# Local Energy Access and Industry Location: Evidence from World War II 'Emergency Pipelines'*

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**Abstract**

Does improving local energy access affect the location of energy intensive manufacturing and associated job creation? We exploit a natural experiment: the US government's rapid construction of pipelines during 1942-1944 to transport oil and gas as quickly as possible from the Southwest to the Northeast, to serve industrial users and refiners/exporters in terminus locations. Postwar, the pipelines were converted to also supply en route customers, creating quasi-random variation in local access to natural gas near pipeline routes. We study the impact of improved gas access on county-level employment in manufacturing industries with high direct consumption of gas as well as high electricity use from new gas-fired power plants using newly-digitized data on pipeline routes, industry energy intensity, and natural gas utility supply relationships. We isolate plausibly exogenous increases in local gas supply from the wartime pipelines by instrumenting for a county's proximity to the pipelines with their proximity to a hypothetical optimal pipeline route that would have been constructed to minimize construction costs. We find immediate increases in energy-intensive employment in counties with greater gas access that persist until the 1970s for gas-intensive employment and until 1997 for electricity-intensive employment, with substantial attenuation during the 1970s energy crisis. These findings have relevance for debates over path dependence in local economic development due to energy resources as well as modern place-based and industrial policies intended to smooth a transition away from fossil fuels.

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# 1 Introduction

Across distinct waves of industrialization and transitions from one major energy source to another, an abundant body of literature has found that direct access to energy reserves is an important determinant of local economic development.[1] However, we know less about how increasing local energy access via transportation infrastructure affects regional economic activity. Understanding that connection is especially valuable today, as the world considers deploying new technology to transport energy over ever longer distances. Historical evidence can help us understand how expanded transportation of energy supplies may affect the spatial organization of production.

In this paper, we study whether the construction of natural gas pipelines by the U.S. government during World War II affected the location of domestic manufacturing activity in the short, medium, and long run. After the outbreak of the war, the United States sped the building of two emergency pipelines (hereafter, the WW2 pipelines), designed for the sole purpose of transporting energy supplies from large oil and gas fields in Louisiana, Oklahoma, and Texas to wartime refineries and manufacturers clustered near Northeastern terminus locations. These efforts, which created the longest and highest-capacity oil and gas pipelines in the world at the time, curtailed the need to transport oil by sea, which had left U.S. supplies exposed to attacks by German U-boats, and provided Northern Appalachian wartime manufacturers with a substitute for depleted local gas supplies. The WW2 pipelines were part of a dramatic expansion of U.S. infrastructure projects to meet wartime needs (Rockoff, 2016). Although new pipelines from the Southwest to the Northeast had been discussed before the war, construction was beset by significant economic, legal, and technological challenges. War-time realities both relaxed regulatory constraints (e.g., eminent domain laws) and made large-scale financing available. After the war, the pipelines were quickly converted to supply en-route customers, and to carry natural gas as well as oil.

The WW2 pipelines affected regional energy supplies in two ways. First, the pipelines made natural gas directly available to nearby industrial users. Some industries (e.g., primary metals, industrial chemicals, cement, glass) need much higher levels of heat in production than purchased electricity can typically provide, which requires them to burn fossil fuels within their facilities

[1] Fernihough and Hjortshøj O'Rourke (2021), for instance, find that for two centuries after 1750, European cities closer to coalfields grew substantially faster than those further away.

as part of the manufacturing process. Second, gas-fired power plants could use new supplies of natural gas to expand local electricity generation. Prior to the WW2 pipelines, power plants in the region had primarily used (more expensive) coal. The ability to purchase electricity in larger supplies and at lower prices would presumably have been especially beneficial to manufacturing industries intensive in the use of electricity in production—such as textile mills, dairy products, rubber, mineral and stone products, and grain-mills. Whereas expanded natural gas supplies would have benefited many types of users, the most energy intensive manufacturing industries potentially stood to benefit the most.

Using data on employment and other outcomes in U.S. counties from 1940 to 1997, we examine whether after World War II locations closer to WW2 pipeline access points became more specialized in energy intensive manufacturing industries, relative to more distant locations.[2] Our county-level treatment is based on being closer to the WW2 pipeline routes and having a gas utility in 1941. Communities that already had a gas utility before the pipelines were constructed were more likely to see improvements in local gas access because the last-mile distribution infrastructure was already in place. To address the potential endogeneity of pipeline routes, we instrument for a county's proximity to the pipelines using a hypothetical least cost path/minimum spanning tree pipeline route, which closely overlap with the actual pipeline routes.[3]

Our analysis begins with the immediate impacts of access to the WW2 pipelines on regional industry specialization and then examines evidence for impacts at progressively longer time horizons. On the one hand, ongoing processes of industrial innovation—such as the conversion of steel production from highly energy intensive blast furnaces to more energy efficient mini mills—may have caused the impacts of regional energy supply shocks to attenuate over time. Indeed, other analyses have found little impact of resource supplies on long-run local economic growth or even negative impacts akin to a resource curse (Clay and Portnykh, 2018; Matheis, 2016; Papyrakis and Gerlagh, 2007; Klein and Crafts, 2012). On the other hand, impacts may have been longer lived if local economic development is subject to path dependence. The historical literature has

[2]We analyze impacts of the WW2 pipelines on employment outside of the three main natural gas-producing states during the mid-20th century, Texas, Louisiana, and Oklahoma. Although certain northeastern and Midwestern states (West Virginia, Ohio, and Pennsylvania) produced natural gas in the late 1960s/early 1970s, production levels were just 5 to 10 percent of that in the main southern gas-producing states (EIA, 2024). See Figure 3a.

[3]Historical evidence indicates that pipelines were routed in a technocratic process that sought to build on the fastest possible means of transporting oil and gas from the Southwest to Northeast consumers while minimizing use of construction inputs severely limited during wartime (such as steel, equipment, and skilled labour). See Scott (2023) for analysis that uses an electrical generating plant's preexisting proximity to the natural gas pipeline network as a source of exogenous variation for plants converting from coal to gas.

found evidence suggestive of path dependence in industrial activity related to regional oil reserves (Michaels, 2011), coal reserves (Glaeser et al., 2015; Fernihough and Hjortshøj O'Rourke, 2021), and hydroelectric power potential (Severnini, 2023; Fiszbein et al., 2022).[4]

To preview our findings, we detect near-term increases in energy-intensive employment in counties with greater gas access that persist until the 1970s for gas-intensive industries and until 1997 for electricity-intensive industries. For counties that had a gas utility pre-war, being one standard deviation closer to the pipelines (71 miles) led to a 1.9 percentage point increase in the share of county employment in gas intensive industries by 1950 that peaks at an 8.9 percentage point increase in 1968 (relative to 1940 levels). A similar increase in county energy access led to a 1.5 percentage point increase in the share of employment in electricity-intensive manufacturing industries by 1950 and an 8.0 percentage point increase by 1968. We also find an initial decrease in the share of county employment in agriculture in counties with greater gas access, suggesting that pipeline construction may have accelerated a structural transformation out of farming.

