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Life Ain't Fair for a Miner's Son: Intergenerational Outcomes for Sons of US Miners in the Early Twentieth Century

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Abstract

In the early twentieth century, the mining industry was characterized by isolation, dangerous working conditions, employer power, and declining employment. However, miners also enjoyed high earnings, flexible schedules, and company housing. In this article, I explore intergenerational economic mobility for miners' sons. Using linked full-count US Census data to explore outcomes for miners' sons compared to other sons, I find that miners' sons usually do worse than manufacturing workers' sons but better than farmers' sons. Successful sons of miners grew up in urban neighborhoods that were mining-dependent, had access to education, and moved from their childhood counties. Sons of miners in the coal industry, which was shrinking, also did worse than sons of miners in the oil industry, which was expanding. This article sheds light on the effect that industry growth and geographic isolation has on intergenerational outcomes.

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Introduction

Whether the mining industry is a boon or a bane for local communities is a contested issue. While "the resource curse" usually refers to the effects of mining dependence at the national level, there is growing evidence of a subnational resource curse (Jim Cust and Claudia Viale 2016; Tom Mueller 2021). Mining can positively impact communities in terms of jobs, tax revenue, and economic spillover, but it also has negative economic, environmental, and social consequences. Technological change and declining demand for coal have caused large declines in economic output and employment in coal-dependent areas. In 2021, the United Mine Workers of America (UMWA) recognized that it is time to start helping coal workers survive through the energy transition by retraining for non-mining jobs in addition to lobbying to keep existing coal jobs. The US lost over half of its coal jobs from 2011 to 2021 (United Mine Workers of America 2021), and the long-run employment outlook for miners is not good.

To add to the literature on the mining industry's effects, I explore the intergenerational mobility of miners' children. I compare outcomes for sons of miners to sons of fathers in other similarly skilled occupations, and I identify characteristics of miners' sons that were associated with better outcomes. Some of these characteristics are individual, like father's education and nativity, while some are associated with the county a son grew up in, such as industry dependence and access to education. I also look at outcomes between coal, oil, metal, and non-metal mining subindustries.

I use full-count Census data to study outcomes for boys born between 1900 and 1910 in the contiguous US. The data are linked from father to son in 1910 when the son is young, then linked to son outcomes in 1940 using automated Census linking (Ran Abramitzky et al. 2019). In this era of American history, coal employment had a large-scale boom driven by industrialization and a subsequent bust driven both by technological displacement of coal employees and the Great Depression. These changes make the period especially relevant.

First, I find the "occupational inheritance" of miners: how many miners' sons become miners themselves? I compare the occupational inheritance of the mining occupation to other occupations. I also compare son income, geographic mobility, and intergenerational income mobility across occupations and mining sub-industries, Then, I run a multi-level regression to predict son income and educational attainment in 1940 given father and childhood county characteristics.

"Occupational inheritance" of miners is high, meaning that miners' sons are very likely to go into mining. Miner's sons were 8 times more likely to become miners than the general population, while operatives' sons were 1.4 times more likely to become operatives and service workers' sons were 2.3 times as likely to become service workers. These numbers are particularly striking because, while "operative" and "service worker" are broad classes that include many types of jobs, "miner" is a very narrow occupation that is a subset of the "operative" category. Farmers, who often pass land onto their children and traditionally run a family enterprise, had sons that were 2.2 times as likely to be farmers as the general population. The occupational inheritance of miners is very high compared to similar occupations.

Sons of miners have lower expected earnings in 1940 than sons of laborers, operatives, and service workers. However, the skill and pay of miner fathers do not predict lower incomes. Miners are semi-skilled, similar to operatives and service workers, and are usually more skilled than laborers. Miners also receive similar pay to operatives. Son outcomes are not worse due to miners' skill or income, and instead are likely worse due to geography or industry characteristics.

The kind of mining which the father does has a large effect on the son's economic outcomes. Sons of metal and petroleum miners have significantly higher expected income compared to sons of nonmetal and coal miners. Petroleum mining continued to see growth

throughout the century, while coal mining lost jobs in the 1920s and never fully regained them, and metal and nonmetal mining stayed roughly the same. Despite poor prospects, coal miners' sons still tended to stay in the mining industry; 18 percent of coal miners' sons went into the mining industry, while 10 percent of petroleum miners' sons and nine percent of metal miners' sons did.

Father occupation mattered, but county-level factors were also influential in a son's success. The biggest predictors of son income are the industry dependence in the son's childhood county and urban status of the neighborhood. Sons who moved from their childhood counties did significantly better than those who remained. Industry dependence, which is often attributed with making outcomes worse for residence, was positively associated with son income once other factors were accounted for.

These data and methods give a comprehensive view of the intergenerational outcomes from mining communities because they cover a large portion of men in this cohort. Looking at these outcomes in a historical period which parallels today can illuminate how occupations and industries affect long-term economic outcomes for workers. Early US mining is an informative case study for researchers studying extractive development today. Across the world, mining workers are facing similar crises to those miners faced a century ago: declining employment, employer's monopsonistic power, and industry dependence. The most successful sons from this study—those who had access to education, lived near cities, and were able to move when the opportunities were available—would also likely be the successful ones today.

Many of the policy recommendations that follow are ones that are already implemented to some extent. Mining companies are often required to have plans for increasing the resilience of the communities they operate in, which often include providing education and public infrastructure. These should be taken seriously and required in all cases. Regional governments should try to diversify their employers by drawing in industries that are unrelated to mining. Also, support should be provided to those who are moving to new opportunities in other places.

I begin with a literature review that covers the unique challenges that mining communities in the early twentieth century faced and the importance of intergenerational mobility. Then, I explain the data and methods used in the article. I present the descriptive statistics and regression results, and finally discuss and conclude.

Literature Review

In some ways, mining is not unique in the challenges its workers faced. In the early twentieth century, many industries employed unskilled labor at very low wages. Income inequality in the US was high during the early 1900s and peaked during the Great Depression (Robert D. Plotnick et al. 1998).

