductibles, or premiums. Compared to 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).

For the first nine months of 1949, the UMWA rolled out an initial insurance plan that paid providers directly on a fee-for-service basis (Krajcinovic 1997). The initial version of the insurance, however, was short-lived and chaotic, suffering from overcharging and abuses and was quickly ended (Krajcinovic 1997, J. E. Ploss 1982). In an alternative specification of our

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6 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).

7 While the insurance was available for the first nine months of 1949, we view this period as a “false start.” This initial plan covered everything from aspirin to primary care to hospitalization without premiums, deductibles, or copayments (J. E. Ploss 1982). The UMWA paid providers directly on a fee-for-service basis (Krajcinovic 1997). Overcharging and abuses included hiring nurses and billing them as doctors and charging three times as much as the going rate for a tonsillectomy (J. E. Ploss 1982). After June 1950, the insurance program began consistently providing benefits.
analysis, we show that this “false start” initial program was not effective – it did not have any 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 increases in hospital care and declines in infant mortality.

While primary care was not covered, doctors could receive reimbursement for services if the doctor took their patient to the hospital for care (J. E. Ploss 1981, J. E. Ploss 1982). Restrictions, however, were established to limit unnecessary and excessive treatment and utilization of care (Krajcinovic 1997, J. E. Ploss 1981, J. E. Ploss 1982). Non-specialists were only reimbursed for the services they performed outside of a hospital if they eventually took the patient to a hospital (J. E. Ploss 1981, J. E. Ploss 1982).

(b) The UMWA Hospital Program (Supply Side)

Soon after the hospital insurance plan was established, the UMWA realized it had made a bad 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 additional supply of quality hospitals and doctors to an isolated, rural area like Appalachia: “[w]e believed that if we permitted our beneficiaries to choose any physician whom they wished, organized medicine… would see to it that these physicians rendered services of high quality within their capabilities” (J. E. Ploss 1982, 87, Draper 1958). To remedy this problem, “both adequate facilities and an adequate guaranteed income were required in order to attract well-trained medical specialists to coal mining communities” (J. E. Ploss 1982, 88).

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, attracting top medical talent to the area (Krajcinovic 1997). The hospitals, known as the Miners Memorial Hospitals, ran as a managed care operation, in which physicians received salaries instead of fee-for-service (Krajcinovic 1997). The hospital program cost $34 million in 1955, equivalent to around $350 million in today’s dollars (Architectural Forum 1956). In 1964, the New York Times called the hospital building program one of the “boldest privately financed social-welfare ventures ever attempted” (Franklin 1964, R. Mulcahy 1993). The hospitals, scattered throughout population centers in Central Appalachia, opened in 1955 and 1956 (Figure 2). While these hospitals were built by the UMWA to remedy conditions for UMWA beneficiaries, the hospitals were open to
all, and, as a result, represented an increase in available hospital services for all residents (Krajcinovic 1997).

II.  Data and Methodology

1.  Data

   To examine the effect of the two UMWA health care interventions on health care and health 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) hospital survey data from the 1940s through 1965 for all 399 counties in Appalachia.\(^8\) Our health care utilization measures hospital obstetric care and overall hospital care: the fraction of births in a hospital (from the Vital Statistics, 1946 to 1965) and per capita hospital admissions (from the American Hospital Association, 1948 to 1965). The UMWA insurance provided free access to hospital care for coal miners and their families, in particular to hospital-based obstetric care. To measure effects on inputs to the supply of health care, we use data on the number of hospital beds per capita (from the American Hospital Association, 1948 to 1965) and full-time equivalent hospital employees (from the American Hospital Association, 1951 to 1965). We also measure the number of doctors (MDs) per capita using the Bureau of Health Professions Area Resource Health File data. Finally, we examine the effects on health outcomes by using Vital Statistics data on infant mortality (1942 to 1965) and overall mortality rates (1940 to 1965).

   We choose 1965 as the last year in our sample to avoid confounding effects from the introduction of the War on Poverty programs, most notably the introduction of Medicare and Medicaid in 1966. Including years through 1965 also allows us to examine a time when the UMWA scaled back benefits. 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

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\(^8\) 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).
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). By including 
1960 to 1965 in our analysis, we are able to examine not only the effect of the initial rollout of 
the insurance, but also the elimination of coverage.

To measure each county’s exposure to the UMWA’s free 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). The average Appalachian county has 3 percent of the population 
employed in mining (Table 1). Some counties have as few as zero mining employment, while in 
others, miners make up 20 percent of the population. The fraction of workers employed in 
mining is particularly concentrated in Central Appalachia (Figure 1).9 To measure each county’s 
exposure to the UMWA’s hospital program, we use a binary treatment indicator for whether a 
particular county contains a UMWA hospital using information from Krajcinovic (1997).

There is substantial variation among the Appalachian counties in health care utilization, 
health care facilities, number of doctors, and health outcomes. Table 1 presents summary 
statistics for our entire sample, and Table 2 presents the same statistics for 1948, pre-UMWA 
interventions. 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. Our 
outcome measures are considerably worse before the UMWA health care interventions. On the 
utilization side, the share of births in a hospital for the average Appalachian county for our full 
sample is relatively high – 82 percent on average (Table 1). Before the UMWA programs, in the 
average county in Appalachia (Table 2), only around 60 percent of births were delivered in a 
hospital. 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 person in the full sample. In the pre-program period, these figures are 

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9 Figure A1 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.
only 1.2 and 1.5, respectively. The federal Hill-Burton hospital infrastructure program set a target of 4.5 beds per capita at the time, considerably higher than the average county in Appalachia. The supply of doctors was also fairly low in Appalachia, with around 0.62 per thousand in the average Appalachian county compared to 0.77 per thousand for the average US county.

Additionally, the infant mortality rate in mid-century Appalachia was high relative to 21st century standards. At the time, the average Appalachian county had an infant mortality rate of 32.6 per 1,000 births (Table 1). By contrast, in 2015, the infant mortality rate in the U.S. was 5.9 per 1,000 (Centers for Disease Control 2015). At the time, however, the infant mortality rate in Appalachia was only slightly higher than the U.S. national infant mortality rate – the national infant mortality rate in 1950 was 30 per 1,000 births.24

2. Methodology – Difference-in-Differences

(a) Specification

We use a difference-in-differences approach to estimate the impact of the two UMWA programs on health care and health outcomes in Appalachia.11 We estimate a combined specification with both the insurance and hospital intervention to separately measure the insurance program effects from the combined effects of the insurance program and hospital program. Our main specification is:

\[
y_{ct} = \alpha_c + \alpha_t + \beta_1 post_{1t} * ME_c + \beta_2 post_{2t} * H_c + \Gamma X_{ct} + \epsilon_{tc} \tag{1}
\]

where \(y_{ct}\) is the outcome variable for county \(c\) in year \(t\). Our outcomes \(y_{ct}\) include measure of health utilization, measures of inputs to health care supply, and health outcome variables. For health utilization, we measure the impact of the UMWA programs on the fraction of births in a hospital and hospital admissions per capita, with regressions weighted by total births and total population in a county-year, respectively. For inputs to health care supply, we measure effects on the number of hospital beds per capita, the number of full-time equivalent (FTE) hospital

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10 Author calculations form US Vital Statistics data. The national average, however, masks large disparities between white and black infant mortality as documented in Almond, Chay, and Greenstone (2006).

