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Can the IRA and CHIPS Act Reduce Labor Earnings Inequality? Lessons from the US Shale Boom

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We study how the US shale boom decreased labor earnings inequality by increasing demand for low-skill labor in small labor markets. The similarities in the concentrated geographic distribution of investments and the labor needed to build capacity between the US shale boom and the manufacturing construction influx that has followed the passage of the IRA and CHIPS and Science Acts raise the possibility that these bills could also impact labor earnings inequality in a similar way.

In August 2022, President Biden signed into US law two acts that could have major implications for American manufacturing: the Inflation Reduction Act (IRA) and the CHIPS (Creating Helpful Incentives to Produce Semiconductors) and Science Act. The IRA allocates a significant sum of money to investments in manufacturing, particularly in the clean energy sector. The IRA created or supplemented more than 20 tax incentive programs aimed at boosting manufacturing and clean-energy production.[1] The CHIPS and Science Act makes substantial investments in semiconductor research and manufacturing that amount to nearly $53 billion, including $39 billion toward manufacturing incentives, and a 25 percent tax credit for capital investments in semiconductor manufacturing. As of August 2023, the Department of Commerce reported that it had received more than 460 statements of interest from companies for projects in the semiconductor industry.[2]

Estimates suggest that the manufacturing incentives from these two acts have already spurred large investments in private-sector manufacturing across the country. A number of large projects were announced between the introduction of the bills in Congress and the signing of the bills. In August 2023, the White House reported that, in the one year since CHIPS was signed into law, companies had announced more than $166 billion in manufacturing in semiconductors and electronics investments.[3] Alternatively, the Financial Times estimated that, in this same time span, at least $224 billion in cleantech and semiconductor projects had been announced and were expected to create 100,000 jobs.[4] According to a more recent estimate by Jack Conness, as of March 2024, at least 182 projects linked to the IRA and the CHIPS and Science Act had been announced. His estimates indicate that these projects amount to more than $263 billion of investment, 113,400 new jobs directly created,

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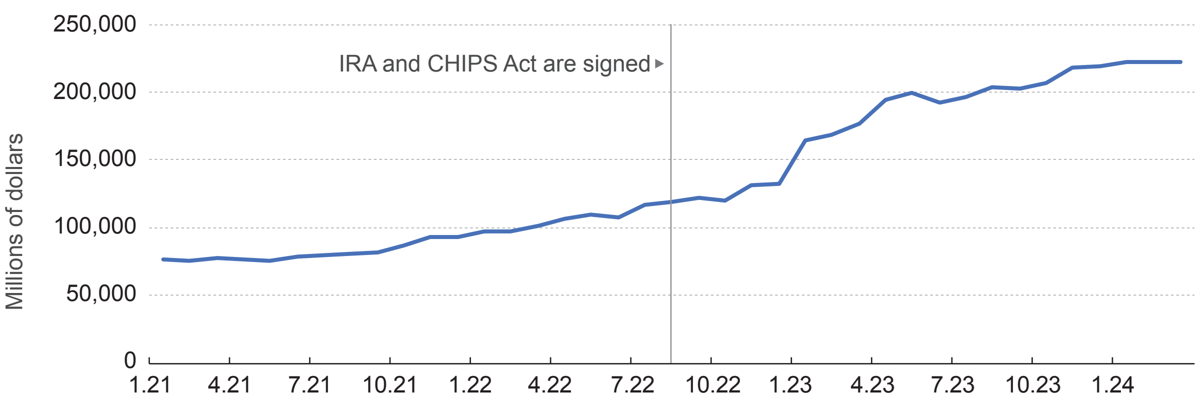
and hundreds of thousands of jobs indirectly created.[5] There are indications that the acts are already affecting the aggregate data. As shown in Figure 1 (a), total construction spending in manufacturing increased by more than 85 percent from August 2022 to March 2024, from $119.3 billion to $222.6 billion. Furthermore, construction spending in manufacturing had already been on the rise, increasing by nearly 50 percent from August 2021 to August 2022, potentially in anticipation of these two policies. Most of the increase in manufacturing spending has been driven by the computer, electronic, and electrical sub industry, which were directly targeted by these two policies. This is shown in Figure 1 (b). In the year leading up to the passage of the IRA and CHIPS Act, this subsector experienced a 311 percent growth in construction spending; since the acts were approved, the construction spending in this subsector has grown by an additional 190 percent. It now represents 58 percent of total manufacturing spending, up from 27 percent at the beginning of 2022.