Labor conditions in the early 1900s were not good for unskilled workers. Work was dangerous. Each year from 1906 to 1930, over 1,000 miners died in workplace accidents (Price V. Fishback 1992), and the loss of a parent to mining accidents had large negative effects on a child's economic outcomes (Ezra G. Goldstein 2021). After the start of the machine-loading era around 1930 which greatly increased coal dust underground, the black lung became a common disease among miners (Keith Dix 1988). However, mines were not the only dangerous workplaces, as demonstrated by incidents like the Triangle Shirtwaist Factory Fire, a famous disaster that killed 146 garment workers which was worsened by low safety standards and regard for workers lives.

For many industries, employment in 1940 was lower than before the Great Depression (Stanley Lebergott 1966). Agriculture dropped from 11.8 million workers to 9.6 million between 1910 and 1940, and transport work dropped from 2.0 million jobs in 1910 to 1.3 million jobs in

1940. In this regard, mining is not remarkable, as it dropped from 1.1 million jobs to 0.9 million. Many industries experienced employment declines, and the mining industry employed less than three percent of the US workforce.

However, mining occupations were special in a few ways. Unlike manufacturing or transport work, mining tends to be in remote areas with little other economic activity. Miners often worked in towns that were set up for the mining company, with company-owned housing and stores (Fishback 1992). Early coal miners famously were taken advantage of by these systems, and, anecdotally, many miners "owed their souls to the company store". In the coal fields of Southern Appalachia and in the Rocky Mountains, roughly 65 to 80 percent of miners lived in company towns, whereas in less isolated areas, very few did. Unlike agriculture, where 62 percent of farmers owned their farm in 1910 (Bureau of the Census 1914), few miners owned their houses or were able to reap any profits from their labor. Since the only purpose for many mining towns was the mine, few workers owned their homes and miners' wives had few opportunities to work (Fishback 1992).

Local dependence on a single industry is not unique to mining, as many areas experienced and continue to experience dependence on single industries (US Department of Agriculture Economic Research Service 2019), but local dependence on a single *company* is. This dependence allowed mining companies to control local bureaucracy and land prices (Craig R. Humphrey, et al. 1993). The companies often bought large tracts of surrounding land to prevent competitors from entering the local market. This scared off other types of businesses, as they did not want to be subject to the whims or instability of the mining company (Steven C. Deller and Andrew Schreiber 2012). The economic multiplier of mining jobs is lower than other jobs because they are typically in isolated communities which have a single employer and landowner.

In addition to controlling local real estate and government, the market power of mining companies gave them the opportunity to set wages below the marginal productivity of the worker, which reduces the resources available to educate children and give them material well-being necessary to improve their economic lot. William Boal (1995) reported that the coal industry in the early twentieth century had very high turnover rates of 100 to 200 percent a year, which he pointed to as an indication of a lack of market power. However, there were significant employment frictions; separating from an employer that provided company housing meant getting evicted and usually moving towns (Fishback 1992). Such frictions allow employers to follow a low-wage/high-turnover strategy, in which they continually offer poor conditions and low pay compared to their competitors but still keep some of their labor force (Alan Manning 2003). In modern mining, monopsony power appears to exist (Tom J. Mueller, Jesse E Shircliff and Marshall Steinbaum 2021), and anecdotal evidence suggests that this was also true in the early twentieth century (Dix 1977). Beyond simply controlling wages, mining companies also often controlled the prices employees paid through company housing and the company store, though some evidence shows that company store prices were not as exorbitant as some historians would suggest (Fishback 1992).

Boal (1995) analyzes coal mining data in West Virginia from 1897 to 1932 and finds that coal mines had little market power. Part of his argument is that the large number of coal companies and the high turnover rate were indications that monopsony could not exist. The presence of monopsony power in mining in the early twentieth century is still empirically uncertain, and analysis is limited by available data. Despite this uncertainty, violent episodes like the Ludlow Massacre of 1914 and the West Virginia Mine Wars (Lon Savage 1990; Thomas C. Andrews 2008) indicate that mine operators had power over workers. This kind of power reduces the ability of workers to advocate for themselves or their children.

Communities that specialize in one industry may over-adapt to that industry, changing the workforce and local infrastructure to accommodate that industry, thus becoming industry-dependent (Humphrey, et al. 1993). In areas with high levels of dependence on natural

resource extraction, individuals and communities are less likely to invest in human capital, both at the national level (Nancy Birdsall, Thomas Pinckney, and Richard Sabot 2001; Thorvaldur Gylfason 2001) and the subnational level (Jorge M. Aguero, et al. 2021). Jobs in natural resource extraction are typically low skill (Gylfason 2001) and in the early twentieth century any skills required for mining were learned on the job, usually from family members or friends (Fishback 1992). In areas where there were well-paying blue-collar jobs and the opportunity cost of education was high, like mining communities, individual investment in high school education was low (Claudia Goldin and Lawrence F. Katz 1999). Young people who believe that they will grow up to be miners will have little incentive to invest in their education and may start working at a very young age. Demand for education was low.

Supply of education was also low. Mining communities will not choose to invest in public schools, since educated youths will likely move away (José Carlos Orihuela 2018). In the early twentieth century, mining turnover rates were very high (Boal 1995), so parents would not take the time to lobby for better schools. Whether a small town chose to fund a high school was dependent on many things, including income distribution and the fragmentation of social groups (Goldin and Katz 1999). In highly unequal areas, a larger portion of the population might opt out of public schooling—the poor to start working, the rich to attend private schools. Mining communities had high levels of inequality and a lack of middle-skill jobs due to company-controlled institutions and industrial homogeneity, and so community investment in public education tended to be low. Additionally, in highly fragmented areas with low levels of social cohesion, which is likely in company towns with high turnover, people are less willing to invest in the education of their community's youths. Whether a community funded a high school early in the high school movement is still associated with social capital measures of today (Goldin and Katz 1999).