11 As noted above, we are only able to examine the effect of the insurance and the effect of the hospitals in addition to the insurance. One may argue that we could identify the effect of the insurance and the hospitals separately using a triple difference. Our context and data, however, prohibit such an analysis. A triple difference analysis would essentially require splitting the ten counties that received hospitals by high and low mining. As a result, the estimation results would be relying on a very small number of counties to separately estimate the effects of the hospitals from the insurance.
employees per capita, and the number of medical doctors (MDs) per capita, each regression weighted by population in a given county-year. For health outcomes, we measure infant and overall mortality rates. For infant mortality rate regressions, we weight by total births in a county-year and for overall mortality rates we weight by county-year population.

The variable postₜₜ measures the post-treatment period for the insurance program and is set equal to one for all years 1950 and later, the first year in which the UMWA provided its hospital insurance program.¹² The variable post₂ₜ measures the post treatment period for the hospital program and set equal to one for all years 1956 and later.

We rely on two separate cross-sectional treatment measures. For the insurance program, our treatment variable is the 1950 county-level mining employment as a share of total population age 14 and older, $M_{Ec}$. 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 estimation strategy measures intent-to-treat (ITT) estimates, as we cannot measure whether a given eligible coal miner chose to take up the insurance or not.

In addition, note that the UMWA insurance was only available to union coal miners. Unfortunately, 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).¹³ However, we are in effect counting 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 towards zero. On the contrary, if places that have high mining employment actually have low union membership, our proxy for insurance eligibility is negatively correlated with true eligibility, and our estimates are not picking up the effect of the insurance and instead picking up some other effect that is correlated with mining employment itself, but not insurance eligibility. The more likely scenario, however, is that union membership is positively correlated with mining employment: counties

¹² 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.
¹³ 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.
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.

Our data and treatment variable allow us to improve upon earlier studies examining the effect of health insurance introduction by providing a better proxy for the eligibility for treatment. For example, Finkelstein (2007) 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. Because our outcome variables are measured at the county level and we have county level data on the fraction employed in mining, our analysis improves upon analysis with treatment at higher levels of geographic variation.

For the hospital program, we rely on a county-level indicator for a UMWA hospital as a measure of treatment. These point estimates measure the impact of a UMWA hospital opening in a county on top of the effects of the insurance, which had already been rolled out 6 years prior. The level of treatment for the hospital program is the county (rather than the individual, in the case of the insurance). Though the primary intended beneficiaries of the UMWA hospitals were miners who already had UMWA insurance, the UMWA hospitals accepted non-miner beneficiary patients, in addition to serving the UMWA beneficiaries. As a result, all residents of the county gained access to additional hospital facilities once the UMWA hospitals were opened.

We also include county fixed effects, \( \alpha_c \), to control for average, baseline pre-UMWA program county characteristics such as the number of hospitals, the number of physicians, or household income. Fixed effects account for counties with differing numbers of hospitals and income levels at baseline. Finally, we also control for observable characteristics of the counties in \( X_{ct} \). Specifically, we include controls for county real median household income, county population, fertility rates (births to female population), and the number of hospital beds added by the Hill-Burton program in each county-year during this time period.

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

\( \beta_1 \) and \( \beta_2 \) are our parameters of interest. \( \beta_1 \) measures the impact of the demand-side free insurance policy, and \( \beta_2 \) measures the additional impact of the supply-side hospital program. For the insurance program, we can think about the following theoretical chain of effects: first, take-up, second, increased hospital utilization, and third, improved health outcomes and an increase in the quantity of healthcare supplied (hospital beds, doctors).

For take-up, if the coal miners’ existing hospital insurance covered similar services at similar cost, we would expect very little effect from the implementation of the UMWA insurance. The UMWA insurance would simply crowd out existing insurance coverage and \( \beta_1 \approx 0 \). However, since the UMWA insurance covered more services at lower cost, we expect a high level of take-up. If take-up is high, then the next step in the causal chain is increased demand for hospital care by shifting the demand curve for health care to the right. Therefore, for our health care utilization outcomes, the fraction of hospital births and hospital admissions per capita, we expect \( \beta_1 > 0 \). In particular, we expect to see effects for pregnant women, as the UMWA insurance provided women with free hospital obstetric care for the first time. We may also expect increased fertility rates for two reasons. First, if women choose to have more children due to the presence of the insurance, and second, if the insurance increases the chances a woman carries her baby to term. A study of the RAND health insurance experiment shows that women randomly selected to receive free health insurance had 29 percent more births compared to those with a high out of pocket expenses (Leibowitz 1990).

Next, if more people are going to the hospital and are receiving better care than before, we would expect an improvement in health outcomes, or \( \beta_1 < 0 \) for our infant and overall mortality outcomes. Leading up to the UMWA interventions, infant mortality (and maternal mortality) was declining nationwide in part due to the availability of antibiotics, which were administered in a hospital (Almond, Chay and Greenstone 2006, Thomasson and Treber 2007). These drugs were most effective at preventing death in the post-natal 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. We, however, 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.\textsuperscript{15} The additional care provided to adult miners is unlikely to have been able to prevent deaths from heart disease.

Finally, with more people going to the hospital, we expect doctors to move to the area and hospitals to add more beds to respond the increased demand. In other words, an increase in the quantity of health care supplied in response to the demand curve shifting to the right. Therefore, we also expect \( \beta_1 > 0 \) for our supply side variables (FTEs per capita, hospital beds per capita, MDs per capita). If \( \beta_1 \) is greater than zero and significant for the demand side outcomes but \( \beta_1 \) is not statistically different from zero for the supply side outcomes, then, contrary to the UMWA program designers’ initial expectations, the insurance would not be enough to draw in more doctors from the outside to treat the new influx of patients.

Our second parameter of interest is \( \beta_2 \), which measures the impact of the supply-side intervention (hospitals and doctors) on the same outcome variables, but measures effects in addition to the demand side insurance intervention. We can think about the following theoretical chain of effects: first, a net increase in hospitals and health care workers (i.e. non-full crowd out), then, increased health care utilization, and then improved health outcomes.

Similar to the insurance program, which could simply crowd out existing insurance coverage, it could be that the UMWA hospitals and doctors simply crowded out existing hospitals and doctors. If the supply side of the market had responded adequately to meet the new demand from the insurance program, we would expect \( \beta_2 \approx 0 \), or full crowd out of existing hospitals. However, if the UMWA hospitals responded to a true need for more health care supply, then we would expect \( \beta_2 > 0 \) for hospital beds, doctors, and full-time equivalent employees (FTEs). If \( \beta_2 \) is greater than zero and significant, we would also expect \( \beta_2 > 0 \) for our demand side outcomes of hospital births and admissions, since otherwise there would be no need for the increased supply. Finally, if the new hospitals and doctors were in fact better at preventing deaths than those from before, we would expect further declines in infant and overall mortality rates, or \( \beta_2 < 0 \).