Why did the impact of gas access attenuate more quickly for gas-intensive than for electricity-intensive industries? During the 1970s energy crisis, price regulation led to much larger profit opportunities for gas producers supplying (unregulated) intrastate markets (i.e., mostly within TX, OK, LA) than in the interstate market where gas prices were set by the federal government (Blanchard, 2021). Contemporary analyses predicted that areas dependent on inter-state gas supplied via the WW2 pipelines would suffer worse gas shortages (FEA, 1975). In line with these accounts, we find that the effect of pipeline gas access on gas-intensive employment becomes statistically indistinguishable from zero in the mid-1970s. By contrast, there continues to be higher electricity-intensive employment in pipeline-treated counties until the late 1990s, although it does decrease in magnitude during the 1970s. This is consistent with electricity-intensive industries being better able to access energy during a shock to oil and gas due to electrical generators being able to substitute to alternative fuels (e.g., coal).

**Contribution to literature.** We contribute to a large literature on how policies and programs associated with the 1930s New Deal and the mobilization for World War II affected regional economic development. Kline and Moretti (2014) find that the Tennessee Valley Authority led to persistent gains in manufacturing employment that continued to intensify well after federal transfers

[4]Other related literature studies path dependence related to river transport (Bleakley and Lin, 2012), the Tennessee Valley Authority (Kline and Moretti, 2014), and World War II public investments in manufacturing (Bianchi and Giorcelli, 2023; Garin and Rothbaum, 2022; Jaworski, 2017).

had lapsed, consistent with the presence of agglomeration economies in manufacturing. Jaworski (2017) finds that despite a boom in manufacturing activity during the war, there is little evidence for differential postwar growth due to capital deepening in counties that received more investment. Garin and Rothbaum (2022), by contrast, find that World War II emergency production activities had enduring local effects on industry location. In data for Italy, Bianchi and Giorcelli (2023) find that provinces that received greater Marshall Plan reconstruction grants experienced more extensive industrialization. While the macroeconomics of the U.S. energy transition during World War II have been studied closely (Johnstone and McLeish, 2020; Rhodes, 2018), there has been little research on the regional economic impacts of wartime pipelines.[5]

Our work aligns with existing studies of how energy supplies affect local economic development. For data on U.S. counties, Michaels (2011) finds a long-run positive impact of oil abundance on mining and manufacturing employment, population growth, and per capita income. Severnini (2023) finds that U.S. dams constructed before 1950 spurred short-run local population growth, in large part thanks to a cheap-local-power advantage, which persisted for five decades. Fiszbein et al. (2022) similarly exploit geographic variation in proximity to early hydroelectric power plants, and also leverage cross-industry variation in pre-electricity energy intensity. They find large and rapid productivity gains for manufacturers in cities that adopted hydroelectricity. In data for Switzerland, Brey (2021) exploits exogenous spatial variation in hydroelectic power potential, finding that early adoption of electricity was conducive to local economic development in the short-run and in the long-run, with persistent outcomes due to increased human capital accumulation and innovation. More recently, Kahn and Mansur (2013) find that between 1998 and 2009 energy-intensive industries were concentrated in low electricity price US counties.[6]

Other studies show evidence for little impact of energy access on long-run development, or even negative impacts. Klein and Crafts (2012) find little evidence that coal prices mattered for the location of fuel-intensive industries in the United States between 1880 and 1920. Wolf (2007) similarly finds no evidence that mineral endowments explained the location of fuel-intensive industries in Poland during the 1920s and 1930s. Crafts and Wolf (2014) find that coal prices did not matter for the location of cotton mills across the U.K. in 1838, but did affect the size

[5] Much of the existing research on wartime pipeline projects focuses on advances in engineering (Casella and Wuebber, 1999; Jensen and Ellis, 1967) and their embodiment of regulatory and public-private cooperation (Castaneda, 1990; Johnson, 1967) rather than their economic impact. Barreca et al. (2014) mentions the pipelines as a main reason that natural gas displaced coal in Northeastern urban households after WW2.

[6] Our findings also have relevance for modern place-based and industrial policies intended to smooth a transition away from fossil fuels (Hanson, 2023).

of those mills. Clay and Portnykh (2018) find that over 1936-2015, states with larger coal and agricultural endowments per square mile experienced significantly slower population growth than states with smaller endowments per square mile, although resource endowments had no effect on long-run growth in per capita income. Studying a later period from 1986 to 2001, Papyrakis and Gerlagh (2007) find that natural resource abundance decreases investment, schooling, openness, and R&D expenditure and increases corruption, and show that these effects can fully explain the negative effect of natural resource abundance on growth. Other analyses even find 'reversals of fortune' where areas that previously benefited economically from energy access experienced relative declines as energy and industry evolved. Matheis (2016) finds that coal production increases had positive net impacts on non-urban county-level population and manufacturing over an initial ten-year span, but this effect becomes negative over later decades. While Glaeser et al. (2015) find in their first stage results that cities closer to coal deposits in 1900 had larger average manufacturing establishments in 1963, these deposits are associated wth reduced entrepreneurship for cities in the 1970s onward, even in industries unrelated to mining. Internationally, Berbée et al. (2022) find that areas of Germany that industrialized earlier due to access to coal were more likely to experience relative economic declines between 1926 and 2019 due to deindustrialization.

In Section 2, we discuss the history of natural and manufactured gas, the WW2 emergency pipelines, and the 1970s energy crisis. In Section 3, we describe data used in this analysis, including newly-digitized data on local gas access and industry energy intensity. In Section 4, we detail our identification strategy, and in Section 5 we present our empirical results. Finally, in Section 6 we offer a concluding discussion.

# 2 Historical background: Natural gas, the WW2 emergency pipelines, and the 1970s energy crisis

## 2.1 Uneven early adoption of natural gas

Before large quantities of natural gas were first discovered in Titusville, Pennsylvania in 1859, manufactured 'coal gas' had been used in the United States from the early 19th century for lighting, and later for heating and cooking as well (Castaneda, 2001). Manufactured gas was produced from heating coal in the absence of oxygen and adding oil, an inefficient and highly-pollutive process resulting in a substantially worse product than natural gas in terms of thermal efficiency, safety and cost. However, for most of the late 19th and early 20th centuries natural gas was mostly viewed as a nuisance to be vented or flared from oil wells that was worthless without any means of transporting it to customers.[7]

The first natural gas pipelines appeared in the 1880s, connecting gas deposits within Pittsburgh to users elsewhere in the city. In 1891, a 120 mile line connected gas fields in central Indiana to Chicago (Hopkins, 2007; Blanchard, 2021). The benefits of natural gas—when supply was available—were already clear. Large iron and steel works in Pittsburgh took advantage of its high and stable temperature. Local residents and commercial establishments used natural gas for heating purposes, with the New York Times proclaiming in 1884 that natural gas would reduce Pittsburgh's coal smoke pollution.(Castaneda, 2001) In Indiana, local government officials offered free natural gas to manufacturers relocating to the state, enabling it do rapidly develop within a decade into the second-largest glass-manufacturing state, an industry highly reliant on heat-intensive production (Blanchard, 2021). However, because rapidly-diminishing local gas supplies could not meet growing demand, these early natural gas industries collapsed within two decades. Both Pittsburgh and Indiana shifted back towards burning coal (Blanchard, 2021).