The reliance on mining jobs is not a problem during mining booms, when jobs are plentiful. However, mining is subject to boom and bust cycles that first induce migration and increase wages as the industry grows, then leave the community in poverty as the industry declines. In the early twentieth-century mining industry, coal employment and output experienced a large boom from 1890 to 1923, then a large decline in employment due to increased mechanization and later an output bust related to the Great Depression (Fishback 1992; Mike Matheis 2020). Many boys in the early 1900s who expected to become miners like their fathers were unable to do so, and any educational decisions they made on that expectation were for a world that was disappearing.

Mining areas may not enjoy long-term benefits from extractive development. Using a few case studies, Scott Frickel and William R. Freudenburg (1996) found that extractive industries aided regional development through the first half of the nineteenth century, but that afterwards the extractive market was so saturated that local economic benefit disappeared. Often, the best answer for children from areas that are over-adapted to a failing industry was to move, which was one of the best strategies for economic mobility in this time (Zachary Ward 2023).

While workers in many industries in the early 1900s faced challenging working conditions and low pay, the challenges which miners faced—remoteness, over-adaptation, instability, and mining companies' power over food, housing, and wages—were unique to the industry. Despite these challenges, many economic historians have put the mining industry in a positive light (Boal 1995; Fishback 1992). For instance, Fishback (1992) argues that coal miners had options to counteract monopsonistic power in the labor market which included setting up unions and moving towns— "voice or exit". He shows that annual earnings for coal miners were roughly equal to those for manufacturing, and that hourly wages were often higher, so that coal miners were able to work less for the same compensation. Miners in the hand-loading era also had large amounts of freedom and little supervision; they could take off work or leave in the middle of the day if they pleased (Dix 1988). Fishback (1992) argues that

the higher pay and flexibility in mining offset the costs of remoteness and danger relative to manufacturing. In some ways, mining employment was quite desirable.

Many of the perks of being a miner, like flexibility and lack of oversight, had disappeared by 1940 as machines became more common (Dix 1988). Miners' wages did not increase proportionally with those of other operatives. In 1920, mine workers made between 1.1 and 1.3 times the annual earnings of manufacturing workers (Fishback 1992), but in 1940 miners made less on average ($909 for miners and $1,098 for operatives) (Steven Ruggles, et al. 2020). Miners continued to make more than laborers ($634) and farm laborers ($363), though farm workers likely had more in-kind compensation.

Intergenerational Economic Mobility

This article focuses on a long-term effect of mining employment, intergenerational economic mobility, rather than on concurrent effects, like poverty, income, and employment. Several studies have recently used historical data to find measures of occupational mobility (Xi Song 2021; Elisa Jacome, Ilyana Kuziemko, and Suresh Naidu 2021; Joseph Price, et al. 2021). Economic mobility is a long-term measure of well-being that can give us more insight into how mining was able to induce or hinder long-term economic improvement at the worker level. A study found that the oil boom in Norway in the 1970s increased intergenerational mobility and broke the earnings linkage between grandfathers and their grandsons (Aline Bütikofer, Antonio Dalla-Zuanna, and Kjell G. Salvanes 2018). This is likely not always true, for instance during mining busts or in places with fewer worker protections and less social spending. Since mining outcomes often vary based on geography and institutions, studying many places and time periods is helpful for understanding these outcomes.

Mobility is a geographically-dependent phenomenon (Raj Chetty, et al. 2018), and outcomes are likely different in communities that are reliant on a declining industry. James J. Feigenbaum (2015) finds that sons that grew up in cities with the largest downturns in the Great Depression had much lower mobility measured many years later than those who grew up in less affected cities. It is likely that sons in declining mining communities had lower mobility as well.

Mobility is also important because one of the reasons why fathers worked hard in the mines was to improve the economic possibilities for themselves and their family. Immigrants and former slaves came to work in the mine for a living wage, and many miners had dreams of buying a farm (Fishback 1992), likely thinking of leaving it to their children so they could have a better life. Fathers or other family members often took the boys into the mine, training them to make sure they could mine safely (Dix 1988). As mining and agricultural employment went into decline, the outcomes for the children of these miners were put in jeopardy.

Data and Methods

I use full-count decennial US Census data from 1910 and 1940, accessed through IPUMS (Ruggles, et al. 2020). To link the data between these Censuses, I use the Census Linking Project, which uses several automated methods to link individuals across Census pairs using first and last name, year of birth, and state/country of birth (Abramitzky, et al. 2020). Fathers are linked to their sons in 1910 if they are in the same household.

The Census Linking Project has several options for name matching and probability of mismatches. I used name matching based on the New York State Identification and Intelligence System (NYSIIS), which uses standardized names rather than exact names so that names can be matched even if there are spelling differences across censuses. I also chose to use standard rather than conservative matches to increase the sample size. This linking strategy has a match rate (efficiency) of roughly 30 percent between each census, and the accuracy compared to hand linking is roughly 90 percent.

The Linking Project data do not have representative linking, as the project is more likely to link literate people and taller people, but the difference in occupational scores between linked and unlinked individuals is statistically insignificant (Abramitzky, et al. 2019). I created inverse proportional weights to make the matched data representative of the 1940 population using education, income, age, whether the son migrated states, and Inter-university Consortium for Political and Social Research (ICPSR) region. Weights are created by predicting the probability of a successful match given those characteristics.

I use the cohort of sons aged zero to 10 in 1910. This cohort contains 10,589,806 men. I link these sons to the 1940 Census and only include sons with father characteristics recorded in 1910. Roughly six percent of sons do not have matched fathers in 1910, meaning that their father is not in their household. The matched sample with linked fathers contains 2,497,754 sons, or roughly 23.6 percent of the original sample. Farmers' status is very hard to identify in this period because the heterogeneity of what being a farmer means and the presence of benefits besides income; farmers could be wealthy and productive landowners, or they could be subsistence sharecroppers, and their occupation is recorded as the same. Because of this, I exclude farmers in several of my analyses.

