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The Effect of Income on Health
: Using the Coal Boom as a Natural Experiment

Sunghoon Lim, Beomsoo Kim

The Institute of Economic Research - Korea University
Anam-dong, Sungbuk-ku, Seoul, 136-701, South Korea, Tel: (82-2) 3290-1632, Fax: (82-2) 928-4948

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Using the Coal Boom as a Natural Experiment

Sunghoon Lim
Department of Economics
The Pennsylvania State University
State College, PA 16802 USA
Tel: (814) 863-2334
Email: sul75@psu.edu

Beomsoo Kim
Department of Economics
Korea University
Seoul, Korea 02841
Tel: (82) 2 3290 2204
Email: kimecon@korea.ac.kr

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Highlights

This study examines the protective role of income on health conditions.

Exogenous increases in income significantly improved the birth weight of babies and reduced low birth weight.

Exogenous increases in income insignificantly reduced infant mortality.

Abstract

This study estimates the effect of positive income shocks on health conditions. We analyze the birth weight and mortalities of babies born in the US states of Kentucky, Ohio, and West Virginia during the early 1970s. Babies who were born in a coal-mining county benefited from the boom of the coal mining industry, whereas other babies did not. During the period, there was a sudden increase in the price of coal, resulting from an increase in the price of oil, which, in turn, resulted from an oil price embargo by the Organization of the Petroleum Exporting Countries.

We use per capita personal income, which is the average income of people living in a county, as a measure for income. However, it is well known that there is an endogeneity issue when estimating the effect of income on health. To overcome the problem, we adopted the instrumental variable approach and use coal price as an instrument for income.

We find that an exogenous $1,000 (in 1984 dollars) increase in income increases birth weight by 56 g. In addition, low birth weight would decrease by 0.9% poin, which is 12% of the sample mean (7.6%). Our study avoids possible bias from compositional change by focusing on the period directly before and after the economic shock.

JEL Classification Codes: I10, I18, I12

1. Introduction

Public policy focuses on improving health of newborns since several studies have shown that low birth weight is associated with many socially costly outcomes (Almond *et al*, 2005; McCormick *et al*. 1992, and Richards *et al*. 2001). The Women, Infants, and Children (WIC) program reached 8.9 million people and spent 7.1 billion dollars in 2012 (http://www.fns.usda.gov/wic/wic-funding-and-program-data) to improve the nutritional well-being of low-income pregnant women and children less than five years old. It is widely acknowledged that there is a positive association between income and health (Deaton 2003; Smith 2004, 2005). However, Smith (2004) points out that the positive association may not suggest positive causation of income on health. Numerous studies have attempted to show the protective nature of income on health. Some found statistically significant effects (Lindahl, 2005), while others found statistically insignificant results (Meer, Miller, and Rosen, 2003; Kim and Ruhm, 2012) or even opposing results (Evans and Moore, 2011).

Many previous literatures tried to establish the causal relationship using the health outcomes of adults (Meer, Miller, and Rosen (2003); Frijters, Haisken-DeNew, and Shields (2005); Lindahl (2005); Evans and Moore (2011); Kim and Ruhm (2012)). However, as Grossman (1972) points out, one's health status has a stock nature, that is, it is a function of the current period as well as past periods. Driven by this concern, some of the studies focus on the health status of babies, since their health has been accumulated over a relatively short period of time. Even after restricting studies to the health of babies, results are mixed. Although Currie and Cole (1993) find insignificant effects of income on birth weight, Hoynes, Page, and Stevens (2011), Almond, Hoynes, and Schanzenbach (2011), Hoynes, Miller, and Simon (2015), and Chung, Ha, and Kim (2015) show a positive causal relationship of income on birth weight.

Our study has several advantages over previous literatures. First, we use positive income shocks that impact aggregated geographic areas (mining counties). This will mitigate the individual selection issue, compared to individual level income shocks such as participation in welfare programs (for example Women, Infant, and Children (WIC), Food Stamp, or Aid to Families with Dependent Children (AFDC)). Welfare program participants might be different from non-participants or ineligible persons in observable and unobservable ways, and econometric techniques might not solve this issue completely, leading to biased results. However, the aggregated level income shocks that we are using will not be subject to these selection issues.

Second, our study compares babies born in geographically adjacent areas. By comparing a baby born in a coal mining area to the others born nearby, we could minimize the bias from unobservable characteristics.

Third, our study uses a sudden and sharp economic impact, and we examine outcomes only during a short time period to minimize possible bias from composition changes.

Lastly, our study population is similar to the target group of federal programs such as WIC. A large or moderate coal area's median income ($6,842 and $7,287 in 1984 dollars, respectively) is below the 25th percentile of income in the United States ($7,368 in 1984 dollars). The income guideline for WIC is under 185% of the federal poverty line; 33% of the population belongs to the group under 200% of the federal poverty line, based on the Kaiser family foundation (http://kff.org/other/state-indicator/population-up-to-200-fpl/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D). Therefore, the majority of our study population in coal areas would be eligible for WIC, for example. The findings of our study could be quite similar to the impact of a federal level welfare program such as WIC.