Natural gas still had fundamental advantages, if it could be supplied to a location. It burned more efficiently and had twice the heating content of manufactured gas (Castaneda and Pratt, 1989). Other than glass production, this high and constant heat was particularly important for steel, rubber, chemicals, carbon-black, and brick manufacturing (Tussing and Tippee, 1995; Castaneda, 1990). For residential use, natural gas heating meant gas utilities did not need to establish heavily-polluting gasification plants ('gasworks') in costly locations within cities, nor require often-expensive coal inputs (Castaneda and Pratt, 1989).

As gas fields in the South and West began production in the early 1900s nearby cities therefore took advantage of their proximity, including Los Angeles and the Kansas/Oklahoma border region (Tussing and Tippee, 1995). Kansas leveraged this new gas supply to become the largest producer of zinc (Blanchard, 2021). While local supplies in the Southwest initially starting running out as they had in Appalachia, vast new deposits such as the combined Panhandle/Hugoton Field were soon discovered, guaranteeing plentiful supply for decades (Castaneda, 2001).

[7] Natural gas also made oil exploration more dangerous given the possibility of unstable and highly-flammable gas accompanying oil deposits. Blanchard (2021) reports that in the early days of petroleum drilling "the first prayer of the roughneck was to find oil. His second prayer was not to find natural gas."

In the 1920s, innovations in pipeline construction such as stronger steel pipes and new welding methods (acetylene and electric arc) (Jensen and Ellis, 1967) enabled this Southwestern natural gas to start being moved to larger markets north and eastwards. This lead to the first wave of long-distance pipeline construction typified by the 'grand dames' built in 1928-31 to connect the Southwest to the Midwest and Southeast (Castaneda, 2001). However these new lines did not extend Northeast any further than Indiana or Michigan, leaving the Appalachian industrial heartland unconnected to gas supplies (Blanchard, 2021). This first wave of pipeline construction ended with the onset of the Great Depression, as gas demand fell, leading to excess capacity in existing pipelines and dwindling pipeline investment (Blanchard, 2021). Manufacturing gas and other coal-based fuels therefore remained the primary source of heat and non-hydropower electricity in Appalachia and the Northeast.

## 2.2 WW2 emergency pipelines

The two major WW2 pipelines were the longest, most technically-advanced, and highest capacity ever constructed.[8] Although both pipelines were constructed during the war as straw lines, with the singular aim of rapid end-to-end transmission and used post-war for natural gas, the rationales for their construction differed slightly. (Jensen and Ellis, 1967)

The largest and most publicized pipeline was in fact two 'Inch lines': the 24 inch diameter and 1,341 mile-long 'Big Inch' line and the 20 inch diameter and 1,475 mile 'Little Inch' line that were twinned along most of their route (Jensen and Ellis, 1967). These pipelines were built to carry oil and refined products (respectively) to the Northeast for shipping to Europe during the war, and converted post-war to transport gas. At the onset of the war, 95 percent of oil delivered to the US eastern seaboard was shipped by sea, with only 50,000 out of a total 1.4 million barrels per day shipped via pipeline and one-tenth of that by shipped by rail (Jensen and Ellis, 1967; Blanchard, 2021). By 1941 severe oil shortages emerged in the main Northeast domestic markets—first as the US loaned oil tankers to the UK, then substantially worsened after the US entered WW2 and German U-boats began sinking hundreds of oil tankers along the East Coast in Operation Drumbeat. (Blanchard, 2021) Gulf Coast oil shipments soon fell to 100,000 barrels per day, with rail shipments struggling to make up even 10 percent of the shortfall (Blanchard, 2021).

By late 1941 Harold Ickes, Secretary of the Interior and head of the Petroleum Administration

[8] Note two other, shorter/lower capacity pipelines were built during WW2, the Plantation and Southeastern lines, but are excluded from our analysis since they were only ever used for refined products (Johnson, 1967).

for War, had begun advocating for a cross-country oil pipeline to address the supply shortages (Casella and Wuebber, 1999). Other advisors soon agreed, with one noting that “No one ever sank a pipeline” (Blanchard, 2021). In March 1942 pipeline industry executives and engineers met in Tulsa, Oklahoma over three days to devise a plan for re-organizing and expanding the US pipeline network to move oil from the Southwest to the Northeast as quickly as possible (Johnson, 1967). The pipeline was soon approved and by June 1942 construction supplies, under severe wartime limits, were allocated to the project (Blanchard, 2021).

The pipeline route changed repeatedly during the planning process based on design feasibility reconsiderations (Johnson, 1967). Wartime shortages of construction equipment and materials—particularly steel—and skilled workers meant the pipelines had to follow the most direct route possible (Blanchard, 2021). The final routes had the Big Inch pipeline start in Longview, Texas and run northeast through Arkansas and Missouri to a rail depot in Norris City, Illinois, where oil would be loaded onto rail tankers to enable delivery to the East Coast during construction of the second leg of the pipeline eastward through Indiana, Ohio, Pennsylvania, and New Jersey (Casella and Wuebber, 1999; Blanchard, 2021) (see Figure 1). The Little Inch line would start further south in Baytown, Texas and cross northern Louisiana before joining with the Big Inch near Little Rock, Arkansas. Construction began in the summer of 1942 and finished on the Big Inch the following July, with the Little Inch being completed in December 1943 (Casella and Wuebber, 1999).

The second WW2 pipeline we study is the ‘Tennessee gas line’, so named for its owner-operator the Tennessee Gas and Transmission Company. This was a 24 inch diameter and 1,265 miles long (Raley, 2008) Unlike the Inch Lines, this pipeline transported natural gas from its start. It was constructed in 1943 and 1944 with the goal of supplying Northern Appalachian war industry manufacturers with an alternative source of gas given declining local supplies (Raley, 2008). Appalachian gas production had peaked in 1917, despite clear unmet local demand as prices doubled over the following five years (Tussing and Tippee, 1995). Appalachia had remained a "gas island, unconnected to the great fields in Texas, Oklahoma, and Louisiana" after the 1920s pipeline boom (Blanchard, 2021). Appalachian gas supplies continued to decline through the early 1940s and a massive drilling program proved insufficient, just as factories critical to the war effort (for example producers of steel, aluminum, and chemicals) needed to expand production (Blanchard, 2021). By August 1943, a year after the Inch Lines were approved, the Tennessee Gas pipeline was given permission to procure construction materials. Aerial surveys of possible pipeline routes and preliminary engineering designs had already begun in May 1941 (Castaneda, 1993). The final route was based in part on a right of way originally purchased for another line that was caught in legal entanglements (Raley, 2008) but with significant amendments in November 1942 to better serve wartime industries (Blanchard, 2021). Upon opening in 1944, the pipeline ran from gas fields in Texas northeast through Louisiana, Mississippi, Tennessee, and Kentucky until its terminus in Cornwall, West Virginia.