From the 1910 full-count Census, I use individual-level variables including age, father's nativity, father's sub-industry and occupation, father's earnings score, father's literacy, a homeowner indicator, and an indicator for neighborhood urbanicity. From 1940, I use earned income and detailed education. With the linked data, I create an indicator for if the son moved counties between 1910 and 1940.

To estimate the occupational income score for fathers in 1910, I use the percentile ranking of the expected value of the wage in 1940 by occupation, state, and age band. Therefore, the earnings score is essentially the percentile income rank for an occupation based on 1940 wage income. This ranking was created using all working-age men from 1910, not just matched fathers. I calculate the 1940 income score using a similar method but using individual wages rather than the state/occupation's average earnings.

The "mining industry" is different from the occupation "miner", but "miner" is the most common occupation in the mining industry. The mining industry has four subsectors—metal, nonmetal, coal, and oil. It employs a variety of occupations, including craftsmen, like blacksmiths and engineers, and white-collar workers, like clerical workers and managers. This analysis is focused on "sons of miners" rather than "sons of fathers in the mining industry" since miner was the most common occupation and because miners were more vulnerable than other occupations. Miners had on-the-job skills that were not often transferrable to other industries and were paid on a piece rate rather than hourly basis, in contrast to other occupations in the mining industry. Additionally, miners were more at risk of losing their jobs to technological advancement than other jobs. Though I focus on miners, I also include other occupations in the mining industry in parts of the results. When I compare mining sub-industries, I group laborers with miners, since, particularly in the oil industry, they shared similar status.

To get the mining, manufacturing, and agricultural employment in each county, I use full-count Census data for all men in 1910. To determine if a community is "mining-dependent", "agriculture-dependent", or "manufacturing-dependent", I use the method from the US Department of Agriculture Economic Research Service (2019) to calculate modern county typologies for 1910. The thresholds for industry dependence are the mean percent employment in an industry plus one standard deviation. The Economic Research Service uses only non-metro counties, but defining metropolitan counties in the early 1900s is conceptually difficult, as many counties have both urban and non-urban areas. Specifications excluding counties in the top 10^{th} percentile of population yield similar typologies, so I use all counties in my calculations.

Occupational transition was quite common during this time, and fathers may have worked many occupations even within a year. This means there may have been some men who were miners during a child's life that were not recorded as a miner in 1910, or men who were recorded as miners in 1910 that only briefly had that occupation. To account for this, I link fathers to their records in 1900 and 1920 using IPUMS Multigenerational Longitudinal Panel (MLP) links (Jonas Helgertz, et al. 2023). These links are superior to the Census Linking Project links because they have a higher linkage rate and higher accuracy (Helgertz, et al. 2022), but they are only available for consecutive Censuses, so I only use them for this portion of the analysis. For the 2.5 million linked sons that have father observations, 86 percent could be linked to at least one other census, and 44 percent could be linked in all three.

As a proxy for access to education, I use Census data to find the number of teachers in the county and divide that by one hundred times the number of children in the county. Unionization rates are the percent of coal workers with paid-up membership in the UMWA at the state level, averaged from 1912 to 1923, from Table 3-2 in Fishback (1992).

I first report descriptive statistics, including father-son transition matrices for occupational categories and father and son characteristics by broad occupation categories, community dependence, and mining industry subsector.

I then use a multi-level model (MLM) to identify the effects of individual- and county-level variables on son outcomes. I perform three sets of regressions: one which only includes sons of fathers with all occupations except for farmer and explores father occupation in 1910; one that explores the effect of the father ever being a miner in any of the three censuses used; and another which includes only sons of miners in 1910. The MLM removes the issue of clustering error and allows for variables at both the individual and county level. I use a random intercept and fixed coefficients model, so intercepts can vary by county but each coefficient is the same across all counties. Equation (1) shows the MLM specification.

$$Y_{ij} = \gamma_{00} + \gamma_{0j} + \beta X_i + \alpha X_j + \varepsilon_{ij} \quad (1)$$

Y_{ij} is the outcome of either son's income or son's education. γ_{00} is the overall intercept, and γ_{0j} is the intercept for county j. β is the vector of coefficients on the individual variables which include son's age, geographic mobility, and whether they lived in an urban neighborhood. Individual variables also include father's literacy, occupation, homeowner status, and nativity. α is the vector of coefficients for the county-level variables which include industry dependence and the number of teachers per 100 children. For the regressions which only include miners and laborers in the mining industry, father's mining subindustry is an individual variable, and the average unionization rate is a state variable.

This article focuses on a few results from these regressions. One is the relative outcomes for sons of miners compared to sons of other workers. Another is the other factors that affect whether miners' sons are successful. Finally, the article compares outcomes between sons of miners' in the various subsectors.

Results

Father Occupation Change

Between 1900 and 1910, 51 percent of fathers stayed in the same occupational groups, and 44 percent had the same occupation. Miners had slightly higher occupational stability: 53 percent of miners in 1900 were also miners in 1910. Occupational stability increased for the 1910 to 1920 period: 60 percent of fathers stayed in the same occupational group, and 52 percent had the same occupation. This may be because the men measured here who were

fathers in 1910 were getting older and more settled. The stability for miners only increased slightly: 56 percent of miners in 1910 were also miners in 1920.

Stability over all three censuses was substantial: 32 percent of fathers had the same occupation over all three censuses if they had occupations recorded. For men who were miners in 1910, 36 percent were also miners in 1900 and 1920. Because there was still significant turnover, I will incorporate this stability into the regression analysis. In those parts of the analysis, observations are only included if the father's occupation is measured in at least two censuses. Fathers are grouped into three categories: "always a miner", which means that they were a miner in each census they appeared in; "once a miner", which means they were a miner in one census but not in the other one or two censuses they appeared in; or "never a miner".

Occupational Inheritance

Table 1 shows the occupational transition matrix for fathers in 1910 and sons in 1940. The values are the percentage point difference from "perfect mobility", where the occupational distribution for sons would be the same for everyone regardless of father occupation. For instance, in perfect mobility only eight percent of sons would be professionals themselves regardless of their father's occupation. Instead, 30 percent of sons with professional fathers were professionals themselves, and the difference is 22 percent.