\textsuperscript{15} 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).
Identification Assumptions

We have two key identification assumptions because we have two separate difference-in-difference estimators: one estimator for the insurance program and one for the hospital program. For the insurance program, the assumption is parallel trends in our outcome variables in low mining and high mining counties pre-UMWA insurance. For the hospital program, the assumption is parallel trends in our outcome variables in counties that got UMWA hospitals and counties that did not. Our data allow us to test for parallel trends by running a more flexible specification than (1) in which we interact each of the treatment variables with indicators for each of the years in our sample.\(^{16}\) We also use this specification to show that there were no differential effects in treatment counties in 1949, the year when the UMWA rolled out its chaotic initial insurance program.

Based on data from the City County Data Book and the Vital Statistics, the counties where the UMWA built hospitals had fewer hospital births, higher infant mortality, and higher mining employment, but with larger populations and more pre-existing hospital beds and admissions compared to Appalachian counties that did not receive a UMWA hospital. However, these level differences do not undermine our difference-in-differences identification strategy as long as trends in our outcome variables are parallel in hospital and non-hospital counties conditional on controls.

\section*{III. Results}

We find the strongest effects of the insurance program on what we would predict from the theoretical discussion in section 2.2: hospital births, hospital admissions, and infant mortality. For the hospital program, we find the strongest effects on hospital beds, full-time equivalent employees, and hospital admissions. We discuss our results separately by intervention: first insurance, then hospitals.

\subsection*{1. Effects of the UMWA Hospital Insurance Program}

We first discuss results from the first UMWA intervention, free hospital insurance for coal miners, working and retired, and their dependents. We discuss our results in the order of the predicted effects discussion in section 2.2: take-up (which we cannot measure), then increased

\footnote{\(^{16}\) 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.}
hospital utilization, then improved health outcomes and an increase in the quantity of healthcare supplied (hospital beds, doctors).

The first row of Table 3 shows estimates for $\beta_1$, our difference-in-differences estimator for the impact of the insurance program (the coefficient on $\text{Post Ins} \times \text{Mining EPop share 1950}$). In , we test for parallel trends in results for the insurance program in the left panels. We normalize the year 1948 to zero. Typically, one would normalize the pre-treatment year (1949) to zero in an event study. However, in 1949 the UMWA rolled out its chaotic “false start” initial insurance program that it quickly end, lasting only nine months. While the true, lasting intervention started in 1950, it is reassuring to see that the “false start” 1949 program did not drive our outcomes, and for our main results, it is not until 1950 that we see significant impacts of the insurance program.

These point estimates are the impact of the average county going from zero employment in mining and no UMWA insurance coverage to all workers employed in mining and all workers eligible for UMWA insurance (minus non-union miners). For some specifications, $\beta_1$ can be interpreted as a household-level treatment effect.

(a) Utilization: Hospital Births and Admissions

In theory, once households take up the free UMWA health insurance, we expect increased hospital utilization if households were not previously going to the hospital because it was too expensive. We find very 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) presents results for the effect of the insurance on the fraction of women giving birth in a hospital. The coefficient can be interpreted as the intent-to-treat (ITT) effect, as we can measure eligibility for insurance, but not take-up. Moreover, these coefficients can be interpreted as a household level probability.\footnote{The county-level specification can be interpreted as a collapsed version of a household-level regression. If we had household-level data on pregnant women, we would run a regression of an indicator for whether a woman in a given household delivered in a hospital on an indicator for whether her husband is a coal miner (and therefore she is eligible for insurance). If we collapse this data to the county-year level, we end up with the same specification as equation (1), as long as the mining employment shares across all men and those with pregnant wives is equal.}

The estimated coefficient in Table 3, row (1), column (1) of 0.518 suggests that for the average mining household with a pregnant woman, the probability that woman delivers her baby in a hospital increases by around 52 percentage points, or a percent increase of around 85
percent. These large effects suggest a high rate of take-up, since if take-up were low then we would not see very large effects on hospital utilization, in contrast to other subsidized insurance programs in the development literature (Chemin 2017). We can also calculate treatment effect for the average Appalachian county. We multiply the mining employment-to-working age population in the average county of 3 percent by the estimated coefficient of 0.518, then divide by the baseline fraction of hospital births of 62 percent. For the average Appalachian county, the UMWA insurance increased hospital births by three percent. Figure 3, panel (a), left graph shows that none of the pre-treatment coefficients are statistically different from zero, including the coefficient on the “false start” treatment in 1949.

We also find evidence that the UMWA 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. Note that here, we cannot interpret the estimates for $\beta_1$ as household-level effects as we can for hospital births.\(^{18}\)

We can, however, calculate the magnitude of the coefficients for the average Appalachian county (as we also did for hospital births). The coefficient of 61.09 from column (2) indicates that for the average Appalachian county, the insurance induces an increase of around 1.9 additional admissions per thousand people (significant at the ten percent level).\(^{19}\) This represents a percentage increase of around four percent from a pre-treatment average of around 53 admissions per thousand. The results are statistically significant and relatively stable across specifications. Figure 3, 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 14 and over share. The figure shows no evidence of pre-trends. However, the data on hospital admissions begin in 1948, reducing the number of pre-treatment years to one in fixed effects specifications.

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\(^{18}\) The reason is, that for example, in the case of hospital births, we have two pieces of information for each county-year: (i) the total number of women who experience the particular health event of childbirth in a given year, and (ii) how many of those women chose to have that health event treated in a hospital. The first piece of information is crucial. The county-level share of births in a hospital can therefore be interpreted as the household-level probability that a given household with a pregnant woman chooses for the woman to deliver that baby in a hospital. With hospital admissions, we can only measure the total number of people who actually go to the hospital have a particular health event treated. We cannot measure the total number of people with, say, influenza, in a given county-year. We can only measure those people who both had influenza and went to the hospital.

\(^{19}\) 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).
To compare our results on hospital admissions to the existing literature, the most similar study to ours is an analysis of Medicare, subsidized insurance for the elderly that covered both hospital and primary care (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, nationwide intervention, covering nearly an additional 7.5 percent of the nationwide population. While in some counties, the UMWA insurance covered nearly 20 percent of the working age population (14 years and older), for the average county, the insurance covered only three percent. 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 large declines in infant mortality, as theory would predict if more women are delivering their babies in a hospital and those hospitals can provide life-saving treatments to infants. Table 3, row (1), column (3) shows that for the average woman eligible for insurance, the probability that her infant dies before the age of one declines by around 27 per thousand. This represents a large decline from a pre-insurance mean of 36 per thousand to 9 per thousand. For the average Appalachian county with three percent of the population 14 and over employed in mining, the insurance reduces the infant mortality rate by around 0.83 per thousand, or a percentage decline of around two percent. The effects for infant mortality are highly statistically significant across all four specifications, however adding in state specific linear time trends cuts the coefficients to around 20 deaths per 1,000 births. Figure 4, panel (a), left graph shows that the yearly estimates of the effect on infant mortality are noisier, and the parallel trends assumption is not as strong as for hospital births. Though the coefficients on the five years leading up to the treatment year (1945-1949) are not statistically greater than zero, there is an uptick in 1944, where the confidence interval is slightly above the zero line. However, 1944 is not statistically different than the other years leading into the treatment year.