Despite the wartime prerogative, both pipelines faced substantial opposition from landowners along the routes, coal interests (for whom gas seemed an existential threat) and railroads (for whom coal and oil transport was a lucrative business)(Blanchard, 2021).[9] The latter was particularly difficult opposition given their large property holdings. Government backing and the use of eminent domain was therefore essential to the construction of both pipelines (Raley, 2008; Castaneda, 1990). Government financing also played a key role, both for the directly government owned and operated Inch Lines as well as the privately-owned Tennessee Gas line that relied on Reconstruction Finance Corporation loans (Blanchard, 2021).

Following World War Two, there was vast potential demand for natural gas in the Northeast, if supply could be found. Parsons (1950) reports that at least 80 gas utilities then distributing manufactured gas in the Mid-Atlantic and New England stated a willingness to take as much natural gas as was available, as soon as possible.

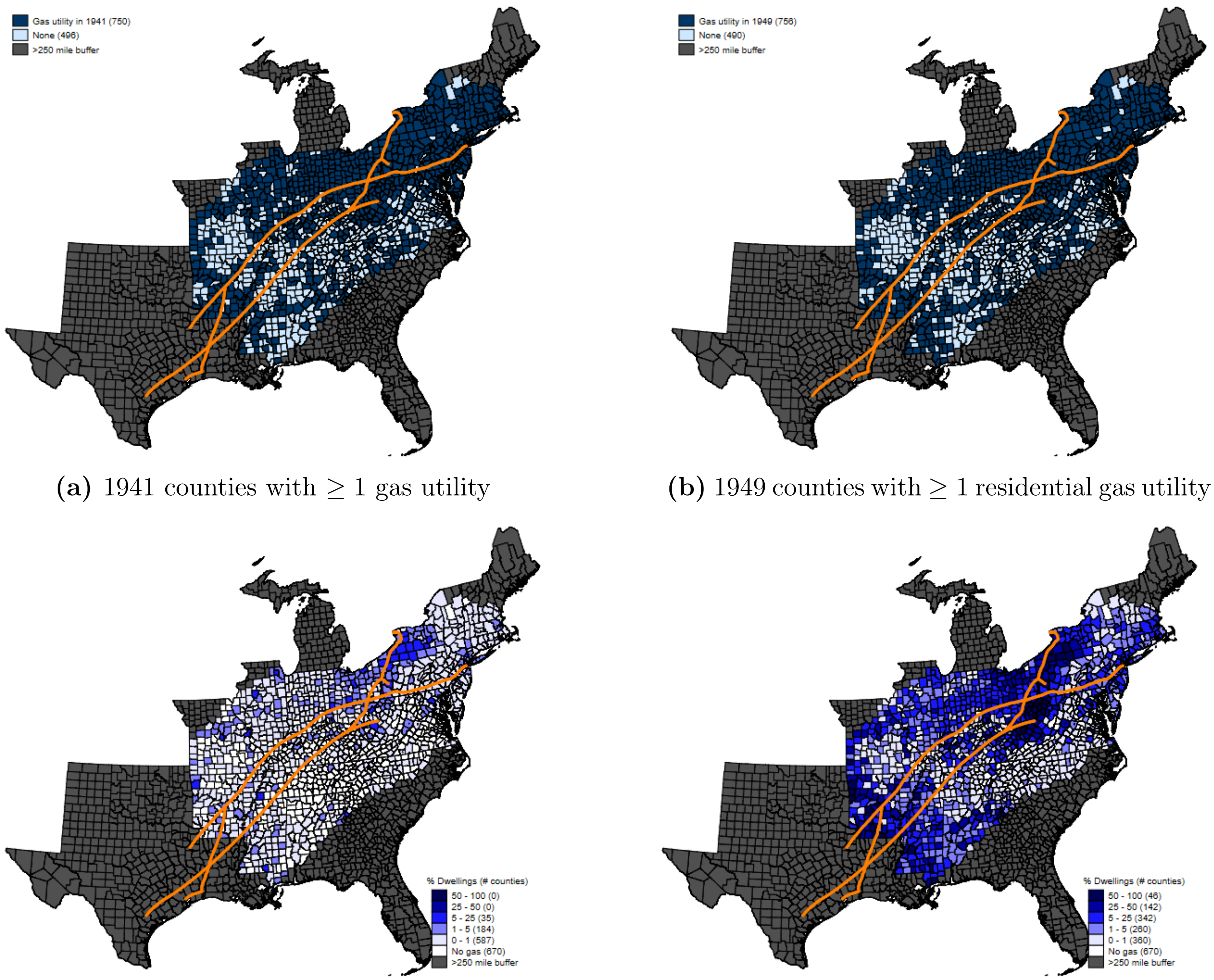
The WW2 pipelines enabled the Southwest's vast natural gas supplies to flow to large Northeastern markets previously reliant on manufactured gas.[10] Following WW2, the Inch Lines underwent a dramatic process of "disposal" where they were auctioned to a private owner, the Texas Eastern Corporation (TETCO), and eventually converted to natural gas. (Castaneda and Pratt, 1989)[11] The Big Inch drew on natural gas produced in Texas and Louisiana (particularly the Carthage gas field around their border) while the Little Inch drew from coastal areas (Parsons, 1950). Both pipelines were repeatedly 'looped' with additional pipes and run at higher pressures to increase their carrying capacity (Casella and Wuebber, 1999; Parsons, 1950). In 1949 the Tennesee Gas line was also extended northwards from Kentucky to Buffalo NY (Parsons, 1950).

[9]For example, another wartime (refined products) pipeline, the Plantation Pipeline from Louisiana to North Carolina, had been planned before WW2 but could not be completed due to railroads refusing to grant right of ways, fearing competition to their petroleum shipping business (Johnson, 1967).

[10]Note that liquefied natural gas technology developed much later and did not become common until 1970s, when LNG imports peaked at seven hundred million cubic feet per day (Barreca et al., 2014; Blanchard, 2021).

[11]Although in 1957 the Little Inch was converted back to petroleum over part of its route (Jensen and Ellis, 1967). See Johnson (1967) for an extensive account of this privatization.

**Figure 1:** Growth of utility gas, 1940-1950




**(a)** 1941 counties with $\geq 1$ gas utility

**(b)** 1949 counties with $\geq 1$ residential gas utility

**(c)** 1940 % homes use gas for central heating

**(d)** 1950 % homes use utility gas for heating

*Notes:* These maps show the post-WW2 pipeline routes in orange and county-level changes in utility gas availability on two extensive-margin measures. Panels (a) and (b) are shaded for a county-level indicator of presence of a local gas utility (1941 indicated by whether any communities in county were served by a gas utility in FPC (1942); 1949 indicated by whether county had any residential gas utility customers in AGA (1950). Panels (c) and (d) are shaded by the share of occupied dwellings in each county that report primarily using utility gas for heating in the Censuses of Housing (1940 proxied by use of gas for central heating; 1950 directly reports use of utility gas for heating).