The rest of this paper is organized as follows. Section 2 reviews the economic boom of our study area and Section 3 discusses the empirical methodology. Section 4 presents the results. Lastly, Section 5 concludes the paper.

2. Background

In the 1970s, there was a significant oil price increase due to an oil embargo by the Organization of Arab Petroleum Exporting Countries. The steeply rising oil price induced an increase in the US coal price. As a result, the coal price significantly increased from 1970 onwards, following its relative stability until 1969 (see Figure 1 for prices during 1965–1974). We will use this exogenous income shock generated by the coal price increase as a natural experiment. We define our study area as the US states of Kentucky, Ohio, and West Virginia, which have significant coal reserves. Data from Black (2002) enable us to access information about the coal reserves of Kentucky, Ohio, Pennsylvania, and West Virginia. Following Black (2002), we classify each county into a No Coal area, Moderate Coal area, and Large Coal area. A county is defined as a No Coal area if it has coal reserves of less than 100 million tons, as a Moderate Coal area if it has coal reserves greater than or equal to 100 million tons and less than 1 billion tons, and as a Large Coal area if it has coal reserves greater than or equal to 1 billion tons.

The most important question for this study is whether the coal price increase really increased personal income. For example, Large Coal areas should have higher personal income growth compared to No Coal areas during the coal boom. According to Figure 3, Large Coal areas experienced positive income growth; Moderate Coal areas showed a flatter slope than the Large Coal areas, but a slight increase has still been observed; No Coal areas did not show any change in the real per capita personal income level. Therefore, we are confident that the coal price increase generated meaningful exogenous variation in personal income according to area of residence.

3. Methods

3.1. Data

We use data from three main sources. First, we use the Natality Detail File to measure a newborn's health.[1] The dataset records comprehensive information on all live births in the United States. For each birth, the birth weight—which has been used often in previous literature as a reliable measure of newborns' health status (Rosenzweig and Schultz, 1983; Corman *et al*., 1987; Rosenzweig and Wolpin, 1991; Almond *et al*., 2005)—is captured. The Natality Detail File also contains detailed demographic information of mothers (e.g., age, education, race, and place of residence) and babies (e.g., gender, and birth order).[2] It further provides detailed pregnancy records, including pregnancy characteristics (e.g., parity and plurality), and prenatal care (e.g., the timing of the first prenatal visit), so that we can control many of the observable characteristics that will impact birth weight. In addition, the Natality Detail File records the birth month and year of individual births.

[1] Depending on the recording area, the dataset contains either 50% or 100% of the possible data points. We weighted the data accordingly, for every regression and descriptive analysis in this study.

[2] We decided to exclude babies born in Pennsylvania, since the data did not contain the mother's education level.

Second, we use mortality data to examine newborn mortality. The data contain information on state and county of residence, year of death, race, sex, and age at death for all deaths that occurred in the US.[3]

Third, we use the Regional Economic Information System of the Bureau of Economic Analysis for income data. We use the per capita personal income (PCPI) of each county for which annual data are available. One supplemental dataset to identify coal reserves information comes from Black (2002). All prices are converted to the baseline of 1984, using CPI.

Finally, information on the Supplemental Nutrition Assistance Program (SNAP)[4] comes from the United States Department of Agriculture (USDA). The data contain the estimated amount of SNAP given to county residents per year since 1969.

3.2. Outcomes

We use birth weight as a composite measure of children's health. Birth weight is widely known to have a considerable influence on health and socioeconomic outcomes later in life (Rosenzweig and Schultz, 1983; Corman *et al*., 1987; Rosenzweig and Wolpin, 1991; Almond *et al*., 2005). We use low birth weight (LBW) as the second measure of children's health. We follow the general convention of defining LBW as a birth weight of less than 2,500 g. Almond (2005) pointed out that medical costs and mortality rates are significantly higher for LBW babies than for their counterparts.

Mortality is the ultimate health outcome that we can measure. Common measures of newborn mortality are Early Neonatal Mortality (<7 days), Neonatal Mortality (<28 days), and

[3] Linked birth and death data do not exist at the individual level for the period of interest. However, the shock is at the aggregated level, and meaningful variation is therefore not lost.
[4] SNAP was formerly called as the Food Stamp Program.

Infant Mortality (<1 year). We merge the data at the county level for a certain year, since mortality data do not contain individual identifiers that can be matched with birth data. For example, the infant mortality rate is defined as the number of deaths of infants younger than one year divided by the number of live births, after which the quotient is multiplied by 1000. We use mortality data to count the number of deaths within a certain period for each county: the number of people that died annually (e.g., from January to December, 1970) in a county at an age of less than 7 days (28 days, 1 year) is used as the numerator. The denominator comes from birth data: the number of annual live births in a county (e.g., from January to December in 1970) is used as denominator, to arrive at an average Neonatal mortality of 15.00, for example.

3.3. Key independent variable: Income

We use PCPI, which is the average income of people living in a county. While reverse causality will be less of an issue for newborns, a third factor (such as a discount factor) could impact income as well as birth weight of newborns. For example, parents who value their future more would achieve higher education as well as invest more in their children during pregnancy. Even at the aggregated level, this confounding third factor might bias the estimate. We will use the instrumental variable approach to solve this endogeneity issue of income. Our instrumental variable is an income change due to a sudden increase in the coal price. By using the instrumental variable approach, we only use income changes generated by the coal price increase in the mining area. In addition, we do not lose any variation by using county level income instead of individual level income, because the instrumental variation happens at the county level.