In comparison to the literature, our results magnitudes are larger than a previous study of the Medicaid program, which provided subsidized insurance for the poor (Currie and Gruber

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20 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.
(1996). Currie and Gruber (1996) find that Medicaid reduced infant mortality by three deaths per 1,000 births, from a base of around 10 deaths per 1,000 births. Unlike the UMWA insurance, Medicaid, a subsidized insurance program that targets the poor and was established in 1966, also included primary care coverage, which may have provided additional health improvements for infants and children, as Goodman-Bacon (2018) found. Our results are also larger in magnitude than a subsidized insurance program in Costa Rica (Dow and Schmeer 2003).

Finally, we look at overall mortality, which 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, we do not find consistent results for overall mortality. Some of the point estimates are positive and significant (opposite of expected), though this is not true in column (5), our preferred specification. Moreover, Figure 4, panel (b), left graph shows that in the years immediately before treatment, there was a negative and significant trend difference between counties with high levels of mining employment and counties with low levels of mining employment in the years leading up to the treatment year. It may be that the reductions in infant mortality get overwhelmed by the differential trends going on in non-infant mortality. As discussed previously, since a large share of adults died of heart disease and life-saving treatments such as heart-lung machines and blood pressure medication had not yet been invented, the hospital insurance was likely less effective for non-infant mortality.

However, it is likely that the UMWA programs improved the outcomes of adult miners along dimensions which, due to data limitations, we cannot observe. Consider two examples – (1) a miner injured in a non-fatal workplace accident and (2) a miner who is stricken with a non-fatal illness. In the case of the miner who is injured in a non-fatal workplace accident, the new hospitals may provide him with better care or rehabilitation services, thus improving his health and well-being. In the case of the miner who becomes sick, knowing that his treatments will be covered by the insurance may encourage him to seek medical attention before the illness gets worse. In both cases, neither miners’ life would be saved as a result of the UMWA interventions, but both miners’ quality of life and health status probably increased as a result of access to the UMWA insurance and hospitals.
(c) Health Care Supply-Side Response (Quantity Supplied): Hospital Beds and Doctors

In section III.1.a, we find that the insurance program increased hospital births and overall hospital admissions. These results are evidence that the program increased demand for hospital care, and, as a result, the equilibrium amount of hospital care increased in the market. Therefore, we expect to see corresponding increases in measures of hospital care supply to meet this new demand. To measure the supply side response to the increased demand, we look to results on the impact of the insurance program on the number of hospital beds and doctors, as measured in the AHA survey data.

Row (1), column (5) of Table 3 shows results for the impact of the insurance program on hospital beds per thousand people. We expect the number of hospital beds to increase as a result of the increased demand for hospital care. However, our results are somewhat unstable across specifications, and are not consistently statistically significant.

We can also compare these results on hospital beds to those from the previous study of Medicare, just as we do for hospital admissions. Like the effects on hospital admissions, Finklestein (2007) finds Medicare had larger effects hospital beds than the UMWA insurance: beds increase by around 30 percent, while the point estimate from column (2) suggests only a four percent increase (though not statistically significant). Figure 5, panel (a), left graph shows no evidence of violating the parallel trends assumption. However, like data on hospital admissions, the data begin in 1948, offering only one year of pre-treatment data in specifications with fixed effects.

Finally, we find no evidence that the increase in insurance had an effect on the number of doctors (Table 3, row 1, column 6). Instead, our results suggest that the UMWA insurance led to a reduction in the number of doctors, although these estimates are only significant at the 10 percent level. Nevertheless, we attribute the suggestive decline in the number of doctors to the practice of the UMWA of certifying only a subset of local doctors to accept the insurance. Recruitng doctors from the outside proved difficult. The remaining, uncertified local doctors,

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21 The administrators of the UMWA insurance created a list of doctors and hospitals whose services they would reimburse and distributed this list to local unions to inform the members (Boyd, Konrad and Seipp 1982, Draper 1960, Krajcinovic 1997). While these lists did not explicitly favor younger doctors over older doctors, doctors had to provide evidence that they were qualified to perform the services they billed the insurance for (Boyd, Konrad and Seipp 1982). There is evidence to suggest older doctors at this time in Appalachia coal country either had received their medical degrees from a medical school that was forced to close because of inadequate training or had been licensed to practice by the state legislature without any formal training (R. Mulcahy 1996).
who were more likely to be older, likely lost patients and may have stopped practicing. Unfortunately, however, we only have limited data on the number of doctors. Specifically, we only have data for three years – 1940, 1950, and 1958. As a result, we cannot run as many specifications as we can with other outcomes and we cannot test for parallel trends.

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

   We now turn to results on the UMWA’s second intervention, the hospital program, which consisted of constructing and operating ten state-of-the-art hospitals and recruiting higher quality doctors and specialists. We find the strongest results on health care inputs: hospital beds and full-time equivalent employees. We again present the results in the order of the following sequence of effects: a net increase in hospitals and health care workers (i.e. non-full crowd out), increased health care utilization, and then improved health outcomes.

   Note, these results reflect the *combined* effects of the insurance program plus the hospital treatment. Since there are ten counties that got hospitals, we do not have enough data to separately identify treatment effects across high and low coal counties within this set of ten counties. We return to Table 3 and now examine the estimates in the third row, which are the results for $\beta_2$ in equation (1) (the first and second rows are the coefficient and standard errors for the impact of the insurance intervention, respectively). $\beta_2$ is the coefficient on $post_{2t} * H_c$, where $H_c$ is an indicator for whether county $c$ got a UMWA hospital, and $post_{2t}$ is post-1956, after the hospitals opened. Differing slightly from the intent-to-treat (ITT) estimates from the insurance analysis, these point estimates measure the impact of getting an UMWA hospital in a county that received a hospital. In other words, we estimate treatment on the treated (TOT) effects, since the level of treatment is the county (rather than the individual, in the case of the insurance). The UMWA hospitals accepted both beneficiary and non-miner beneficiary patients, meaning everyone in the county has access to the hospital, and was therefore treated.

   As with the insurance program results, across each table, each column has a different set of controls. To test for parallel trends, we turn to the right graphs of Figure 3 through Figure 5. Like the left graphs, these figures represent a version of the Table 3 regressions with series of coefficients over time for the hospital treatment multiplied by indicators for each year, allowing us to test for parallel trends. The year before the treatment (1955) is normalized to zero.
(a) Outcomes for Input to Health Care Supply: Hospital Beds, FTEs, and Doctors

We find stark results for increased hospital beds and full-time equivalent hospital employees (FTEs) in counties that got hospitals. If no additional health care supply (beds, doctors) was needed after the insurance program, then we would not expect large effects of the supply-side hospital treatment on top of the insurance program. In other words, the additional hospital supply from the UMWA hospitals might simply crowd out existing hospitals, which may reduce capacity or close down altogether.

We find strong evidence that the UMWA hospitals increased the supply of hospitals with lower levels of crowd out than found in other literature. Table 3, row (3), columns (5) and (7) estimate (1) with the total number of hospital beds and full time equivalent hospital employees as dependent variables, respectively. Table 3 row (3) shows that for the average county receiving a UMWA hospital, there was an increase of around 1.7 beds per thousand people (column 2). This represents a percent increase of around 60 percent for counties that received the hospital program. Figure 5 shows no evidence of violating the parallel trends assumption, with a large, clear, persistent jump in the number of beds post-1956.