Conversion from manufactured to natural gas was not only profitable for pipeline companies but also very popular in the northeast as natural gas offered a safer, cheaper means of heating homes and supplying energy to industry. In 1947 natural gas from Texas cost less than a third as much in New York City as the alternative gas manufactured from coal (and was much more efficient) (Constant, 1989). Similar price dynamics drove the post-war replacement of manufactured coal gas elsewhere in the northeast and convinced state officials in Pennsylvania that manufacturers would be interested in locating in areas with natural gas access (Castaneda, 1990).

By 1950 the two pipelines combined to provide over 10 percent of total US gas demand (Blanchard, 2021). Some gas-producing regions were less enthusiastic about these flows, with one official predicting that the "syphoning" of natural gas from the Southwest to Northeast would "remove the main basis for the hopes for industrial decentralization" (Parsons, 1950) given their use of low-priced natural gas to incentivize industry location (FPC, 1948).

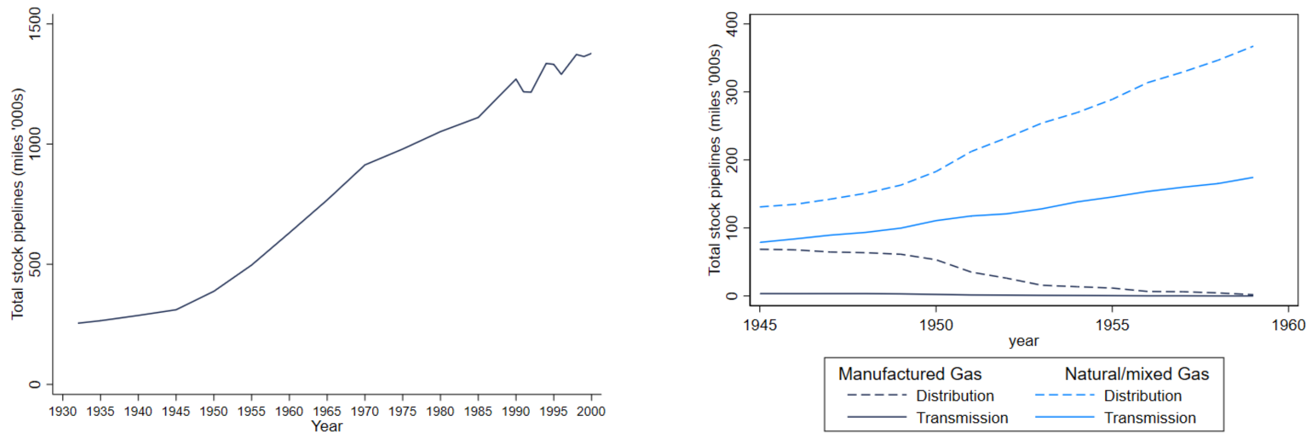
Nonetheless, profit opportunities using the newly-available pipelines made the gas flows difficult to combat, enabling natural gas to be the fastest growing domestic energy source from the late 1940s through the 1960s (Castaneda, 1993). By 1949, even after field prices had quadrupled over the preceding 8 years, burning natural gas produced heat at 1/6th the cost as from oil and 1/25th the cost from coal (Parsons, 1950) The main cost associated with consuming natural gas was from its transportation, though even after taking transport costs into account natural gas was still 1/4th the price of manufactured gas per unit of heat provided (Parsons, 1950). Utilities could relatively easily transition from coal to natural gas, through an 'enrichment' process of mixing it into its distribution system, though some opted to immediately transition solely to natural gas, which required some appliance conversions (Castaneda and Pratt, 1989). This led to widespread growth across all uses, where increases in industrial use of gas slightly outpaced residential use from 1939 to 1950 and through to 1970.[12] New technological possibilities also enabled increased natural gas-fired electrical generation post-war (Miser, 2015). From 1949 to 1955, 17 percent of electricity generated in the US was from natural gas.[13]

By 1957, natural gas provided 23.1 percent of the nation's energy, versus 12.6 percent in 1945, and over 1 million miles of natural gas distribution pipelines had been installed, compared to 25,000 miles the previous decade (Carpenter, 2021). Figure 2 shows the increase in total pipelines installed driven by the increase in pipeline mileage dedicated to transporting natural gas (alongside a decrease in manufactured gas pipelines). However, constraints on steel production, exacerbated by the Korean War demands, continued to limit construction of some larger transmission lines and resulted in oil pipeline construction receiving priority over gas pipelines (Carpenter, 2021; Parsons, 1950).

[12]Based on either total number of customers or total energy use. Author calculations from Table S 190-204 in Bureau (1975).

[13]In terms of KwH. Author calculations of data from U.S. Energy Information Administration Annual Energy Review (AER) 2012, accessed at `https://www.eia.gov/totalenergy/data/annual/showtext.php?t=ptb0802a`.

**Figure 2:** Growth in US pipelines due to natural gas




**(a)** Total installed pipeline mileage

**(b)** Total mileage by gas and pipe type

*Notes:* Panel (a) displays the total mileage (in thousands) of all pipelines installed in the US. Panel (b) compares the total mileage (in thousands) of pipelines by the type of gas pipe is dedicated for use of and the type of pipeline (excluding liquid petroleum gas and field/gathering pipelines). Data from AGA (1961) and BTS (2021).

## 2.3 Later developments and the 1970s energy crisis

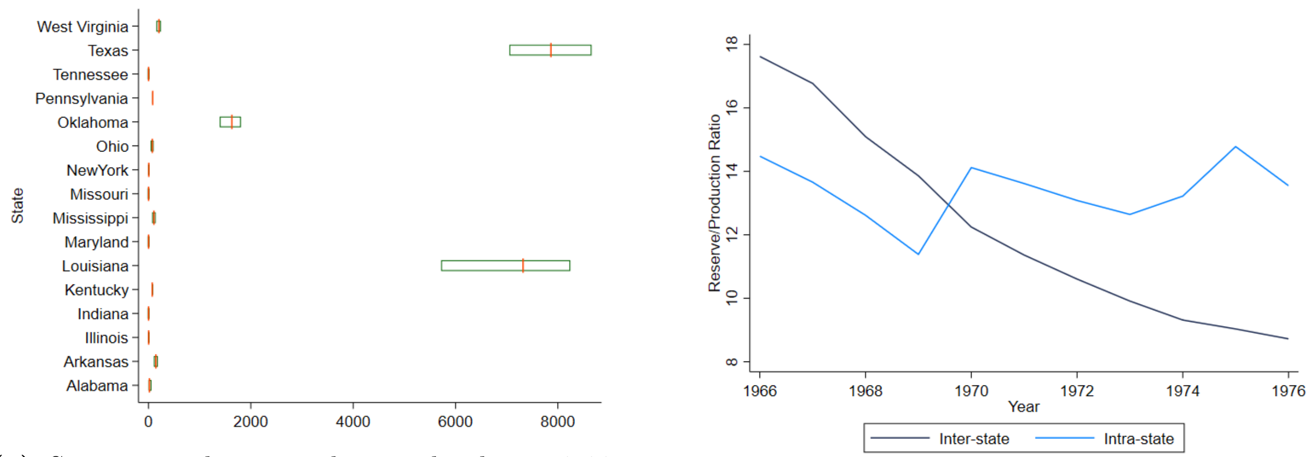
By the mid-1960s, much of the US consumed gas drawing from Southwestern supplies that were showing the first signs of being constrained. Large gas reserves that had been built over the preceding decades were drawn down over the 1950s and 1960s and began dropping more quickly than oil reserves in 1968 (Blanchard, 2021). Figure 3a shows both the relative size of Southwestern production over minimal levels elsewhere in the Eastern half of the US as well as decreasing availability of Southwestern natural gas on interstate markets in the late 1960s and 1970s. The relative decline of interstate vs. intrastate gas supplies was due mainly to Federal Power Commission (FPC) regulation over interstate gas prices only, which both made intrastate sales relatively more profitable and eliminated any price signal that would cause gas extractors to increase production and cause consumers to use less gas (Blanchard, 2021). This pricing system reflected federal regulators' beliefs that interstate supply relationships were much less competitive due to long-distance transmission pipelines being tied to specific interstate firms as well as that natural gas was discovered only as an "adjunct" to oil exploration, so low prices would not act as a signal to decrease gas supplies via reduced exploration (Lifset, 2014).