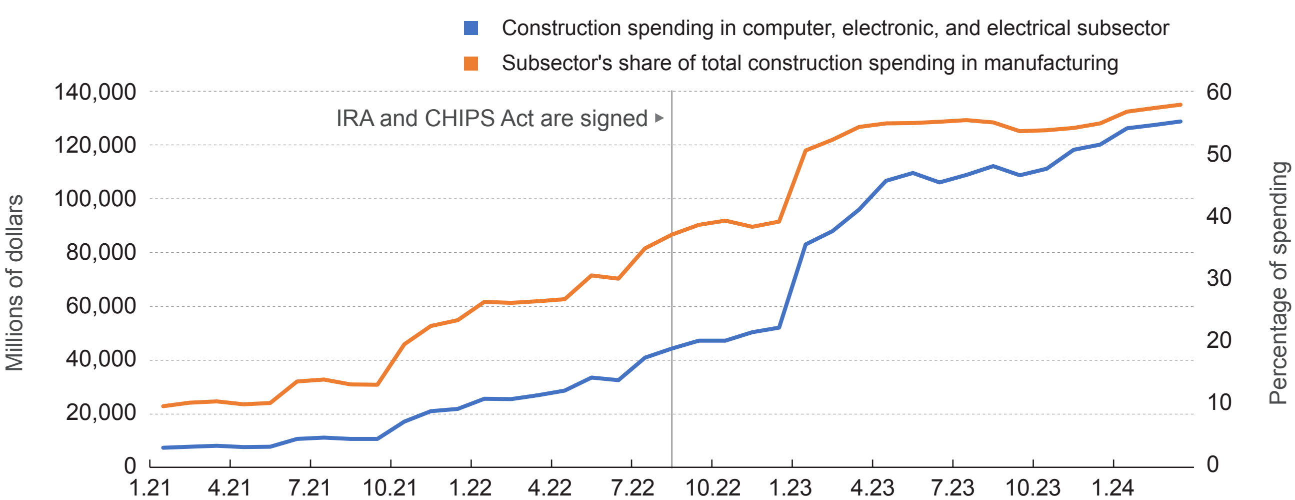
The announced projects span most US states; however, they aren't evenly distributed across states, with 68 percent of investment dollars concentrated in just five: Arizona, New York, North Carolina, Georgia, and Idaho.[6] The reasons for this concentration might include the existence of similar industry in the area and the fact that several single location projects are large enough to represent a meaningful amount of the total announced investments related to these acts. Further, many of the announced projects are located in relatively small labor markets. For example, a new Toyota battery manufacturing plant has been planned in Liberty, North Carolina, and is projected to create 5,000 jobs in a county with a labor force of 62,203.[7] A new manufacturing facility for the automotive parts company Hwashin is set to be built in Laurens County, Georgia, and is expected to create over 460 direct jobs and hundreds of additional indirect jobs in a county with a labor force of roughly 20,000.[8] Plans for a new computer chip-manufacturing facility in Coffey, Kansas, were announced by EMP Shield. The

Figure 1

Panel A: Construction Spending in Manufacturing



Panel B: Construction Spending in Computer, Electronic, and Electrical Subsector



Source: Construction Spending, US Census Bureau

Note: Panel A shows the total spending on construction in the manufacturing sector in millions of dollars. Panel B shows in blue the spending on construction in the computer, electronic, and electrical subindustry. The series in orange shows the share of construction spending in manufacturing that is from the computer, electronic, and electrical subindustry.

labor force of the county is just north of 4,000, and the plant is projected to create more than 1,200 jobs.[9] Another example of a large investment in a small labor market is Hyundai Motor Group's EV and battery facility opening in Bryan County, Georgia, which has a labor force of 19,275. This investment is projected to create an estimated 8,500 direct jobs and thousands of indirect jobs.[10] There are many other examples of project announcements for facilities to be built in small labor markets, and most of them are related to electric vehicles, batteries, clean energy production, and semiconductors.