3.4. Econometric Model

3.4.1. Two-stage Least Squares

We are interested on the following equation.

$Y_{ict} = f + Real\ PCPI_{c(t-1)} * g + X_{ict} * h + v_{ict}$, (1)

where *Y* is the birth weight or LBW; *i* denotes the individual; *c* denotes the county; t denotes the year. X includes information of the mother, such as age, race, and education level, SNAP program participation in the county, the birth order (first child, second or later child, and birth order not available), the mother's age (less than 19 years, 20–24 years, 25–29 years, 30–34 years, 35–39 years, and greater than or equal to 40 years), race (white, black, others, and race not available), and education level (no high school degree, high school graduate, college graduate, higher than college graduate, and education not available).[5]

We will use data over a period of two years: one year before and one year after the coal price increase. By choosing two years, we would like to minimize the composition change of newborns. For example, the coal price increase might induce more labor in the coal mining area and newcomers might be different from the existing population.

Babies normally spend 40 weeks (i.e., 10 months) in the mother's womb. When someone receives a positive income shock starting in any given month, babies born 10 months later would have been fully exposed to this positive income shock. Babies that are born in the month in which the income shock occurs only experienced a maximum of one month of exposure to positive income before birth. Although our birth data identify the month of the birth year, we will use year t+1 as an outcome measurement, since income data are measured annually. When

[5] Race, education and number of children information not available is 0.1, 1.3 and 0.3 % respectively. Including these observations does not change results qualitatively.

people in the mining area received positive income shocks in 1970, babies born in 1971 would have experienced the positive income shock during pregnancy. Therefore, the birth outcome of the 1971 cohorts would have improved. On the other hand, 1970 birth cohorts who were in the mother's womb during 1969, were not exposed to the positive income shock.[6]

Real PCPI, aggregated at the county level, is not exogenous. To address this issue, we will use two-stage least squares (TSLS), following Black (2002).

The first stage equation that we estimate takes the form:

$Real\ PCPI_{c(t-1)} = a + Real\ CRV_{c(t-1)}*b + X_{ict}*d + u_{ict}$, *(2)*

Our instrument is real coal reserve value.

For this instrumental variable to be valid, the real coal reserve value (real CRV) should impact the health of a newborn only through real per capita personal income (real PCPI). It is difficult to conceptualize another path toward health impact, other than through income due to an increase in the coal reserve value.[7] The first stage of the regression will show that the areas that house the mining industry would experience a positive income shock, compared to areas with no mining industry during the coal price increase.

We want to estimate mortality by means of the following model:

$MR_{ct} = f + Real\ PCPI_{ct}*g + X_{ct}*h + v_{ct}$, *(3)*

where $MR_{ct} \equiv \frac{The\ number\ of\ deaths\ of\ infants\ under\ 7\ days\ (28\ days, 1\ year)\ old}{The\ number\ of\ live\ births} \times 1000$ is the mortality rate; *c* denotes the county; t denotes the year. The unit of observation is the county. X includes information on SNAP participation, baby-related information (proportion of first child, second or later child, birth order missing), information on the mother's age (proportion of age

[6] Babies born during December 1970 are exposed to the annual income of 1970, that is, before treatment is mixed (treated and untreated). Subsample analysis is used to review the robustness of this issue in section 4.3

[7] When mining activities increased the air or water pollution of the areas, this could cause adverse health outcomes. However, this effect is not clear for the fetus during pregnancy. If there is a negative health impact, then we are calculating a lower bound here.

less than 19 years, 20–24 years, 25–29 years, 30–34 years, 35–39 years, and greater than or equal to 40 years), the mother's race (proportion of mothers that are white, black, other race, and race not available), and mother's education (proportion of high school graduate, …, education not available). The first stage will be the same as equation (2). The timeframe is different compared to birth weight regression. We use 1969 data for mortality before the shock, and 1970 data for mortality after the shock. We try to measure the effects of income changes after birth. Therefore, income in 1970 will impact babies born in 1970.

4. Results

4.1 Health of Newborns

The left panel of Table 1 summarizes all births in Kentucky, Ohio, and West Virginia from 1970 to 1971. During this period, 543,798 babies were born[8].

Table 2 reports the results using birth weight as an outcome. In the first column, the OLS result shows that a $1,000 increase in real PCPI (in 1984 dollars) did not result in a statistically significant change in birth weight. In the second column, we report the first stage regression result. An increase in the real coal reserve value increases the real per capita personal income. The first stage is quite strong, thus increasing our confidence with the TSLS result. The TSLS result shows that an exogenous $1,000 increase in real PCPI increases birth weight by 56.6 g in the last column and it is statistically significant. Standard errors are clustered by county level.