Intrastate prices began exceeding FPC-regulated interstate prices after 1970, with even earlier price differences for gas from certain major plays like the Permian Basin, but the FPC did not keep up with regulated price hikes (Blanchard, 2021). The resultant decrease in gas supplied to interstate markets began being felt by Northeastern consumers in 1971 as the FPC was forced to develop criteria for rationing natural gas (Lifset, 2014). Beginning in 1972, interstate pipelines began a first round of large-scale gas supply curtailments (i.e. not delivering contracted amounts to customers) and in January 1973 the FPC began rationing gas by priority-of-service category, with industrial customers having lowest priority after residences and businesses (Blanchard, 2021). There was therefore already a serious crisis in the natural gas sector ten to 24 months before the Organization of the Petroleum Exporting Countries (OPEC) banned exports to the US and drastically reduced global oil supplies in October 1973 (Lifset, 2014). The ensuing embargo exacerbated the growing gas shortage as factories switched boiler fuels from petroleum to natural gas (Castaneda, 2001).

The energy crisis continued for several years, severely worsening during winters. During the winter of 1976-1977 the gas shortage resulted in 1.2 million workers becoming unemployed due to gas curtailments; factories, schools and hospitals forced to shut down for extended periods; and industries such as metals, glass, textiles, chemicals and food processing being denied gas deliveries (Cramer, 1983). These negative economic effects were localized as certain counties were typically served by a single transmission pipeline. For example, a 1975 report to the White House from the Federal Energy Administration predicted localized factory output reductions and shutdowns in areas of Northeastern and Midwestern states based on their pipeline-specific gas supplies and industrial composition (FEA, 1975).[14] On the other hand, areas of the US with access to gas experienced growth as a result. The Gulf Coast, for example, had begun developing energy-intensive petrochemicals industries even by 1950 thanks to low-cost natural gas (Parsons, 1950), but during the 1970s energy crisis the Southwest became a "manufacturing powerhouse, in both petrochemicals and other energy-intense industries." (Blanchard, 2021)

[14] This was in part because although in the 1970s there were ‘emergency interconnections’ between gas pipelines, the US pipeline system was not an interconnected grid between different transmission companies’ pipelines (Cramer, 1983) because New Deal-era federal natural gas regulation had not deemed gas transmission companies as common carriers (Blanchard, 2021). Only in the mid-1980s did the FERC transform interstate pipelines into "virtual common carriers" allowing utilities and end-users to purchase gas directly from producers (Castaneda, 2001).

**Figure 3:** Relative decline of interstate gas supply during 1970s




**(a)** State annual gas production levels, 1967-77 (minimum, mean, and maximum billion feet$^3$)

**(b)** Intrastate vs. interstate gas availability

*Notes:* Panel (a) displays the mean (orange line), minimum, and maximum (green boxes) annual level of marketable gas production in each state between 1967 and 1977 in billion cubic feet. Panel (b) compares the reserves-to-production ratios (estimates remaining years of consumption available) for gas dedicated to intra-state vs. inter-state pipelines. A declining ratio means that natural gas was being extracted faster than new gas was being discovered. Figures reproduced from Blanchard (2021).

# 3 Data and measurement

## 3.1 Employment by industry

Our main outcome of interest is the share of total county employment in each of a mutually exclusive and comprehensive set of economic sectors including the most energy-intensive industries. These sectors are defined below based on employment in industry codes as listed in the 1950 census (the 'IND1950' variable available from IPUMS (Ruggles et al., 2022)). For 1940 and 1950 we tabulate counts of employment by industry (for those age 16 and above) from the full-count Censuses of Population available from IPUMS (Ruggles et al., 2022). We also tabulate total county population for these years and from the full-count 1930 census. For later-years employment, we use data from the County Business Patterns (CBP) for 1964 to 1997 from Eckert et al. (2020, 2022).[15][16] Some county-level employment in the historical CBP is available only at a two-digit SIC sector level. We remove these 'residual' employment counts from the denominator when calculating the share of

[15] Prior to 1964, CBP data for many counties are grouped together into totals for up to ten counties.

[16] We crosswalk SIC industry codes in the CBP to IND1950 using concordances available from Eckert et al. (2020), Eckert et al. (2022), and Autor et al. (2019).

county manufacturing employment in energy-intensive manufacturing industries, but retain them in the denominator when calculating the share of county employment in non-manufacturing sectors, all other manufacturing industries than those in the top quartile or top decile according to each energy-intensity measure; agriculture; and services and all other sectors. This allows us to explore the impact across all groups of employment in a county.[17]

Our analysis focuses on 1,246 counties in the eastern half of the US with county centroids that are located within 250 miles of any point on the pipeline routes, as defined by their 1940 boundaries. Data from most of sources was available only with counties as defined by their boundaries in other years. County-level data from other years was crosswalked to 1940 boundaries using crosswalk weights from Ferrara et al. (2022).[18] We combine independent cities in Virginia into their neighbouring counties, to align with county definitions in AGA (1950, 1953).

## 3.2 Energy-intensive industries

Our primary focus is on changes in energy-intensive employment. For each of our three energy types we define energy-intensive sectors as subsets of IND1950 manufacturing industries that fall in the top decile (above or equal to the 90th percentile industry energy-intensity value) or top quartile (between the 75th and 90th percentiles) of energy intensity, as well as a sector of all other manufacturing industries (which has a shifting composition by energy type based on the industries included in the top quartile). We calculate energy intensity using newly-digitized data on national-level industry energy consumption, value-added, and employment from historical tables of fuel consumption and general industry statistics in the 1939, 1947, and 1971 in Censuses of Manufactures (Census Bureau, 1942, 1950, 1976).[19] Pre-war employment by sector in 1940 is defined based on industry energy intensity as of 1939 while post-war employment by sector

[17]Note that the County Business Patterns data used in the long-term analysis, for outcomes from 1964 on, only collects employment information of "all private, nonfarm employer establishments in the United States" (Eckert et al., 2020) and therefore compared to the Census includes a substantially smaller subset of agricultural employment (only Agricultural Services, Forestry and Fisheries) and no public-sector employment.