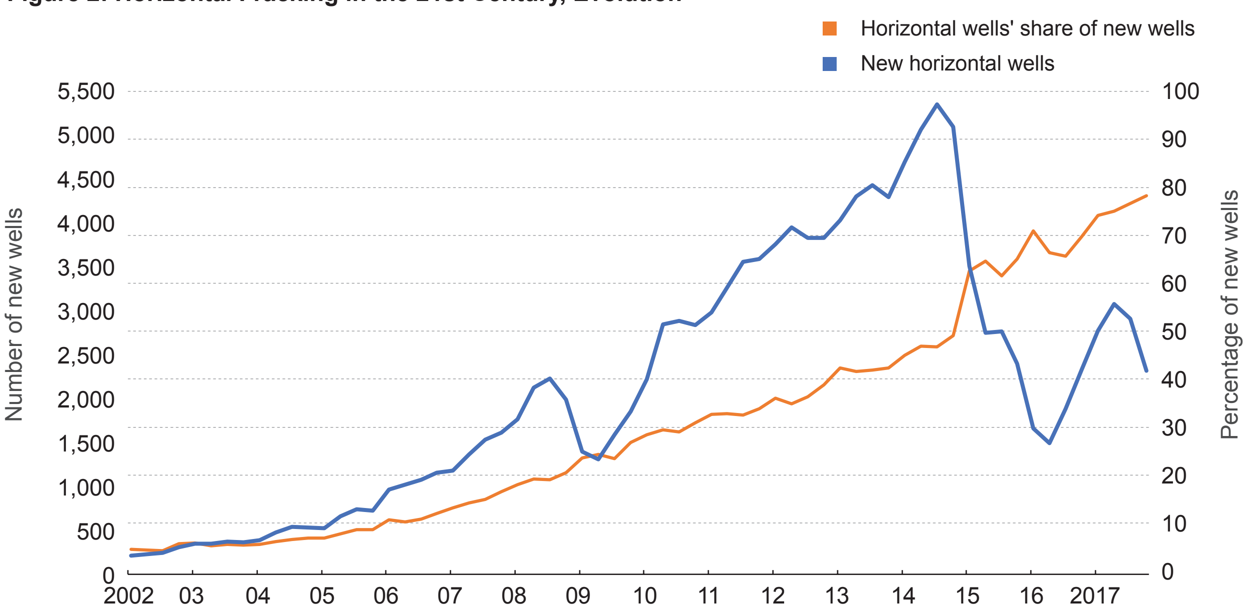
Large shocks to local labor markets—such as a sharp increase in labor demand in particular sectors within a region—could have substantial effects on local aggregate employment and earnings, but they could also have strong distributional consequences. While these projects should increase employment in local manufacturing and supporting activities in the long run, in the short run, their effects on employment should be seen in the industries that are setting up this new capacity. These industries—construction, manufacturing, and transportation and warehousing—have a high proportion of workers without a college education, with the ratio of non-college-educated to college-educated employment at 4.1:1 (construction), 3.4:1 (manufacturing), and 4.0:1 (transportation and warehousing).[11] The expected increased demand for non-college-educated labor in these small markets could reduce the earnings gap between non-college-educated and college-educated workers, as was the case for many counties exposed to the US shale boom of the 2000s and 2010s.

The US Shale Boom

Starting in the mid-2000s, the combination of hydraulic fracking and horizontal drilling along with the high cost of natural gas and the deregulation of the oil and gas sectors made the extraction of fossil fuels trapped in shale formations both technologically feasible and economically viable. The response to these advances was a rapid expansion of horizontal fracking, as shown in Figure 2. Before 2003, horizontal fracking did not play a major role in the extraction sector. At that point, less than 5 percent of newly spudded wells (that is, wells that had begun drilling operations) were horizontal. Over the next decade, however, horizontal wells would become the predominant well type. Between 2003 and 2014, the number of new horizontal wells spudded per quarter rose tenfold, from less than 500 per quarter in 2003 to more than 5,000 per quarter in 2014, and horizontal wells made up nearly 50 percent of all newly spudded wells. By the end of 2017, this share had increased to 80 percent.