These results are larger than increases in hospital beds from the federal Hill-Burton hospital construction program in Chung, Gaynor, and Richards-Shubik (2017). The Hill-Burton program existed at the same time as the UMWA programs. As discussed above, however, Appalachia received relatively few Hill-Burton funded hospital beds during our sample timeframe. The Hill-Burton program was much larger than the UMWA program, providing billions of dollars in 2018 dollars in funding annually to hundreds of counties across the country.

To compare the two programs, in Table 4, column (2) we run a version of (1) with a difference measure of treatment for the hospital program, similar to a specification in Chung, Gaynor, and Richards-Shubik (2017). Instead of using an indicator for whether a county got a hospital as treatment, we instead use the number of \textit{additional} hospital beds per 1,000 people 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). In other words, we measure the intensive margin (number of hospital beds) rather than the extensive margin (existence of a hospital). The right hand side is the same as in Table 3 column (5), total number of hospital beds per 1,000 people (UMWA beds

\footnote{The relevant pre-treatment mean in this case is 2.65 beds per thousand, the average number of beds in counties in years after the insurance program but before the hospitals were completed.}
plus other existing hospital beds in each county). That way, we can compare the two programs on a “per-new-bed” basis.

Table 4, column(2) row (3) displays the point estimates for the new hospital treatment, Post Hospital x UMWA beds per 1,000. It is possible that other hospitals closed down or reduced capacity when the UMWA hospitals opened. In the extreme, for every new UMWA hospital bed, each county loses a bed in an existing hospital. This case corresponds to full crowd-out, and the coefficient on the alternative cross sectional treatment, the number of UMWA beds per 1,000, would be zero. If the coefficient equals one, there is no crowd out: for every additional UMWA hospital bed, the county did not lose any beds in existing hospitals.

The coefficient in row (3) is nearly equal to one, meaning almost zero crowd out. However, these estimates are annual averages across all post-treatment years. We also take a more 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 in 1959 (results available upon request), after the hospitals had been open for four years, we find smaller results. For every additional new UMWA hospital beds, total hospital beds increase by around 0.60, or a crowd-out rate of 0.30. This rate is still statistically higher than that found in a comparable time frame in Chung, Gaynor, and Richards-Shubik (2017). Additionally, the point estimates on the insurance treatment (row 1) become positive and statistically significant once we use a different measure of the hospital treatment.

Since we find that the UMWA hospitals increased total county-level hospital beds with relatively low levels of crowd out, we also look to see whether the hospitals increased the number of hospital full-time equivalent employees. Table 3, column (7), shows an increase of around 3 FTEs per thousand, more than double the employees compared to a pre-treatment mean of 2.5 per thousand. Note that we cannot analyze effects for FTEs of the insurance program since the FTEs data start in 1951, the year after the insurance program began. Figure 5, panel (b) shows a sharp increase in FTEs with no evidence of differential pre-treatment trends.

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.
(b) Health Care Utilization and Health Outcomes

We find weaker evidence for effects further along the causal chain. We find some evidence of further increases to hospital admissions on top of the insurance program, though these results do not hold up to state-year trends (Appendix Table A1). Table 3, column (2) row (3) presents results for the impact of the hospital treatment on admissions per thousand. 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 3, column (1) row (3) shows statistically significant increases in hospital births. However, again these results do not hold up to state-year trends (Appendix Table A1).

For health outcomes, infant and overall mortality, we again do not find convincing evidence of additional reductions of the hospitals in top of the insurance program. While the point estimates in Table 3, column (3) row (3) show statistically significant declines in infant mortality, Figure 4, panel (a), right graph shows that the parallel trends assumption is not satisfied. Finally, while Table 3, column (4) row (3) shows that the hospitals may have reduced overall mortality, the right graph of Figure 4, panel (b) shows that in the years leading up to the hospital program, counties with hospitals were trending with differentially higher infant deaths than non-hospital counties.

3. Robustness Checks and Additional Tests

We address an alternative explanations for our results: income effects, the Second Great Migration, and other simultaneous health programs. If coal wages were growing much faster than wages for other occupations during the 1950s, then higher wage growth would be correlated with our treatment of 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. 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 6 plots real hourly wages for all non-farm workers and real hourly coal wages for 1947-1965 (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.
The 1940s and 1950s were a historic period of migration for African-Americans from southern rural areas to northern cities (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. African Americans tended to be poorer on average, and so outmigration would tend to make the overall population richer in 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 treatment areas. The average US 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.

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 led to an increase in both agricultural and manufacturing employment in region (Kline and Moretti 2014). While the increase in income associated with high employment levels could increase health care utilization and health outcomes, 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, and, if anything, 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). Nevertheless, we conduct our analysis excluding the TVA counties from our analysis. Our findings, reported in Appendix Table A2, are robust to excluding these counties from the analysis.

Regarding the potential confounding effects of the War on Poverty programs, we intentionally end our sample period in 1965 to avoid introducing any effects associated with these programs. While many in our treatment counties may have received benefits from Medicaid, whose rollout decreased infant mortality, 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 until 1965 (Jaworski and Kitchens 2016).

Finally, we examine the impacts of the health care treatments on fertility rates. If women were choosing to have more children because they had health insurance, we would expect to see increases in fertility rates associated with our treatment. Table 4 shows results of running our difference-in-difference specification with births divided by female population the left hand side. The results reject any increase in births as a result of the insurance: our results do not suggest that more women are giving birth because they now have access to insurance. The point estimates are all slightly negative, but not significant across all specifications.

IV. Conclusion

We find that the UMWA health care interventions in Appalachia in the 1950s led to an increase in the number of births in a hospital, a decrease in infant mortality, and an increase in health services inputs, namely, hospital beds and the number of doctors. The insurance intervention, however, had no effect on overall mortality or the number of doctors in Appalachia. Only after the UMWA opened its own hospitals do we find statistically significant increases in inputs to health services. Specifically, the new hospitals, in addition to the free insurance, led to an increase in the number of hospital beds, the number of hospital workers, and the number of doctors.

Our findings suggest that dual and complementary nature of the UMWA programs was a crucial factor in increasing access to health services in the Appalachian region. The UMWA initially believed that the increased demand for health services that resulted from the free insurance with a large consumer pool would draw additional quality doctors and hospitals to the Appalachian region (J. E. Ploss 1982). On the contrary, our findings suggest that the UMWA’s additional hospitals were very much needed, as crowd out levels were low compared to the Hill-Burton program.