[18]Specifically, we use county crosswalk weights from model "M2: a population-based model, with county area divided into urban and rural areas, based on historical population estimates from Fang and Jawitz (2018)."

[19]For 1971, we used values for value added and employment from Becker et al. (2021).

(from 1950 onward) is defined based on industry energy intensity as of 1947.[20] We focus on 51 manufacturing industries as defined in the (Ruggles et al., 2022) IND1950 classification from the 1950 Census. We crosswalk industry energy intensity values from SIC vintages used in the Censuses of Manufactures with concordances included in Eckert et al. (2020), Autor et al. (2019), and Fiszbein et al. (2022) as well as a hand-coded crosswalk from the SIC1945 codes used in the 1947 Census of Manufactures to IND1950 (available upon request.) Following Fiszbein et al. (2022), we combine certain industries, resulting in 51 industries total.[21]

We define industry energy intensity based on consumption of three types of fuel:[22]

- all gas consumed (in million cubic feet, i.e. million feet$^3$) per million dollars of value-added, including manufactured, natural and 'mixed' gas.[23]
- only natural and 'mixed' gas consumed (in million feet$^3$) per million dollars of value-added
- spending on purchased electricity as a share of value-added

Looking at all gas-intensity as well as specifically natural and mixed gas-intensity allows us to include industries that converted from manufactured to natural gas post-war.

Table 1 lists all 22 industries that are in the top quartile of at least one energy-intensity measure in 1939 or 1947 (listed in order of all gas-intensity in 1947). Lists of the industry composition of these top quartile or top decile sectors are provided in Appendix Section A.1. Only four industries are in the top quartile of every measure in each year: Blast furnaces, steel works, and rolling mills (industry code 336); Primary nonferrous industries (338); Pulp, paper, and paperboard mills (456);

[20] Appendix Section A.6 presents results where post-war sector employment shares are defined based on 1971 industry energy intensity. However, to the extent that the set of energy-intensive industries changes between 1947 and 1971 (more true for the top quartile than the top decile, for both electricity and all gas-intensity) the analysis using sector employment based on 1971 industry energy intensity for employment in 1964 onwards explores a slightly different question–the persistent location of whatever industries are energy-intensive at a given time–rather than the persistent location of industries that were energy-intensive *when the energy shock occurred* (in this case, early and plentiful gas access from the WW2 pipelines).

[21] Since the crosswalk from 1940 Census of Manufactures to IND1950 used in Fiszbein et al. (2022) combines these industries, we repeat this step for all years in order to have a consistent number of industries. The following IND1950 industry codes are combined: 408, 416, 417, 419, 426 into a single 'Other foods' category; 466 and 467 into 'Synthetic fibers, drugs, and medicines'; and 318 and 319 into 'Structural clay, pottery, and related products'. We also exclude logging from manufacturing since it does not have energy consumption data available in the 1939 and 1947 Censuses of Manufacturing.

[22] Note that we focus solely on consumption of gases for fuel rather than as raw material inputs, as recorded in the Censuses of Manufactures.

[23] 'Mixed gas' represents any mixtures of natural and manufactured gas, all volumes of gas reported by establishments that purchase both types, some gas for which the type was not reported (Census Bureau, 1942).

and Cement, concrete, gypsum and plaster products (317). Only the latter industry is in the top decile of every energy-intensity measure in both years.

This table shows a surge in natural gas usage following World War II in several industries. The most gas-intensive industry in 1947, Blast furnaces, steel works, and rolling mills (336), doubled the volume of all gas used per million dollars of output (in 1939 dollars) and increased the share of that gas that was natural/mixed gas by nearly six-fold. Petroleum refining (476) used a similar amount of gas as before, but now entirely natural or mixed gases. Structural clay, pottery, and related products (318; 319) had a near-constant share of natural/mixed gases but more than doubled its all gas-intensity of production. Some of the most electricity-intensive industries in 1947, such as Primary nonferrous industries (338) and Not specified metal industries (348), increased their electricity spending as a share of value-added but not quite as dramatically. Energy-intense industries as of 1971 are listed in Appendix Section A.1.3.

# Table 1. Energy-intensive industries in 1939 and 1947

| | 1939 | | | | | 1947 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | All gas (Mf$^3$/VA $M) | % Natural/ mixed gas | Electric costs % VA | Fuel + Electric costs ($M) | Emp. ('000s) | All gas (Mf$^3$/VA $M) | % Natural/ mixed gas | Electric costs % VA | Fuel + Electric costs ($M) | Emp. ('000s) |
| Blast furnaces, steel works, and rolling mills (336) | 858.9 | 9.9 | 3.2 | 317.4 | 470.9 | 1726.0 | 58.1 | 4.6 | 731.3 | 547.4 |
| Miscellaneous petroleum and coal products (477) | 387.0 | 14.3 | 2.9 | 14.1 | 36.7 | 1066.5 | 11.7 | 1.9 | 20.0 | 66.2 |
| Petroleum refining (476) | 512.1 | 43.6 | 2.0 | 70.0 | 105.2 | 524.6 | 100.0 | 1.8 | 45.7 | 145.8 |
| Cement, concrete, gypsum and plaster products (317) | 244.0 | 98.5 | 6.9 | 46.6 | 56.2 | 279.2 | 88.4 | 5.5 | 80.0 | 105.8 |
| Glass and glass products (316) | 254.6 | 96.7 | 2.3 | 26.3 | 91.5 | 272.2 | 96.0 | 2.2 | 39.1 | 138.9 |
| Structural clay, pottery, and related products (318; 319) | 86.2 | 96.3 | 2.1 | 41.0 | 175.3 | 206.6 | 97.0 | 2.3 | 39.1 | 127.3 |
| Primary nonferrous industries (338) | 115.7 | 77.9 | 4.1 | 31.8 | 102.2 | 118.6 | 91.7 | 6.2 | 71.8 | 186.7 |
| Miscellaneous chemicals and allied products (469) | 526.3 | 99.9 | 1.8 | 22.9 | 125.4 | 89.9 | 92.7 | 2.7 | 167.4 | 410.8 |
| Pulp, paper, and paperboard mills (456) | 55.4 | 99.9 | 4.2 | 77.7 | 178.6 | 88.5 | 99.9 | 3.5 | 119.5 | 198.4 |
| Not specified metal industries (348) | 18.2 | 45.8 | 2.9 | 3.8 | 20.2 | 70.2 | 73.2 | 3.7 | 6.0 | 22.1 |
| Fabricated steel products (346) | 12.5 | 76.0 | 1.7 | 84.9 | 890.6 | 57.0 | 91.9 | 2.3 | 15.6 | 49.9 |
| Meat products (406) | 41.6 | 96.2 | 1.8 | 20.9 | 203.8 | 38.1 | 96.6 | 1.5 | 25.5 | 274.4 |
| Other primary iron and steel industries (337) | 7.7 | 61.8 | 1.7 | 16.8 | 202.6 | 37.7 | 70.6 | 3.0 | 56.8 | 267.3 |
| Miscellaneous nonmetallic mineral and stone products (326) | 10.4 | 92.1 | 2.9 | 9.1 | 61.0 | 31.4 | 94.7 | 2.3 | 17.1 | 90.1 |
| Dairy products (407) | 46.4 | 90.1 | 4.0 | 16.1 | 50.4 | 22.5 | 97.6 | 2.5 | 21.9 | 92.7 |
| Grain-mill products (409) | 11.3 | 96.8 | 4.0 | 9.5 | 41.1 | 17.3 | 96.9 | 2.3 | 18.4 | 113.2 |
| Fabricated nonferrous metal products (347) | 22.0 | 68.4 | 2.5 | 15.1 | 93.8 | 14.3 | 71.5 | 1.4 | 151.0 | 1942.9 |
| Rubber products (478) | 11.7 | 78.5 | 2.5 | 17.9 | 152.9 | 11.7 | 97.4 | 2.5 | 62.4 | 518.2 |
| Miscellaneous textile mill products (446) | 0.7 | 58.9 | 3.1 | 1.3 | 12.0 | 2.7 | 66.2 | 2.0 | 6.4 | 60.0 |
| Synthetic fibers, drugs, and medicines (466; 467) | 44.9 | 75.7 | 1.9 | 66.5 | 239.1 | 2.6 | 89.0 | 0.7 | 21.3 | 153.7 |
| Yarn, thread, and fabric mills (439) | 2.8 | 96.6 | 5.0 | 51.1 | 564.1 | 2.0 | 96.1 | 2.8 | 53.1 | 606.3 |
| Photographic equipment and supplies (387) | 53.5 | 98.7 | 0.7 | 1.8 | 24.5 | 1.5 | 66.8 | 0.8 | 2.2 | 50.9 |