Table 3 shows "Low Birth Weight" as an outcome variable. OLS did not show any statistically significant impact in the first column. The first stage shows a statistically significant result with a t value of 7.2, which is quite high. In the last column, the low birth weight—defined

[8] We use weights since Kentucky, Ohio, and West Virginia reported 50 percent sample of live births.

as <2500 grams—decreased by 0.9% point, which is 12% of the sample mean (7.6%). This is statistically significant at the 90% confidence level and represents a sizable impact.

4.2. Mortality of Newborns

In this section, we estimate equation (3). We report three outcomes: 7 days mortality, 28 days mortality, and 1 year mortality. Babies born in 1969 did not experience the coal boom, but babies born in 1970 received a positive income shock due to the coal price increase. The OLS result is statistically insignificant. The number of observations is 366, since we use county level information. These decreased numbers in observation blow up standard errors. In column (2), statistically significant first stage results are shown. The TSLS result shows that an exogenous $1,000 increase in real PCPI lowers early neonatal mortality by 1.58, which is an 11.3% change (-1.58 / 14); however, it is not precisely measured. For the second outcome, neonatal mortality decreased by 1.82 in TSLS; this represents a 12% change, but is still statistically insignificant. In the last column, we report infant mortality as an outcome. An exogenous $1,000 increase in real PCPI lowers infant mortality by 0.22, and this is 1% of the sample mean. Unfortunately, we did not have statistical power to precisely capture the effects on mortality.

"Infant mortality is divided into two age periods: neonatal (birth–27 days) and post-neonatal (28–364 days). Approximately two-thirds of all infant deaths occur in the neonatal period, and one-third occur in the post-neonatal period. Infant deaths in the neonatal period are caused by complications arising from preterm births, birth defects, maternal health conditions, complications of labor and delivery, and lack of access to appropriate care at the time of delivery. Infant deaths in the post-neonatal period are driven by sudden unexpected infant deaths (SUID)

(including sudden infant death syndrome [SIDS]), injury, and infection."
(http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6231a3.htm).

Based on the above explanation, it is plausible that positive income could be able to lower early neonatal or neonatal mortality (although it is imprecise), but that it could not lower the infant mortality rate.

4.3. Robustness Check

In the main analysis, there might be some babies who did not receive the positive income shock cleanly. The cleaner test might be using only fourth quarter births of infants that are conceived in the first quarter of the year. We will use the personal income of the year for this analysis. Table 5 reports results for the subsample of the fourth quarter of 1969 who did not receive the income shock, and one quarter in 1970 in which infants were exposed to the income shock. When we restrict the sample to the fourth quarter births, positive income of $1,000 increased the birth weight by 31 g in the TSLS. The LBW result is very similar to that of Table 3, although it is not statistically significant due to the decreased sample size.

Table 6 following the same format as Table 4 in reports mortality results. Qualitative results are similar to Table 4.

5. Conclusion

Previous research attempts to find causality between income and health, which is difficult due to a lack of exogenous income changes. In this study, we use the exogenous income shock of the coal price increase in the 1970s as a source of variation. We will focus on the newborn's health that has accumulated over only a short period of time, so that we could find a clean impact of the shock.

We find that birth weight has increased by 56 g when the real per capita personal income increased by $1,000 (in 1984 value). In addition, low birth weight has decreased by 12%, and it is statistically significant at the 90% confidence level. The magnitude of the finding is in accordance with the literature. Chung *et al*. (2015) find a 17.7 g increase per additional $1,000, using Alaska as treatment. Alaska is ranked as having the eighth-highest median household income in 1969. On the other hand, West Virginia and Kentucky is the third-poorest or sixth-poorest state based on median household income in 1969. The median household income of Ohio is quite high, but when we focus on the mining area the income level is quite low (see Appendix Table 1).

Currie and Cole (1993) find a 32 gram increase in birth weight when people received Aid to Families with Dependent Children (AFDC). Almond *et al*. (2011) estimate the impact of food stamps on birth weight. They find a 2.2 gram improvement, but when they calculate treatment on the treated, it was 15–42 grams. They also find that low birth weight would decrease by 5%-12%, using data from 1968 and 1977.

We were able to estimate the impacts of a clean positive income shock for a low-income population, and find that improvement in low birth weight as well as in birth weight is statistically significant. However, we did not find precise results for 7-day or 28-day mortality.