Table 1
Occupational Transition Matrix for Fathers in 1910 and Sons in 1940, Difference from Overall Distribution

Father Occupation 1910	Son Occupation 1940: Professional	Lower WC	Craftsmen	Operatives	Service	Farmer	**Miner**	Laborer	Farm Laborer	NA	Distribution Sons - 1940	Distribution Fathers - 1910
Professional	22%	12%	-6%	-8%	-1%	-8%	**-2%**	-6%	-3%	0%	7%	3%
Lower WC	6%	19%	-3%	-4%	0%	-9%	**-1%**	-5%	-3%	0%	23%	14%
Craftsmen	1%	3%	8%	2%	1%	-9%	**-1%**	-2%	-3%	0%	17%	15%
Operatives	0%	4%	3%	7%	1%	-9%	**-1%**	-1%	-3%	0%	17%	8%
Service	1%	7%	2%	0%	5%	-9%	**-1%**	-2%	-3%	1%	4%	2%
Farmer	-3%	-9%	-3%	-2%	-1%	14%	**0%**	1%	4%	-1%	12%	34%
Miner	**-3%**	**-9%**	**0%**	**2%**	**0%**	**-9%**	**16%**	**5%**	**-2%**	**1%**	**2%**	**3%**
Laborer	-2%	-3%	2%	5%	1%	-7%	**0%**	4%	-1%	1%	10%	12%
Farm Laborer	-4%	-10%	-1%	2%	0%	2%	**0%**	6%	6%	0%	5%	3%
NA	0%	1%	1%	0%	1%	-3%	**0%**	0%	-1%	1%	3%	6%

Source: Author's calculations using IPUMS data (Ruggles, et al. 2020)

For every occupation, a son was more likely to have their father's occupation category than the general population. For some this effect is large, like for professionals, while for others it is relatively small, like service workers. The effect for miners is very large; the relative

occupational inheritance for miners is larger than for farmers, which is surprising since farming is often a family enterprise. The proportion of miners' sons that become miners is remarkable—18 percent—particularly when miners only make up two percent of all occupations and the number of mining jobs per worker declined over this period. Mining is only a subcategory of the large "operatives" category in the Census, but the probability a miner's son became a miner was higher than the probability that an operative's son became an operative. Sons of operatives are only slightly overrepresented in the operative category; they are seven percentage points more likely to be operatives than the overall population, while sons of miners are 16 percentage points more likely to become miners. This is larger if the father was always a miner: 21 percent of these sons became miners.

Characteristics of Miners and Miners' Sons

Table 2 shows several characteristics of fathers and outcomes of sons by the father's major occupation group. While the average literacy does not vary widely among the occupation groups, miners have a low literacy rate. The only less literate occupation category is farm laborer. The average earnings score for miners is slightly higher than the average for operatives, though much lower than for craftsman and higher than for service workers and laborers.

Table 2
Characteristics of Fathers in 1910 and Son Outcomes in 1940 by Father Occupation Group

	Father's Occupation										
	Professional	Lower WC	Craftsmen	Operatives	Service	Farmer	Miner	Laborer	Farm Laborer	NA	Average
Literacy Rate	100%	99%	98%	96%	97%	93%	86%	90%	87%	95%	95%
Father Homeowner Rate	47%	48%	38%	28%	32%	62%	36%	34%	29%	49%	49%
Father's Occupation Income Rank by Age	84	81	75	62	48	20	63	40	5	0	47
Father's Occupation Income Rank	85	83	77	64	50	22	65	42	6	0	49
Father/Son Difference in Ranks	-25.7	-23.9	-19.1	-6.5	8.2	18.9	-13.9	9.4	37.4	0.0	1.4
Son Income Rank	58.2	57.1	55.8	55.2	56.1	38.9	49.0	50.3	42.3	50.4	49.2
Son Median Income ($)	1,527	1,408	1,250	1,220	1,273	733	980	1,053	796	1,102	960
Son Moved Counties	73%	62%	56%	53%	56%	61%	66%	57%	65%	65%	41%
Son Moved States	43%	33%	29%	25%	26%	28%	31%	27%	28%	33%	72%

Source: See text.

The average earnings score change between fathers and sons is negative for high earning jobs; there is less room for sons of professionals to go up. For fathers with lower statuses, expected son mobility generally is higher. Miner's sons, however, tend to have lower ranks than their fathers. While miners make slightly more money than the average operative, earnings scores and incomes are noticeably lower for sons of miners.

Sons of miners are more likely to move from their home counties and states than sons of operatives. Generally, the middle of the earnings score distribution is more geographically stable, while professionals and farm laborers each have higher geographic mobility. However, mining does not fit this pattern, likely due to the high turnover rate in mining companies, their geographic isolation, and the lack of alternative jobs in mining towns if a son chooses not to be a miner.

Mining Subindustries

In 1910, 3.5% of the labor force was in the mining industry, while in 1940, 2.5%, or about 1 million male workers, were. The mining industry had several subindustries and employed many kinds of mining workers. Table 3 shows the breakdown of these subindustries and several characteristics of sons of miners. Most workers in the mining industry worked in coal mining. This proportion decreased slightly by 1940, and nonmetallic and oil mining grew, though coal continued to employ the majority of mining workers.

Table 3
Sub-industry Characteristics of Miners' Sons

		All Occupations		Miners' Sons (1940)					
	% Always Miner (Fathers)	1910 Distribution	1940 Distribution	Average Earning Score Change	Median Income ($)	Education	Moved County	Became Miners	Mining Industry
Coal	58%	71%	54%	-14.5	980	8.5	64%	18%	22%
Metal	40%	12%	12%	-12.9	1,094	9.2	72%	9%	12%
Nonmetallic, except fuel	23%	9%	10%	-10.5	1,000	8.9	58%	6%	7%
Petroleum and natural gas	24%	6%	23%	-14.8	1,200	9.9	71%	10%	16%
Not specified	24%	2%	1%	-14.7	1,200	10.2	70%	7%	9%

Source: See text.