The presence of existing shale plays determined whether horizontal wells built using hydraulic fracturing technology could be spudded in a specific area. Thus, the impact of this new technology was limited to the geographic regions located on shale plays. Figure 3 shows the localized nature of the shale boom. Panel (a) shows the existing shale plays in the United States as of 2016:Q2; the uneven spatial distribution of shale plays made the relevance of horizontal fracking highly heterogeneous across space. By the end of 2017, only 19.1 percent of all US counties had spudded any horizontal wells, as shown in Panel (b). Furthermore, many of the counties impacted

Figure 2: Horizontal Fracking in the 21st Century, Evolution

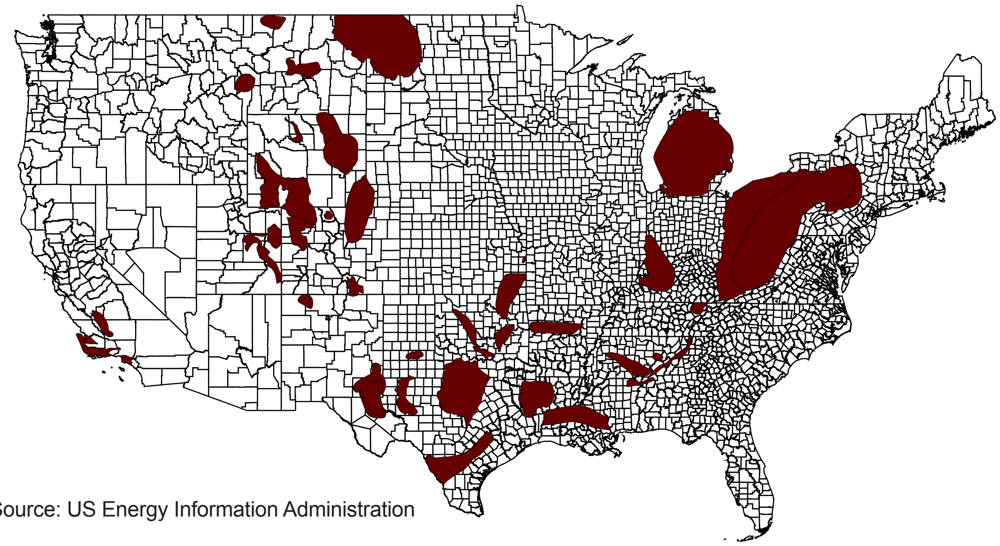


Source: Drillinginfo

Note: Figure 2 shows in blue the total number of new horizontal wells spudded in each quarter. The series in orange shows the share of new wells spudded by quarter that are horizontal.