Moreover, our results suggest that the combination of federal insurance and health facilities programs also likely had complementary effects, possibly more so for poor areas. Increased demand from subsidized insurance may not be enough to induce additional quality health service providers to serve certain areas and populations. Even today, many states have
student loan forgiveness programs for physicians willing to work in underserved areas. As a result, for a given insurance expansion, policymakers who want to expand access to health care may consider assessing the ability of the supply side of the market to respond to the increased demand.
References


### Tables

#### Table 1: Summary Statistics – Full Sample

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<thead>
<tr>
<th>VARIABLES</th>
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<td></td>
<td>N</td>
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<tr>
<td>Fract. Births in Hospital</td>
<td>7,980</td>
<td>0.816</td>
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<td>Infant Mortality/1000 Births</td>
<td>9,576</td>
<td>32.60</td>
<td>13.05</td>
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<td>10,374</td>
<td>9.107</td>
<td>2.107</td>
<td>1.234</td>
<td>22.01</td>
</tr>
<tr>
<td>Admissions/1000</td>
<td>6,989</td>
<td>84.40</td>
<td>84.17</td>
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<td>1,053</td>
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<td>Beds/1000</td>
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<td>2.215</td>
<td>2.190</td>
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<td>Number of Hospitals</td>
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<td>Population</td>
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<td>43,761</td>
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<td>County Real Med. HH Inc $2016</td>
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<td>33,807</td>
<td>15,494</td>
<td>5,467</td>
<td>84,627</td>
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<td>Mining Emp to Pop Share 1950</td>
<td>10,374</td>
<td>0.0311</td>
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<td>Hospital County (Indicator)</td>
<td>10,374</td>
<td>0.0251</td>
<td>0.156</td>
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<td>Births/Female Pop</td>
<td>10,374</td>
<td>0.108</td>
<td>0.0195</td>
<td>0.0448</td>
<td>0.235</td>
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<td>First Yr Hill-Burton</td>
<td>8,892</td>
<td>1954</td>
<td>6.122</td>
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<td>1971</td>
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<td>Hill Burton Beds/1000</td>
<td>10,374</td>
<td>0.719</td>
<td>1.337</td>
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<td>10.52</td>
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<td>FTEs/1000</td>
<td>5,819</td>
<td>3.048</td>
<td>3.550</td>
<td>0</td>
<td>54.20</td>
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<tr>
<td>Doctors(MDs)/1000</td>
<td>1,596</td>
<td>0.618</td>
<td>0.357</td>
<td>0</td>
<td>5.081</td>
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</table>

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-Treatment (1948)

<table>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>N</td>
<td>mean</td>
<td>sd</td>
<td>min</td>
<td>max</td>
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<td>Fract. Births in Hospital</td>
<td>399</td>
<td>0.614</td>
<td>0.232</td>
<td>0.0795</td>
<td>0.995</td>
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<td>Infant Mortality/1000 Births</td>
<td>399</td>
<td>36.38</td>
<td>11.97</td>
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<td>Adult Mortality/1000</td>
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<td>8.712</td>
<td>2.155</td>
<td>3.615</td>
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<td>43,374</td>
<td>89,474</td>
<td>3,515</td>
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<td>Number of Hospitals</td>
<td>399</td>
<td>1.190</td>
<td>1.963</td>
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<td>County Real Med. HH Inc $2016</td>
<td>399</td>
<td>18,336</td>
<td>7,082</td>
<td>5,467</td>
<td>36,071</td>
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<td>Hospital County (Indicator)</td>
<td>399</td>
<td>0.0251</td>
<td>0.157</td>
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<td>1</td>
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<td>Mining EPop Share (Decade)</td>
<td>399</td>
<td>0.0276</td>
<td>0.0464</td>
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<td>0.298</td>
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<td>Births/Female Pop</td>
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<td>0.120</td>
<td>0.0197</td>
<td>0.0778</td>
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<tr>
<td>Admissions/1000</td>
<td>393</td>
<td>53.15</td>
<td>66.35</td>
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<td>525.9</td>
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<td>Beds/1000</td>
<td>399</td>
<td>1.460</td>
<td>1.745</td>
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<td>12.90</td>
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</table>

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 3 – Main Specifications

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Hospital Births</th>
<th>(2) Admissions</th>
<th>(3) Infant Mortality</th>
<th>(4) Overall Mortality</th>
<th>(5) Beds</th>
<th>(6) MDs</th>
<th>(7) FTEs</th>
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</thead>
<tbody>
<tr>
<td>Post Ins. x Mining EPop Share 1950</td>
<td>0.518***</td>
<td>61.09*</td>
<td>-26.82***</td>
<td>-0.0612</td>
<td>0.360</td>
<td>-0.272</td>
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<tr>
<td></td>
<td>(0.159)</td>
<td>(37.01)</td>
<td>(4.946)</td>
<td>(1.046)</td>
<td>(0.636)</td>
<td>(0.215)</td>
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</tr>
<tr>
<td>Post Hosp. x Hosp. County (Indicator)</td>
<td>0.106***</td>
<td>18.05**</td>
<td>-5.720***</td>
<td>-0.507**</td>
<td>1.652***</td>
<td>0.285***</td>
<td>3.023***</td>
</tr>
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<td></td>
<td>(0.0261)</td>
<td>(9.134)</td>
<td>(1.840)</td>
<td>(0.226)</td>
<td>(0.283)</td>
<td>(0.0880)</td>
<td>(0.533)</td>
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<td>County Real Med. HH Inc $2016</td>
<td>-3.49e-06**</td>
<td>0.000268</td>
<td>2.02e-05</td>
<td>-5.90e-05***</td>
<td>-7.24e-06</td>
<td>-4.08e-07</td>
<td>-4.48e-06</td>
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<tr>
<td></td>
<td>(1.62e-06)</td>
<td>(0.000329)</td>
<td>(4.89e-05)</td>
<td>(9.07e-06)</td>
<td>(5.89e-06)</td>
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<td>Births/Female Pop</td>
<td>-2.118***</td>
<td>21.06</td>
<td>-41.56***</td>
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<td>(0.358)</td>
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<td>(1.723)</td>
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<td>(3.384)</td>
</tr>
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<td>Population</td>
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<td>-0.000183</td>
<td>1.01e-05</td>
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<td>-3.69e-06</td>
<td>1.93e-07</td>
<td>1.22e-05***</td>
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<td>(2.91e-07)</td>
<td>(0.000122)</td>
<td>(1.31e-05)</td>
<td>(3.80e-06)</td>
<td>(1.77e-06)</td>
<td>(3.71e-07)</td>
<td>(2.40e-06)</td>
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<tr>
<td>Post Hill-Burton</td>
<td>-0.0174**</td>
<td>-4.486</td>
<td>-1.023**</td>
<td>-0.0217</td>
<td>-0.127*</td>
<td>-0.0046</td>
<td>-0.137</td>
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<td>(0.00739)</td>
<td>(2.883)</td>
<td>(0.400)</td>
<td>(0.0776)</td>
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<td>(0.0201)</td>
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<tr>
<td>Hill Burton Beds/1000</td>
<td>-0.00344</td>
<td>3.558***</td>
<td>-0.0970</td>
<td>-0.0915</td>
<td>0.122***</td>
<td>0.0185**</td>
<td>0.303***</td>
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<td>(0.0281)</td>
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<td>46.13***</td>
<td>14.47***</td>
<td>3.644***</td>
<td>0.872***</td>
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<td>(3.558)</td>
<td>(0.986)</td>
<td>(0.436)</td>
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<td>Observations</td>
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<td>6,989</td>
<td>9,576</td>
<td>10,374</td>
<td>7,134</td>
<td>1,596</td>
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<td>R-squared</td>
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<td>0.809</td>
<td>0.603</td>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>State-Year Trends</td>
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<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
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</table>

Robust standard errors in parentheses, clustered on county. Regressions weighted by LHS variable.