Son outcomes differ by mining subindustry. While miners' sons in all subindustries had negative expected earnings score change, meaning they moved down in the nation's overall income distribution, sons of coal miners had a large decline and lowest expected income. The expected income of sons of oil and petroleum miners was 22 percent higher than the expected income of sons of coal miners. Coal miners also had the lowest educational attainment.

Coal miners' sons were very likely to stay in the coal industry, and very few of those sons would have jobs other than miner. This may be because coal mining was usually more remote than petroleum and natural gas extraction, and other subindustries mechanized more

quickly. This pattern matches the pattern for fathers. Fathers in the coal industry are very likely to stay in the same occupation, while fathers in metal are more likely than not to be miners for just one census. For miners in other kinds of mining, very few stayed miners for long. For other kinds of mining, sons were less likely to stay in the industry, and those who did were more likely to have jobs besides miner. For all father industries, 32 percent of sons stayed in the same industry, so mining is generally less sticky of an industry than many others, though mining as an occupation is very sticky.

The number of mining jobs in 1910 and 1940 were roughly the same despite the labor force growing 38 percent. Mining employment grew until the 1920s, then between 1920 and 1940, 14 percent of the jobs in the mining industry disappeared. In the coal industry, 25 percent of jobs were lost, while nonmetal mining and oil extraction industry jobs increased 26 percent and 23 percent. Depending on the mining subindustry, the economic outlook of miners' sons changed, and, unsurprisingly, being in a declining subindustry was bad for intergenerational mobility.

Industry-Dependent Communities

Communities that are dependent on one industry have characteristics that can hurt economic outcomes, like a lack of other jobs and lower school spending. The amount of employment that constitutes dependence varies by industry; many counties had substantial proportions of farmers, but few counties had many miners. The threshold for mining dependence is that 11.2 percent of those in the labor force need to be in the mining industry, while to be agriculture-dependent, over 76.2 percent had to be in agriculture. The threshold for manufacturing-dependence is 19.6 percent.

Seventy-six percent of miners' sons grew up in mining-dependent counties, and 73 percent of operatives' sons grew up in manufacturing-dependent counties. For these occupations, it was more common than not to grow up in a community dominated by one industry. It is less likely for farmers; only 14 percent of farmers' sons grew up in an agriculturally-dependent county. The bar is high to be classified as an agriculturally-dependent county since most counties had some amount of agriculture.

Mining dependence is highly geographically-dependent. Coal-dependent counties were largely located in the Appalachian Mountains, though there were several coal counties in the Western US. Much of Nevada and Arizona had metal mining-dependent communities. Oil-dependent communities were located mainly in Texas and Oklahoma. These geographical dependencies brought their own challenges; while coal communities in Appalachia were isolated by dense mountains, the metal mines in the West were isolated by desert or the high, rugged Sierra. Oil-dependent communities, on the other hand, were often located near semi-farmable land.

Some outcomes varied by industry dependence. Table 4 shows outcomes for sons of miners, operatives, and farmers by county industry dependence. For miners' and farmers' sons, being in a dependent county led to worse outcomes. These sons had less income and less education on average, and they were more likely to move. Alternatively, for sons of operatives, being in a manufacturing-dependent county was good, leading to higher earnings and lower geographic mobility despite having similar levels of education to sons in non-dependent counties. Industry dependency is fine for mobility as long as the industry is growing, not shrinking. Also, even if a manufacturing subindustry is shrinking, operatives' skills are more transferable to other manufacturing subindustries, while this may not be so for miners.

Table 4
Outcomes by Father Occupation and County Industry Dependence

		Average Earnings Change	Move Counties	Move States	Son Education	Son Income ($)
Miners' Sons	Dependent County	-6.8	58%	28%	4.4	973
	Non-Dependent County	-5.8	56%	27%	5.3	1,023
Operatives' Sons	Dependent County	4.5	38%	18%	5.5	1,297
	Non-Dependent County	-4.1	55%	27%	5.6	1,111
Farmers' Sons	Dependent County	22	62%	27%	4.7	548
	Non-Dependent County	27	51%	22%	5.3	715

Source: See text.
Notes: "Non-dependent" counties here include counties that are not dependent on that particular industry. They may be dependent on one of the other two industries, or they may not be dependent on any of the three.

The commitment to education also varied by industry dependence. Table 5 shows several educational characteristics for counties in 1910 based on industry dependence, including teachers per child, the percent of children in school by age group, adult literacy, and the percent of children age 15 to 17 that are in the labor force. Places that were dependent on manufacturing had more teachers per student, higher literacy, and higher attendance for 10- to 14-year-olds than other places, but had a higher proportion of children age 15 to 17 working and not attending school. Agriculturally-dependent counties were deficient on almost all of the educational characteristics. Mining-dependent counties were similar to the total overall, but the type of mining made an impact. Counties that specialized in oil extraction had higher school attendance and literacy than the average county, whereas coal-dependent counties had slightly lower attendance, lower literacy, and fewer teachers per child.

Table 5
Educational Characteristics of Counties in 1910 Based on Industry Dependence Status

	Teachers per hundred children	Average % in School Ages 10-14	Average % in School Ages 15-17	Adult Literacy Rate	Average % Working Ages 15-17
Total	2.7	87%	58%	89%	68%
Mining-Dependent	2.7	89%	56%	90%	64%
Coal	2.4	89%	54%	89%	70%
Oil	2.4	93%	62%	94%	65%
Metals	3.0	90%	59%	91%	54%
Unspecified	3.4	89%	60%	92%	58%
Manufacturing-Dependent	2.9	89%	50%	92%	68%
Agriculture-Dependent	1.7	81%	58%	82%	80%

Source: See text.