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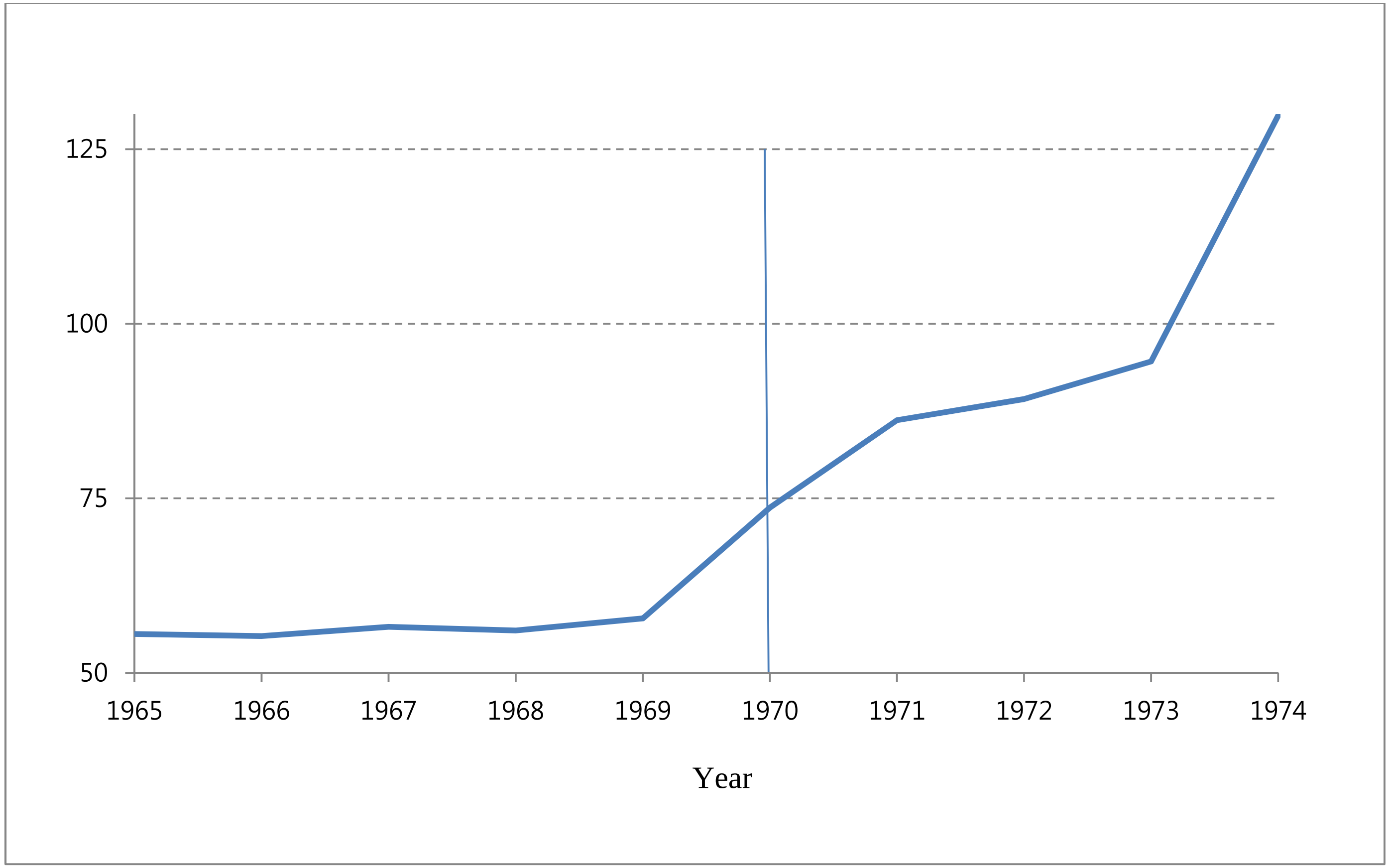
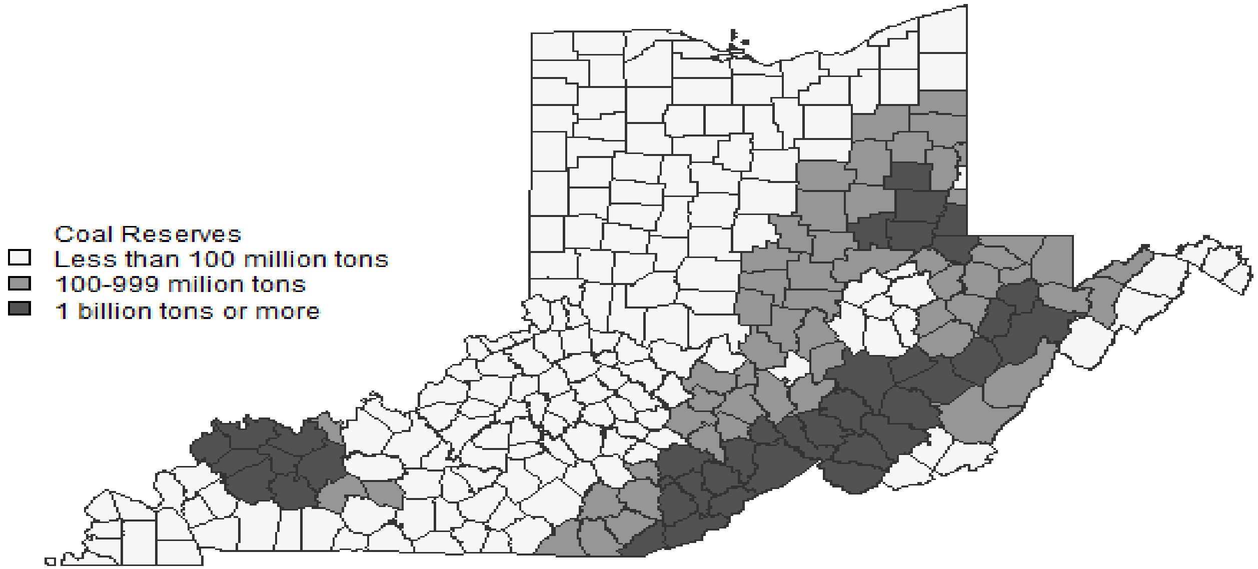
<Figure 1> The real price of coal, (1965–1974)