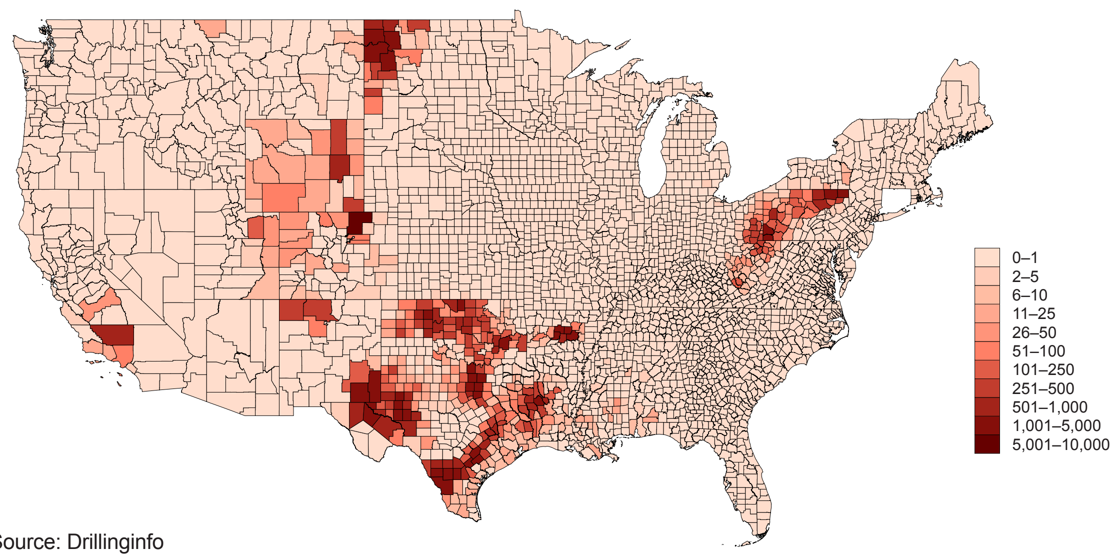
Figure 3

A: US Shale Plays, 2016:Q2



Source: US Energy Information Administration

B: Cumulative Horizontal Wells, 2017:Q4



Source: Drillinginfo

Note: Panel A shows the location of tight oil and shale gas plays in the continental United States in 2016. Panel B shows the total number of horizontal wells spudded by county as of the end of the last quarter of 2017.

by horizontal fracking are part of small labor markets, whose employment and population are small relative to the magnitude of the shock brought about by the increased labor demand of the shale boom.

The previous data indicate that the US shale boom and the IRA and CHIPS Act share three important commonalities. First, both shocks require significant investment in new capacity. Second, the impact of these shocks is highly heterogeneous from region to region of the United States. While some areas will be highly impacted, others might not see its effects. Third, a significant part of the areas directly impacted by these shocks have small labor markets in which these types of shocks represent a large change in economic activity. Thus, looking back at the effects of horizontal fracking could be informative regarding the potential effects of the IRA and CHIPS Act investments on the impacted local labor markets.

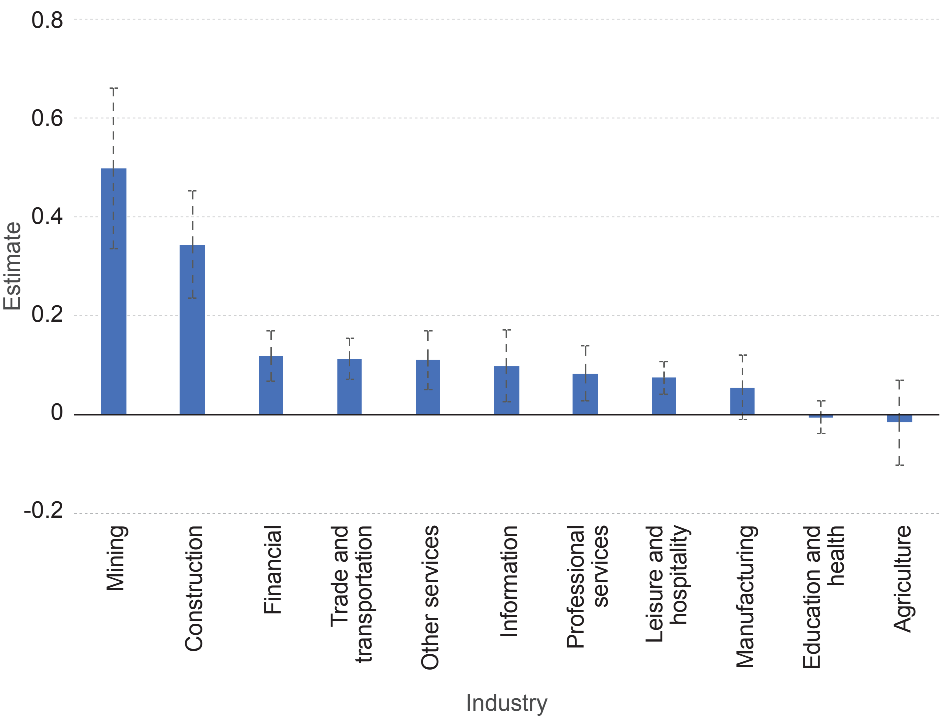
Estimating the causal effects of fracking on the local labor market is not as simple as comparing the outcomes of fracked versus nonfracked areas. Fracked and nonfracked areas differ importantly in many dimensions such as size, urbanization, industry composition, and prefracking labor market evolution. Moreover, even comparisons within areas with available fracking resources could lead to misleading conclusions. The existence and extent of fracking in these areas is not only a function of these resources but also of the decisions made in terms of extracting them. Counties with available natural resources may increase, decrease, or cease horizontal fracking based on economic conditions, a situation that creates an omitted variable-bias problem. Similarly, the decision to allow for fracking in a county could be affected by the availability of different types of labor, a circumstance which would generate a reverse causality problem.