In summary, sons of miners were quite likely to become miners themselves. Miner fathers had similar incomes to operative fathers, but outcomes between operatives' sons and miners' sons were not the same. While sons of operatives enjoyed some upward mobility, sons of miners experienced downward mobility on average. There are many potential reasons

for this. Sons of miners were more likely to move than sons of similar occupations. Being in a dependent community was bad for miners and farmers, but good for manufacturing employees. Sons had different outcomes by mining subindustries. Sons of oil and metal workers had higher expected education and income than sons of coal and nonmetal miners. Whether a father's industry was growing or shrinking affected their son's economic outcomes.

Regression

To find the effects of mining on son outcomes, I ran several multi-level models using several individual and community variables. Table 6 shows these with son income and son education as outcome variables and several variables including father occupation and occupational income as explanatory variables. These regressions were run with sons of all fathers except for sons of farmers and farm laborers. Regressions with farmers and farm laborers can be found in Appendix Table A1**Appendix Table A1**.

Table 6
Fixed Effects for Multi-Level Models for Education and Income Rank for All Fathers Excluding Sons of Farmers

		Son Income Rank	Son Years of Education
	Intercept	26.6 ***	5.2***
Individual Variables	Father Literate	1.8***	0.4***
	Father Homeowner	0.6***	0.5***
	Foreign Father	-1.5***	-0.2***
	Father Occupational Income Rank	0.01***	0.01***
	Father Occupation Group: *Reference – Miner*		
	Professional	4.8***	2.8***
	Lower WC	3.7***	1.8***
	Craftsman	2.3***	0.7***
	Operative	1.8***	0.5***
	Service	2.7***	0.9***
	Laborer	-1.0***	0.1**
	Age in 1910	0.2***	-0.1***
	Moved	6.3***	0.5***
Community Variables	Mining-Dependent Community	2.2***	-0.0
	Agriculture-Dependent Community	-3.0***	-0.0
	Manufacturing-Dependent Community	4.4***	-0.0
	Teachers per 100 Children	1.3***	0.4***
	Urban Neighborhood	3.4***	0.5***
	N	1,101,544	1,291,531

Notes: Level two is the county level; ** and *** denote significant at 5% and 1% levels respectively.

There are two major sources of effect: father/son characteristics and community characteristics. Having a foreign father was negatively associated with income and education. Father's literacy had a positive effect on each outcome. All of the father occupation groups but laborer had a significant positive effect compared to miner, the reference category. Laborer fathers were negatively associated with income, but positively associated with education. Moving had a large positive effect. Age was significantly positive for income, since if a son was older when the Census was taken, he probably had more work experience and higher pay. However, it was negative for education, since the high school movement experienced significant expansion over the period.

Community characteristics also had a large effect. Being in an urban neighborhood had a positive impact. Manufacturing- and mining-dependent counties had better outcomes, but agriculturally-dependent counties had worse outcomes. The number of teachers per 100 children had a positive relationship with both income and education.

Whether a father was a miner in all the periods or just in one period did not seem to matter. Table 7 shows the primary results from a regression of son income and education on father occupational income rank and miner status. If the father was never a miner, the son had a better outcome than if the father had ever been a miner or always been a miner whenever his occupation is measured. The interaction between father's miner status and son's geographic mobility counteracts these effects: if a son of a miner moved, their expected outcome was better than sons of fathers with other occupations, but if they stayed in the county they grew up in, it was worse. Appendix Table A2 shows separate regressions of movers and non-movers which shows other differences in effects between the two groups.

Table 7
Fixed Effects for Multi-Level Models for Education and Income Rank for Geographic Mobility and Father's Miner Status Over Time, Excluding Sons of Farmers, With and Without Interaction

	Son Income Rank		Son Years of Education	
Father Occupational Income Rank	0.05***	0.05***	0.02***	0.02***
Father Miner Status: *Reference: Always A Miner*				
Never a Miner	3.5***	1.6***	1.2***	1.1***
Once a Miner	0.9*	0.2	0.3**	0.2**
Moved	9.5***	6.4***	0.8***	0.7***
Moved*Father Miner Status: *Reference: Always A Miner*				
Never a Miner	-3.2***		-0.2**	
Once a Miner	-1.3**		-0.2*	
N	1,101,544	1,101,544	1,101,544	1,101,544

Notes: Level two is the county level; all variables from Table 6 are included, and variables not in this table have a similar size, direction, and significance; *, ** and *** denote significant at 10%, 5% and 1% levels respectively.

Table 8 shows the results for only sons of miners or laborers in the mining industry. The outcomes are income and education. There are two income models: one with all sons of miners, and another for only sons of miners that did not become miners. This removes the

effect of job stickiness, so each model says something slightly different. Several of the results are similar: literate fathers had a positive impact, and foreign fathers had a negative one; age was positive as well. The type of mining a father did was important; while most types of mining did not have a significant difference, sons of oil miners and laborers had more positive outcomes than sons of other miners.

The largest predictors of son education were mining industry type, whether the son moved, and the number of teachers per child. An interesting result is that the coefficient on unionization rate is significant and positive. Unionization rates in 1921 ranged from five percent in Alabama to 100 percent in Iowa; with this disparity, the effect could be quite large, as the expected increase in education to go from one to the other would be almost a third of a year of education. Unions often bargained for local amenities beyond wages (Fishback 1992), which may have had a small effect on educational availability, but this did not translate into significant increases in son income.

Table 8
Fixed Effects for Multi-Level Models for Education and Income of All Miners' Sons and Only Miners' Sons that did not become miners

		Son Income Rank	Son Income (Not Miner)	Son Education
	Intercept	29.2***	27.6***	4.9***
Individual Variables	Urban Neighborhood	1.9***	2.0***	0.4***
	Type of Mining: *Reference – Coal*			
	Metal	-0.6	-0.8	0.0
	Non-Metal	0.5	0.3	0.2*
	Oil	5.1***	4.3***	1.4***
	Other	-1.4	-1.7	0.3*
	Father Literate	1.1***	1.3***	0.3***
	Father Miner (Reference – Laborer)	0.3	0.3	0.4**
	Foreign Father	1.6***	1.7***	-0.3***
	Age in 1940	0.2***	0.3**	-0.1***
	Moved	7.9***	8.4***	0.7***
Community Variables	Mining-Dependent Community	2.0**	1.8**	0.4***
	Teachers per 100 Children	1.7**	1.8***	0.5***
	Mining Unionization Rate	-0.0	-0.0	0.003*
	N	59,650	49,353	59,650

Notes: Level two is the county level; also includes sons of miners who were laborers in the mining industry; *, ** and *** denote significant at 10%, 5% and 1% levels respectively.