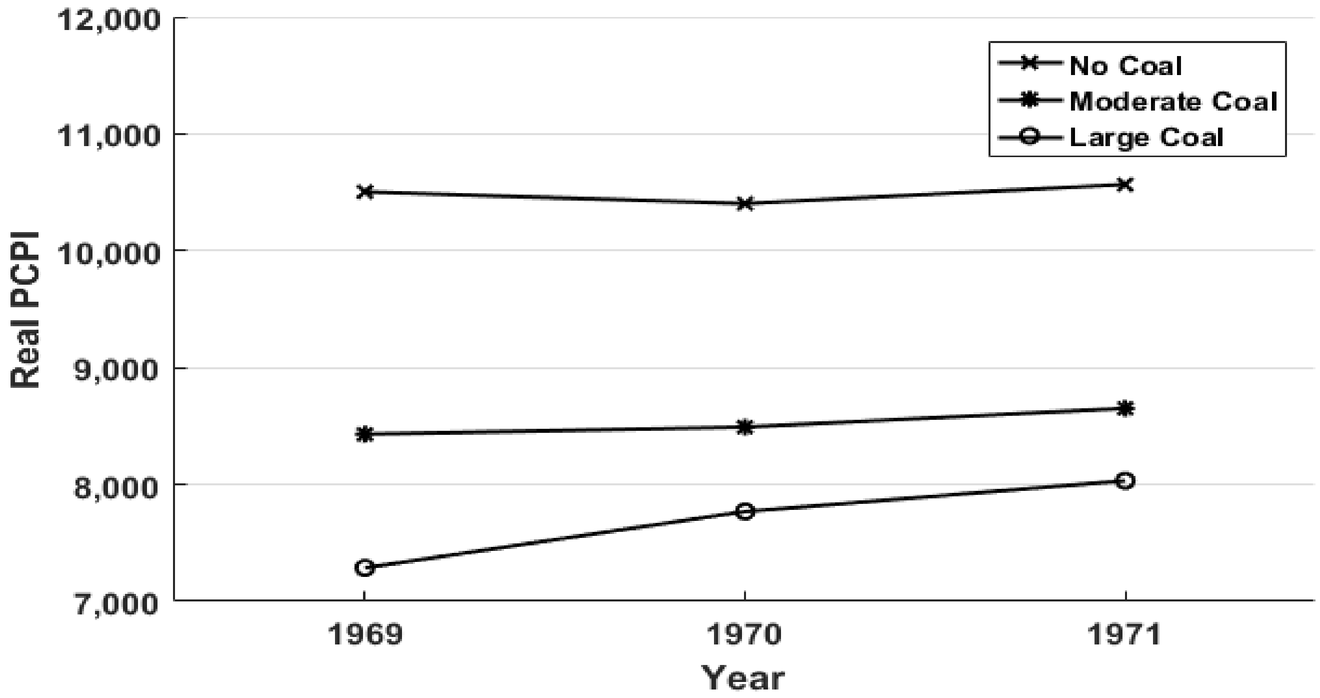
Notes: Authors’ calculations; this figure plots the ratio of the producer price index for bituminous coal to the CPI.

<Figure 2> Coal Reserves



Source: Black *et al*. (2002).

<Figure 3> The real per capita personal income



Note: Based on Regional Economic Information System of Bureau of Economic Analysis

Table 1. Descriptive Statistics

Period: 1970–1971	Mean	Standard Deviation
Birth Weight (in gram)	3,293.3	587.1
Low Birth Weight (< 2500 grams)	0.076	0.266
Real Per Capita Personal Income (in 1984 dollars)	10,084.2	1,796.9
Real Coal Reserve Value (in billion tons)	0.179	0.591
Male	0.514	0.500
Age of the Mother	24.40	5.46
White	0.888	0.315
Black	0.107	0.310
Other	0.004	0.062
Race Not Available	0.001	0.024
No High School Diploma	0.324	0.468
High School Diploma	0.595	0.491
Some College	0.056	0.229
College Diploma or Higher	0.013	0.112
Education Not Available	0.013	0.113
Number of Children[9]	2.554	1.915
Number of Children Not Available	0.003	0.058
First Child	0.360	0.480
Second Child	0.260	0.438
Third Child	0.159	0.365
≥ Fourth Child	0.221	0.415
Total Obs.	543,798	

Note: During 1970–1971, almost every observation represents a 50% sample, while some observations represent a 100% sample. Our calculation was done by assigning twice the weight to the 50% sample.
Note: Neonatal Mortality = Early Neonatal Mortality + Late Neonatal Mortality; Infant Mortality = Neonatal Mortality + Post-neonatal Mortality

[9] The number of observations of Number of Children is 783,017. The mean and standard deviation are calculated using non-missing observations.