*** p<0.01, ** p<0.05, * p<0.1
Table 4: Additional Tests

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<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Births/1000 Female Pop</th>
<th>(2) Total Beds</th>
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<td>Post Ins. x Mining EPop Share 1950</td>
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<td>(74.92)</td>
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<td>Post Hosp. x UMWA Beds/1,000</td>
<td>0.946***</td>
<td>0.00919</td>
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<td>(0.193)</td>
<td>(74.92)</td>
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<td>County Real Med. HH Inc $2016</td>
<td>4.35e-07***</td>
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<td>(7.74e-08)</td>
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<td>Births/Female Pop</td>
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<td>34.91</td>
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<td>(83.05)</td>
<td>(83.05)</td>
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<td>(2.59e-08)</td>
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<tr>
<td>Post Hill-Burton</td>
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<td>-8.020***</td>
</tr>
<tr>
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<td>(2.889)</td>
<td>(2.889)</td>
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<tr>
<td>Hill Burton Beds/1000</td>
<td>5.693***</td>
<td>5.693***</td>
</tr>
<tr>
<td></td>
<td>(1.325)</td>
<td>(1.325)</td>
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<td>Post Hosp. x Hosp. County (Indicator)</td>
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<td>-0.0104***</td>
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<td>(0.00205)</td>
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<tr>
<td>Births</td>
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<td>1.55e-06**</td>
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<td>(7.03e-07)</td>
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<tr>
<td>Observations</td>
<td>10,374</td>
<td>7,134</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.804</td>
<td>0.992</td>
</tr>
<tr>
<td>County FE</td>
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<td>Y</td>
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<tr>
<td>Year FE</td>
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<td>Y</td>
</tr>
<tr>
<td>State-Year Trends</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses, clustered on county. Column 1 regressions weighted by total female population in a county-year. *** p<0.01, ** p<0.05, * p<0.1
**Figure 1: Appalachian Region and Coal Mining**

(a) Appalachian Counties

(b) Mining Employment as a Share of Population 14+

*Notes*: Counties that are not a part of Appalachia are colored white. Counties are defined as part of Appalachia using the Appalachian Regional Commission’s (ARC) 1967 definition of Appalachian counties. The regions of Appalachia are defined using the same definition – the ARC’s 1967 definition. 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*: (a) Data from the Appalachian Regional Commission 1967 provided by James Ziliak. (b) United States County and City Data Book Consolidated File: County Data 1947-1977.
Figure 2: United Mine Workers Hospitals Locations

Source: Ford et al 1962
Figure 3: Effects of UMWA Programs on Health Care Utilization
(a) Share of Births In A Hospital (Hospital Births/Total Births)

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 figure, the treatment variable is the fraction of mining employment of each county in 1950. In the right figure, the treatment variable is a dummy variable for a UMWA hospital. The dashed lines indicate the year of the intervention – 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 1949), and county fixed effects. Source: Authors' calculation using data from the U.S. Vital Statistics and the United States County and City Data Book Consolidated File.
Figure 4: Effects of UMWA Programs on Mortality

(a) Infant Mortality/1,000 Births

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 figure, the treatment variable is the fraction of mining employment of each county in 1950. In the right figure, the treatment variable is a dummy variable for a UMWA hospital. The dashed lines indicate the year of the intervention – 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 1949), and county fixed effects. Source: Authors’ calculation using data from the U.S. Vital Statistics and the United States County and City Data Book Consolidated File.

(b) Overall Mortality/1,000 Population
Figure 5: Effects of UMWA Programs on Inputs to Hospital Supply

(a) Hospital Beds/1000

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 figure, the treatment variable is the fraction of mining employment of each county in 1950. In the right figure, the treatment variable is a dummy variable for a UMWA hospital. The dashed lines indicate the year of the intervention – 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 1949), and county fixed effects. Source: Authors’ calculation using data from the U.S. Vital Statistics and the United States County and City Data Book Consolidated File.

(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. In the left figure, the treatment variable is the fraction of mining employment of each county in 1950. In the right figure, the treatment variable is a dummy variable for a UMWA hospital. The dashed lines indicate the year of the intervention – 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 1949), and county fixed effects. Source: Authors’ calculation using data from the U.S. Vital Statistics and the United States County and City Data Book Consolidated File.
Figure 6: Real Hourly Wages 1947-1965.

Table A1: Effects of UMWA Programs with State-Year Trends

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Hospital Births</th>
<th>(2) Admissions</th>
<th>(3) Infant Mortality</th>
<th>(4) Overall Mortality</th>
<th>(5) FTEs</th>
<th>(6) Beds</th>
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</thead>
<tbody>
<tr>
<td>Post Ins. x Mining EPop Share 1950</td>
<td>0.675***</td>
<td>112.5***</td>
<td>-20.84***</td>
<td>-0.330</td>
<td>0.567</td>
<td>0.777</td>
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<td></td>
<td>(0.130)</td>
<td>(40.47)</td>
<td>(6.196)</td>
<td>(1.198)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Hosp. x Hosp. County (Indicator)</td>
<td>0.0270</td>
<td>10.50</td>
<td>-4.874**</td>
<td>-0.681***</td>
<td>3.294***</td>
<td>1.544***</td>
</tr>
<tr>
<td></td>
<td>(0.0325)</td>
<td>(9.481)</td>
<td>(1.975)</td>
<td>(0.250)</td>
<td>(0.523)</td>
<td>(0.300)</td>
</tr>
<tr>
<td>County Real Med. HH Inc $2016</td>
<td>-1.10e-06</td>
<td>0.000694</td>
<td>-7.24e-05</td>
<td>-7.53e-05***</td>
<td>9.19e-05</td>
<td>-1.46e-07</td>
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<tr>
<td></td>
<td>(1.31e-06)</td>
<td>(0.000427)</td>
<td>(5.67e-05)</td>
<td>(1.11e-05)</td>
<td>(1.93e-05)</td>
<td>(8.23e-06)</td>
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<tr>
<td>Births/Female Pop</td>
<td>-0.789***</td>
<td>135.6</td>
<td>-53.29***</td>
<td>2.654</td>
<td>-4.198</td>
<td>0.328</td>
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<td>(0.264)</td>
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<td>(2.551)</td>
<td>(4.047)</td>
<td>(2.115)</td>
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<tr>
<td>Population</td>
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<td>5.80e-06</td>
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<td>8.82e-06</td>
<td>-4.29e-06</td>
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<tr>
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<td>(3.24e-07)</td>
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<td>(1.28e-05)</td>
<td>(3.76e-06)</td>
<td>(2.70e-06)</td>
<td>(1.86e-06)</td>
</tr>
<tr>
<td>Post Hill-Burton</td>
<td>-0.00720</td>
<td>-5.974**</td>
<td>-1.628***</td>
<td>-0.0613</td>
<td>-0.101</td>
<td>-0.145**</td>
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<td>(0.00621)</td>
<td>(2.743)</td>
<td>(0.441)</td>
<td>(0.0779)</td>
<td>(0.127)</td>
<td>(0.0601)</td>
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<tr>
<td>Hill Burton Beds/1000</td>
<td>-0.0102***</td>
<td>3.238***</td>
<td>0.00687</td>
<td>-0.113*</td>
<td>0.346***</td>
<td>0.133***</td>
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<tr>
<td></td>
<td>(0.00291)</td>
<td>(1.028)</td>
<td>(0.147)</td>
<td>(0.0617)</td>
<td>(0.0761)</td>
<td>(0.0275)</td>
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<tr>
<td>Constant</td>
<td>0.967***</td>
<td>85.86***</td>
<td>51.51***</td>
<td>14.96***</td>
<td>-2.489***</td>
<td>3.479***</td>
</tr>
<tr>
<td></td>
<td>(0.0759)</td>
<td>(23.71)</td>
<td>(3.316)</td>
<td>(0.987)</td>
<td>(0.952)</td>
<td>(0.418)</td>
</tr>
<tr>
<td>Observations</td>
<td>7,980</td>
<td>6,989</td>
<td>9,576</td>
<td>10,374</td>
<td>5,819</td>
<td>7,134</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.900</td>
<td>0.826</td>
<td>0.635</td>
<td>0.837</td>
<td>0.925</td>
<td>0.918</td>
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<tr>
<td>County FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>State-Year Trends</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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</tbody>
</table>