Conclusion

The results of this article show that in the early twentieth century, a father's occupation affected his son's outcomes beyond what his economic status would predict. While this article supports the assertion in Fishback (1992) that miners were comparably paid to manufacturing workers, the long-term effects of mining employment in this period were negative compared to manufacturing work. Sons of miners had lower expected incomes and lower education than sons of manufacturing workers. Partly, this is because sons of miners were likely to become miners themselves, and miners made less than operatives by 1940. Additionally, the manufacturing industry had recovered from the Great Depression by 1940 and had more jobs in 1940 than in 1910, while the mining industry had lost almost a quarter of a million jobs.

In the early twentieth century, it was good to be in the manufacturing industry, not quite so good to be in the mining industry, and bad to be in agriculture. In almost all outcome measures, farmers' sons did the worst. Comparisons between farmers and other workers are challenging since agriculture was experiencing outstanding decline.

The low mobility for miners found here may not be true for other periods; for instance, the cohort of boys born between 1880 and 1890 would have begun working when the mining industry was still growing. These children may have experienced higher upward mobility as more jobs like their fathers' were available to them. Future research should explore different cohorts to see what effects may have come from some of the challenges mining faced through time—remoteness, company power, lack of education, etc.—and which effects come from being in a declining industry. The result that sons of oil workers had better outcomes than sons of coal miners suggests that the loss of coal jobs explains a large portion of the worse outcomes.

Miners' sons that grew up in mining-dependent communities had worse outcomes than miners' sons that grew up in non-dependent communities. There are many potential reasons for this, like isolation, lack of other opportunities, and increased monopsony power. However, since the effect of dependence disappears once local education is controlled for, the result is likely due to the lack of public-school funding and attendance that often accompanies mining dependence. However, a lack of school funding can reflect the power which mining companies had on their local communities and so be a mediating variable between mining dependence, monopsony power, and son outcomes.

Being in a dependent community is not necessarily a problem; sons of operatives in manufacturing-dependent communities did better than those in non-dependent communities. The issue arises when the primary industry is in decline. Farmers' sons were also hurt by dependence, and agriculture was another industry which had large decreases in employment levels over the period. When a father worked in an occupation that was in decline and the son grew up in an industry-dependent community, one of the best indicators of success was geographic mobility. Sons had to move to find opportunities, particularly if they had invested in their own education.

Unions may have been able to bargain for higher wages and other local amenities, but these did not necessarily translate into better outcomes for miners' sons. However, a limitation of this article is that, first, the UMWA data only include coal miners, and second, these data are at the state level. With more detailed unionization rates by subindustry and county, there may be clearer results.

While contemporaneous outcomes for miners may have been quite similar to other jobs in the 1910s, the long-term outlook for miners' families was not as bright. The issues miners' families in the US are facing today ring familiar with the issues from the past. Miners are concerned that there are few opportunities available to their families in the areas in which they live, and this has caused hardship and strife. In the past, local investment in education and geographic mobility were important for economic improvement. While this was likely not the

only way to success and may not be entirely reflective of current economic conditions, the solutions of a century ago may be relevant today.

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Appendix

Appendix Table A1
Fixed Effects for Multi-Level Models for Education and Income Rank for All Fathers Including Farmers

		Son Income Rank	Son Years of Education
	Intercept	22.5***	4.8***
Individual Variables	Father Literate	1.7***	0.5***
	Foreign Father	-1.8***	-0.3***
	Father Occupational Income Rank	0.1***	0.01***
	Father Occupation Group: *Reference – Miner*		
	Professional	2.2***	2.7***
	Lower WC	1.8***	1.8***
	Craftsman	1.6***	0.7***
	Operative	0.9***	0.4***
	Service	2.2***	0.8***
	Farmer	-4.0***	0.7***
	Laborer	0.0	0.1***
	Farm Laborer	-2.4***	0.1***
	Age in 1910	0.1***	-0.1***
	Moved	11.4***	0.6***
Community Variables	Mining-Dependent Community	2.8***	-0.0
	Agriculture-Dependent Community	-2.9***	-0.1*
	Manufacturing-Dependent Community	5.7***	-0.0
	Teachers per 100 Children	0.7***	0.4***
	Urban Neighborhood	3.3***	0.4***
	N	2,263,752	2,226,833

Notes: Level two is the county level; * and *** denote significant at 10% and 1% levels respectively.

Appendix Table A2
Fixed Effects for Multi-Level Models for Education and Income Rank for All Fathers Excluding Farmers, Movers vs Non-Movers

		Son Income Rank: Movers	Son Income Rank: Non-Movers
	Intercept	35.6***	21.4***
Individual Variables	Father Literate	1.8***	1.7***
	Foreign Father	-1.3***	-1.8***
	Father Occupational Income Rank	0.05***	0.04***
	Father Occupation Group: *Reference – Miner*		
	Professional	4.2***	-1.6***
	Lower WC	2.5***	0.0
	Craftsman	1.2***	1.3***
	Operative	0.5**	0.7*
	Service	1.6***	1.5***
	Laborer	-1.4***	0.1
	Age in 1910	0.2***	0.2***
Community Variables	Mining-Dependent Community	1.4***	3.4***
	Agriculture-Dependent Community	-2.6***	-5.5***
	Manufacturing-Dependent Community	2.9***	8.8***
	Teachers per 100 Children	1.0***	1.0***
	Urban Neighborhood	2.8***	4.6***
	N	613,979	487,565

Notes: Level two is the county level; *, ** and *** denote significant at 10%, 5% and 1% levels respectively.