To avoid these issues, we estimate the effects of fracking on the local labor market using an instrumental variable approach. The details of this approach are covered in Hernandez Martinez (2024). Our approach uses areas' geological conditions and the evolution of fracking at the national level in rural versus urban areas to generate exogenous variation in the extent of fracking across counties. Doing so allows us to estimate the causal effects of fracking on employment and earnings in the local labor market. We use employment and average labor earnings data from the quarterly workforce indicators (QWI) and focus on the years 2003 through 2017 and counties with a population of 2,000 or more individuals.

The advent of horizontal fracking had significant effects on aggregate labor market outcomes. As shown in Hernandez Martinez (2024), doubling the number of horizontal wells (the average growth rate over the typical four-year span in fracking counties) increased total employment and earnings by roughly 11.4 percent and 4.4 percent, respectively, and population by 1.7 percent. It also increased the employment-to-population ratio by 2.3 percentage points and reduced the local unemployment rate by 0.5 percentage points. These results are consistent with the findings of previous literature, such as Bartik et al. (2019) and Feyrer et al. (2017). However, the aggregate local labor market effects don't capture the full scope of the impacts of the employment shocks on these communities.

Figure 4 show the effects of fracking on different industries' employment growth. Building and operating the new horizontal wells created jobs in many industries, but the largest gains were in the mining, construction, financial (via real estate), and trade and transportation industries, all of which largely employ non-college-educated labor. Doubling the number of horizontal wells increased employment by an estimated 50 percent in mining, 34 percent in construction, 11 percent in real estate, and 11 percent in trade and transportation. While we do not expect the IRA and CHIPS and Science Act to increase mining employment, both the shale boom and these two policies induced a need to build capacity: wells during the shale boom, manufacturing plants and facilities following the IRA and CHIPS and Science Act. During the shale boom, building and operating these wells had significant impacts on employment in the construction, real estate, and trade and transportation industries. It is possible that in certain local labor markets, these industries have already been impacted in a similar way by the expansion of manufacturing capacity following the IRA and CHIPS Act.

Figure 4: The Impact of Fracking on Different Industries' Employment



Source: QWI and Drillinginfo

Note: Dashed bars represent 95 percent confidence intervals calculated using clustered standard errors at the county level.

Table 1: The Impact of Fracking on Relative Employment

	Growth in non-college-educated employment (%)	Growth in college-educated employment (%)	Growth in relative non-college-educated employment (%)
Growth in total horizontal wells (%)	0.112*** (0.019)	0.086*** (0.018)	0.025*** (0.008)
County FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
On Shale LT	Yes	Yes	Yes
N	170,541	170,541	170,541
KP F-Stat	103.19	103.19	103.19
Counties	3,005	3,005	3,005

Sources: QWI and Drillinginfo

Notes: Table 1 shows the effects of fracking on the outcomes displayed at the top of the columns. The outcomes (in logs) are the change in non-college-educated employment, the change in college-educated employment, and the change in relative non-college-to-college-educated employment, respectively. "On Shale LT": Linear trends for counties on/off shale. "KP F-Stat": F-statistic of the first stage IV regression. "Counties": Number of unique counties included in the estimation. Standard errors clustered at the county level in parentheses. ***p0.01, **p<0.05, *p<0.1.