Table 2. The Effect of Income on Birth Weight

Period: 1970–1971	Dependent Variable: Birth Weight		
	OLS	2SLS 1st stage	2SLS 2nd stage
Instrument: Real Coal Reserve Value (in billion tons)		0.893**	
		(0.124)	
Independent Variables: Real Per Capita Personal Income (in 1984 dollars; in thousand dollars)	-9.026	.	56.606**
	(11.279)		(27.885)
SNAP Participation	7.014	-0.084**	11.179
	(9.025)	(0.041)	(9.203)
First Child	-40.838**	-0.000	-40.791**
	(4.866)	(0.001)	(4.843)
Number of Children Not Available	-26.341	0.028**	-28.066
	(22.078)	(0.008)	(21.800)
Mother's age 20–24 years	28.650**	0.000	28.668**
	(4.314)	(0.001)	(4.288)
Mother's age 25–29 years	45.546**	-0.001	45.655**
	(4.058)	(0.001)	(4.038)
Mother's age 30–34 years	67.783**	0.000	67.828**
	(4.571)	(0.001)	(4.544)
Mother's age 35–39 years	64.990**	0.001	65.024**
	(9.402)	(0.001)	(9.302)
Mother's age 40+ years	81.770**	0.004**	81.720**
	(11.465)	(0.002)	(11.397)
Black	-230.546**	-0.003**	-230.348**
	(4.913)	(0.001)	(4.883)
Other	-138.230**	-0.008**	-137.777**
	(14.793)	(0.003)	(14.855)
High School Graduate	81.147**	0.000	81.118**
	(3.335)	(0.000)	(3.319)
College Graduate	96.421**	0.000	96.377**
	(4.910)	(0.001)	(4.880)
Higher than College	76.640**	-0.004	76.875**
	(9.650)	(0.003)	(9.520)
Education Not Available	32.746**	-0.003	33.179**
	(14.695)	(0.002)	(14.658)
Constants	3,385.166**	6.940**	2,929.664**
	(77.001)	(0.009)	(193.506)
County Fixed Effect?	Y	Y	Y
Clustering s.e.	Y	Y	Y
R^2	0.032	0.995	0.031
Obs.	543,798	543,798	543,798

Note: *, ** denote 5% and 1% statistical significance, respectively.

Note: During 1970–1971, almost every observation represents a 50% sample, while some observations represent a 100% sample. Our calculation was done by assigning twice the weight to the 50% sample.

Note: We linked real PCPI and real CRV of year t to BW and the mother's characteristics of year t+1.

Table 3. The Effect of Income on Low Birth Weight

Period: 1970–1971	Dependent Variable: Low Birth Weight (<2500 grams)		
	OLS	2SLS 1st stage	2SLS 2nd stage
Instrument: Real Coal Reserve Value (in billion tons)		0.893**	
		(0.124)	
Independent Variables: Real Per Capita Personal Income (in 1984 dollars; in thousand dollars)	0.002		-0.009
	(0.003)		(0.005)
SNAP Participation	-0.001	-0.084**	-0.002
	(0.005)	(0.041)	(0.005)
First Child	-0.006**	-0.000	-0.006**
	(0.001)	(0.001)	(0.001)
Number of Children Not Available	-0.006	0.028**	-0.006
	(0.012)	(0.008)	(0.012)
Mother's age 20–24 years	-0.012**	0.000	-0.012**
	(0.001)	(0.001)	(0.001)
Mother's age 25–29 years	-0.013**	-0.001	-0.013**
	(0.002)	(0.001)	(0.002)
Mother's age 30–34 years	-0.011**	0.000	-0.011**
	(0.002)	(0.001)	(0.002)
Mother's age 35–39 years	0.000	0.001	0.000
	(0.003)	(0.001)	(0.003)
Mother's age 40+ years	-0.001	0.004**	-0.001
	(0.005)	(0.002)	(0.005)
Black	0.061**	-0.003**	0.061**
	(0.002)	(0.001)	(0.002)
Other	0.022**	-0.008**	0.022**
	(0.007)	(0.003)	(0.007)
High School Graduate	-0.026**	0.000	-0.026**
	(0.001)	(0.000)	(0.001)
College Graduate	-0.038**	0.000	-0.038**
	(0.002)	(0.001)	(0.002)
Higher than College	-0.035**	-0.004	-0.035**
	(0.004)	(0.003)	(0.004)
Education Not Available	-0.009	-0.003	-0.010
	(0.006)	(0.002)	(0.006)
Constants	0.075**	6.940**	0.149**
	(0.020)	(0.009)	(0.035)
County Fixed Effect?	Y	Y	Y
Clustering s.e.	Y	Y	Y
R^2	0.011	0.995	0.011
Obs.	543,798	543,798	543,798

Note: *, ** denote 5% and 1% statistical significance, respectively.
Note: During 1970–1971, almost every observation represents a 50% sample, while some observations represent a 100% sample. Our calculation was done by assigning twice the weight to the 50% sample.
Note: We linked real PCPI and real CRV of year t to LBW and the mother's characteristics of year t+1.