Robust standard errors in parentheses, clustered on county. Regressions weighted by denominator of LHS variable.

*** p<0.01, ** p<0.05, * p<0.1
Table A2: Effects of UMWA Programs Excluding TVA Counties

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Hospital Births</th>
<th>(2) Admissions</th>
<th>(3) Infant Mortality</th>
<th>(4) Overall Mortality</th>
<th>(5) Beds</th>
<th>(6) MDs</th>
<th>(7) FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Ins. x Mining EPop Share 1950</td>
<td>0.543***</td>
<td>82.31**</td>
<td>-20.68***</td>
<td>0.705</td>
<td>0.335</td>
<td>-0.398**</td>
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<tr>
<td></td>
<td>(0.156)</td>
<td>(39.88)</td>
<td>(4.934)</td>
<td>(1.150)</td>
<td>(0.708)</td>
<td>(0.198)</td>
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</tr>
<tr>
<td>Post Hosp. x Hosp. County (Indicator)</td>
<td>0.106***</td>
<td>16.60</td>
<td>-5.286***</td>
<td>-0.511**</td>
<td>1.618***</td>
<td>0.284***</td>
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</tr>
<tr>
<td></td>
<td>(0.0272)</td>
<td>(10.28)</td>
<td>(1.923)</td>
<td>(0.254)</td>
<td>(0.315)</td>
<td>(0.0976)</td>
<td>(0.586)</td>
</tr>
<tr>
<td>County Real Med. HH Inc S2016</td>
<td>-4.61e-06***</td>
<td>4.93e-05</td>
<td>5.76e-05</td>
<td>-5.88e-05***</td>
<td>-1.03e-05</td>
<td>-1.72e-06</td>
<td>-4.43e-06</td>
</tr>
<tr>
<td></td>
<td>(1.19e-06)</td>
<td>(0.000298)</td>
<td>(4.77e-05)</td>
<td>(1.06e-05)</td>
<td>(7.06e-06)</td>
<td>(2.12e-06)</td>
<td>(1.69e-05)</td>
</tr>
<tr>
<td>Births/Female Pop</td>
<td>-2.580***</td>
<td>-101.8</td>
<td>-38.25**</td>
<td>0.260</td>
<td>-2.438</td>
<td>-0.275</td>
<td>0.708</td>
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<td>(0.401)</td>
<td>(91.78)</td>
<td>(16.62)</td>
<td>(3.163)</td>
<td>(1.959)</td>
<td>(0.745)</td>
<td>(4.126)</td>
</tr>
<tr>
<td>Population</td>
<td>-8.90e-07***</td>
<td>-7.54e-05</td>
<td>2.31e-05***</td>
<td>-6.87e-06*</td>
<td>-2.57e-06</td>
<td>-1.11e-07</td>
<td>1.18e-05***</td>
</tr>
<tr>
<td></td>
<td>(2.71e-07)</td>
<td>(5.25e-05)</td>
<td>(7.09e-06)</td>
<td>(3.54e-06)</td>
<td>(1.45e-06)</td>
<td>(1.67e-07)</td>
<td>(3.02e-06)</td>
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<tr>
<td>Post Hill-Burton</td>
<td>-0.0204**</td>
<td>-3.980</td>
<td>-0.553</td>
<td>0.0571</td>
<td>-0.127*</td>
<td>-0.0109</td>
<td>-0.0473</td>
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<td>(0.00869)</td>
<td>(3.212)</td>
<td>(0.412)</td>
<td>(0.0907)</td>
<td>(0.0741)</td>
<td>(0.0226)</td>
<td>(0.152)</td>
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<tr>
<td>Hill Burton Beds/1000</td>
<td>-0.00385</td>
<td>2.796***</td>
<td>-0.159</td>
<td>-0.0958</td>
<td>0.114***</td>
<td>0.0159*</td>
<td>0.277***</td>
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<td></td>
<td>(0.00404)</td>
<td>(1.030)</td>
<td>(0.178)</td>
<td>(0.0706)</td>
<td>(0.0321)</td>
<td>(0.00892)</td>
<td>(0.0923)</td>
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<tr>
<td>Constant</td>
<td>1.341***</td>
<td>116.1***</td>
<td>40.41***</td>
<td>14.54***</td>
<td>3.841***</td>
<td>1.055***</td>
<td>0.0249</td>
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<tr>
<td></td>
<td>(0.0482)</td>
<td>(15.14)</td>
<td>(2.455)</td>
<td>(1.112)</td>
<td>(0.433)</td>
<td>(0.147)</td>
<td>(1.177)</td>
</tr>
</tbody>
</table>

Observations: 5,760 5,050 6,912 7,488 5,157 1,152 4,204
R-squared: 0.839 0.832 0.638 0.818 0.919 0.934 0.924
County FE: Y Y Y Y Y Y
Year FE: Y Y Y Y Y Y
State-Year Trends: N N N N N

Robust standard errors in parentheses, clustered on county. Regressions weighted by denominator of LHS variable.
*** p<0.01, ** p<0.05, * p<0.1
Figure A1: Beds Provided by Hill-Burton Funded Hospitals, 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 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.
Figure A.2: Mining Employment as a Share of Total Employment by County, 1950

Notes: The fraction of mining employment in each county is calculated as the fraction of individuals employed in mining divided by total county employment. Source: United States County and City Data Book Consolidated File: County Data 1947-1977.
Notes: Hill-Burton provided funds are defined as total 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.

Figure A4: Beds Provided by Hill-Burton Funded Hospitals, 1950 and 1960

(a): Beds Provided by Hill-Burton Funded Hospitals, 1950
(b): Beds Provided by Hill-Burton Funded Hospitals, 1960

**Notes:** Hill-Burton provided beds are defined as the 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.

**Source:** Hill-Burton Project Register, 1948 to 1970.
Figure A5: Total Hill-Burton Funds Received, 1950 and 1960

(a): Total Hill-Burton Funds Received, 1950
(b): Total Hill-Burton Funds Received, 1960

Notes: Hill-Burton provided funds are defined as total 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.