Table 2: The Impact of Fracking on Relative Earnings

	Growth in non-college-educated labor earnings (%)	Growth in college-educated labor earnings (%)	Growth in college-educated- to non-college-educated labor earnings gap (%)
Growth in total horizontal wells (%)	0.059*** (0.010)	0.038*** (0.011)	-0.021*** (0.008)
County FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
On Shale LT	Yes	Yes	Yes
N	170,541	170,541	170,541
KP F-Stat	103.19	103.19	103.19
Counties	3,005	3,005	3,005

Sources: QWI and Drillinginfo

Notes: Table 2 shows the effects of fracking on the outcomes displayed at the top of the columns. The outcomes (in logs) are the change in non-college-educated average labor earnings, the change in college-educated average labor earnings, and the change in relative college-to-non-college-educated average labor earnings, respectively. "On Shale LT": Linear trends for counties on/off shale. "KP F-Stat": F-statistic of the first stage IV regression. "Counties": Number of unique counties included in the estimation. Standard errors clustered at the county level in parentheses. ***p0.01, **p<0.05, *p<0.1.

The increased labor demand in these sectors because of the shale boom increased the relative demand for non-college-educated labor in these local labor markets. As shown in Table 1, non-college-educated workers' employment increased more than college-educated workers' employment. Specifically, doubling the number of horizontal wells increased non-college-educated employment by 11.2 percent and college- educated employment by 8.6 percent. As a result, fracking increased relative non-college-educated employment in the local labor markets. Over an average four-year period, relative non-college-educated employment increased by a statistically significant 2.5 percent as a direct result of fracking.

These relative effects in labor demand translated into effects on relative earnings. Table 2 shows that both non-college- and college-educated labor earnings increased in response to fracking. However, the labor earnings of non-college-educated workers rose more than those of college-educated workers. Over the typical four-year period, fracking increased non-college-educated labor earnings by 5.9 percent and college-educated labor earnings by 3.8 percent. This differential growth rate of earnings decreased the inequality of labor earnings across groups. Fracking reduced the earnings gap between college- and non-college-educated labor earnings by a statistically significant 2.1 percent over the average four-year period.

The shale boom and the IRA and CHIPS Act are potentially similar on multiple fronts: the concentrated geographic distribution of investments, that these investments are often located in small labor markets, and the short-run spike in demand for non-college-educated labor to build capacity. The impacts of the shale boom on employment, earnings, and labor-earnings inequality between non-college- and college-educated workers in affected counties were substantial, and the investments spurred on by the IRA and CHIPS Act have the potential to induce comparable impacts in the areas where these manufacturing plants are being built. It is still early to assess the effects of the IRA and CHIPS Act, but looking back to similar labor market shocks in the past can be helpful to try to understand how these acts could affect impacted communities.

Endnotes

1. US Department of the Treasury, "Inflation Reduction Act," 2024.
2. The White House, "FACT SHEET: One Year after the CHIPS and Science Act, Biden-Harris Administration Marks Historic Progress in Bringing Semiconductor Supply Chains Home, Supporting Innovation, and Protecting National Security," 2023.
3. The White House, "FACT SHEET: One Year after the CHIPS and Science Act, Biden-Harris Administration Marks Historic Progress in Bringing Semiconductor Supply Chains Home, Supporting Innovation, and Protecting National Security," 2023.
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5. Data as of March 2024. See Conness, "Inflation Reduction Act (IRA) and CHIPS and Science Act (CHIPS) Manufacturing Investment Announcements," 2024.
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8. Georgia Department of Economic Development, "Auto Parts Supplier Hwashin to Bring 460 Jobs to Middle Georgia," 2023; Bureau of Labor Statistics Local Area Unemployment Statistics, January 2021.
9. Brooks, "$1.9 Billion Computer Chip Manufacturing Facility Announced in Burlington," 2023; Bureau of Labor Statistics Local Area Unemployment Statistics, January 2021.
10. *Bryan County News*, "Hyundai, LG Announce to Invest Another $2 Billion, 400 Jobs in Bryan County," 2023; Bureau of Labor Statistics Local Area Unemployment Statistics, January 2021.
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