Table 4. The Effect of Income on Mortalities

Period: 1969–1970	**Dependent Variable: Early Neonatal Mortality (< 7 days)**			**Dependent Variable: Neonatal Mortality (< 28 days)**			**Dependent Variable: Infant Mortality (< 1 year)**		
	OLS	2SLS 1st stage	2SLS 2nd stage	OLS	2SLS 1st stage	2SLS 2nd stage	OLS	2SLS 1st stage	2SLS 2nd stage
Real Coal Reserve Value (in billion tons)		0.843**			0.843**			0.843**	
		(0.153)			(0.153)			(0.153)	
Real Per Capita Personal Income (in 1984 dollars; in thousand dollars)	0.121	.	-1.584	0.125	.	-1.819	-0.028	.	-0.220
	(1.172)		(3.254)	(1.149)		(2.703)	(1.238)		(2.681)
SNAP Participation	0.299	-0.044	0.221	-0.316	-0.044	-0.404	-1.085	-0.044	-1.094
	(1.161)	(0.046)	(1.191)	(1.210)	(0.046)	(1.225)	(1.457)	(0.046)	(1.469)
Proportion of First Child	19.179	0.509	20.236	19.596	0.509	20.802	20.276	0.509	20.396
	(15.246)	(0.596)	(15.313)	(15.283)	(0.596)	(15.217)	(15.780)	(0.596)	(15.834)
County Fixed Effect?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Clustering s.e.	Y	Y	Y	Y	Y	Y	Y	Y	Y
R^2	0.629	0.996	0.625	0.642	0.996	0.637	0.657	0.996	0.657
Obs.	366	366	366	366	366	366	366	366	366
Mean of Dependent Variable Per 1,000 live births		14			15			20	

Note: *, ** denote 5% and 1% statistical significance, respectively.
Note: Each observation was weighted by the number of births

Table 5. Robustness Check: Birth weight and LBW

	Dependent Variable: Birth Weight			Dependent Variable: Low Birth Weight (<2500 grams)		
	OLS	2SLS 1st stage	2SLS 2nd stage	OLS	2SLS 1st stage	2SLS 2nd stage
Period: 1969–1970	**Fourth Quarter Babies**					
Real Coal Reserve Value (in billion tons)		0.881**			0.881**	
		(0.115)			(0.115)	
Real Per Capita Personal Income (in 1984 dollars; in thousand dollars)	1.700		31.047	-0.006		-0.011
	(20.091)		(33.830)	(0.009)		(0.014)
R^2	0.031	0.995	0.031	0.011	0.995	0.011
Obs.	139,756	139,756	139,756	139,756	139,756	139,756
Mean of Dependent Variable		3238.2			0.0793	

Note: *, ** denote 5% and 1% statistical significance, respectively.

Note: During 1970–1971, almost every observation represents a 50% sample, while some observations represent a 100% sample. Our calculation was done by assigning twice the weight to the 50% sample.

Note: We linked real PCPI and real CRV of year t to outcome variables and the mother's characteristics of year t+1.

Table 6. Robustness Check: Mortality

	Dependent Variable: Early Neonatal Mortality (< 7 days)			**Dependent Variable: Neonatal Mortality (< 28 days)**			**Dependent Variable: lnfant Mortality (< 1 year)**		
	OLS	2SLS 1st stage	2SLS 2nd stage	OLS	2SLS 1st stage	2SLS 2nd stage	OLS	2SLS 1st stage	2SLS 2nd stage
Period: 1969–1970					**Fourth Quarter Babies**				
Real Coal Reserve Value (in billion tons)		0.912**			0.912**			0.912**	
		(0.110)			(0.110)			(0.110)	
Real Per Capita Personal Income (in 1984 dollars; in thousand dollars)	0.686		-2.212	0.946		-1.097	-0.253		0.490
	(2.328)		(6.235)	(2.380)		(5.251)	(2.619)		(5.455)
R^2	0.492	0.996	0.489	0.497	0.996	0.495	0.538	0.996	0.538
Obs.	384	384	384	384	384	384	384	384	384

Note: *, ** denote 5% and 1% statistical significance, respectively.
Note: Each observation was weighted by the number of births.

Appendix Table 1. Median household income by state in 1969

State	Median household income	State	Median household income
District of Columbia	14053	Nebraska	9418
Connecticut	12988	Arizona	9414
New Jersey	12299	Michigan	9280
Nevada	12273	Idaho	9114
Massachusetts	11964	Wisconsin	8941
California	11922	Florida	8915
Rhode Island	11704	Maine	8851
Alaska	11511	Minnesota	8832
New Hampshire	10938	North Dakota	8809
Maryland	10793	South Dakota	8483
Washington	10706	Texas	8462
Hawaii	10663	Virginia	7987
Delaware	10660	Missouri	7978
Illinois	10340	Utah	7938
New York	10331	Oklahoma	7857
Wyoming	10301	New Mexico	7798
Iowa	10287	North Carolina	7745
Ohio	10137	South Carolina	7581
Oregon	10026	Georgia	7348
Indiana	10016	**Kentucky**	7340
Vermont	9625	Tennessee	7133
Pennsylvania	9599	Alabama	6983
Kansas	9533	**West Virginia**	6842
Montana	9513	Louisiana	6788
Colorado	9496	Arkansas	6742
		Mississippi	6080

Note: Measured in 1984 dollars. Median household income in No Coal is 9050, Moderate Coal is 7287, and Large Coal is 6842.