*Notes:* Includes all IND1950 industries included in the top quartile of any of three energy-intensity measures (all gas or natural/mixed gas Mf$^3$ per $M of value-added or electricity costs as share of value-added) in either year. Industries listed in order of all gas-intensity in 1947. 'Mixed gas' represents any mixtures of natural and manufactured gas, all volumes of gas reported by establishments that purchase both types, and includes some gas for which the type was not reported (Census Bureau, 1942). 1947 dollar values and derivative statistics converted to 1939 dollars using price indices for Industrial commodities and Fuels and related products and power from Series E 23-39 of Bureau (1975). Data from 1939 and 1947 Census of Manufactures.

### 3.3 Local access to natural gas

Our analysis posits larger increases in local access to natural gas in counties more proximate to the WW2 pipeline routes. Data on these routes was digitized from historical maps of the actual routes in Johnson (1967); Casella and Wuebber (1999); Raley (2008) and Blanchard (2021) by tracing routes while cross-checking maps in each version and validating traced routes with mid-route compressor station locations listed. Further data related to pipeline routes was used for the least cost/minimum spanning tree optimal pipeline route analysis described in Section 4.1.

We also argue that communities that had a gas utility before the war, prior to the pipeline construction, were more likely to subsequently experience an increase in local gas access because the 'last mile' distribution infrastructure was already in place. We digitize lists of all communities of at least 250 residents that were served by a gas utility in 1941, collected by a Works Progress Administration project and published in a 1942 report of the Federal Power Commission (FPC). These communities were geolocated in 1940 county boundaries using an online forward-geocoding service and matching by name to lists of places in each county from Manson et al. (2022). We also digitize tables from reports of the American Gas Association (AGA, 1950, 1953) that detail the number of residential gas customers of each local utility company in each county. This source provides an indicator of which counties had a gas utility post-war, in 1949. By providing lists of *which* local utilities were active in each county post-war, we are also able to record which counties were supplied with gas by one of the transmission companies that owned the WW2 pipelines post-war. This uses additional newly-digitized information on the utilities served by each transmission company in 1948 as reported by the FPC (FPC, 1949), supplemented with information for the following years digitized from the Tennessee Gas and Transmission Company and Texas Eastern Corporation corporate annual reports.

A final source of newly-digitized data is county-level tabulations of the number of occupied dwellings that primarily use utility gas (either natural or manufactured) for heating from the 1940 and 1950 Censuses of Housing. Since a direct measure of whether dwellings use utility gas for heating is only available in the 1950 Census of Housing (reported in AGA (1953)), for 1940 we use counts of dwellings with primarily gas-fueled central heating as a proxy. It is possible that this measure includes homes with central heating fueled by bottled gas since this fuel source is not separately reported in the 1940 Census of Housing. However, restricting the counts to dwellings with gas central heating reduces this likelihood given that gas central heating is very fuel intensive, meaning a utility would be required to deliver this large amount of gas. Of the 806 counties in our sample with $> 0$ dwellings that primarily use gas central heating, 84.1 percent had a gas utility in 1941 (and it is possible that the utility was created between 1940 and 1941). Similarly, only 16.4 percent of the counties that reported zero dwellings with gas central heating in 1940 had a gas utility in 1941.

### 3.4 Sample and variable description

Our final sample for analysis is a cross-section of 1,246 counties that are within 250 miles of the routes of the TETCO Big and Little 'Inch Lines' or the Tennessee Gas pipeline (including the latter's 1949 post-war extension from West Bend, KY to Buffalo, NY.) This area can be seen as the non-gray shaded counties in Figure 1, which shows whether counties had a gas utility in 1941 or in 1949. We include data on employment in each 'sector' subset of industries (described in Section 3.1) in each county from 1940 to 1997 as well as covariates for 1930 and 1940. Table 2 provides summary statistics on the variables used in the regressions (as well as select other variables available).

The construction of key variables is as follows:

- **Gas utility in 1941** - indicator for whether any of the communities with population above 250 in a county were served by a gas utility, according to FPC (1942).
- **% of dwellings with gas central heating, 1940** - proxy indicator for whether county has any occupied dwellings in 1940 Census that reported primarily using gas central heating and share of occupied dwellings in county (see latter in Figure 1c).
- **Gas utility in 1949** - indicator for whether a county had any residential gas utility customers in 1949, according to AGA (1950)
- **Gas utility in 1950** and **% of dwellings with utility heating, 1950** - indicator for whether county has any occupied dwellings in 1950 Census that report primarily using utility gas for *heating* and share of occupied dwellings in county. Also available for utility gas used for cooking fuel. Note this includes use of manufactured coal gas as well as natural and 'mixed' gas.

Table 2. Summary statistics

| | Mean | Std.Dev. |
|---|---|---|
| Gas utility in 1941 | 0.60 | 0.49 |
| % of dwellings with gas central heating, 1940 | 0.64 | 1.50 |
| Gas utility in 1950 | 0.92 | 0.27 |
| % of dwellings with utility gas, 1950 | 10.68 | 16.03 |
| % of residential natural gas customers supplied by WW2 pipelines, 1949 | 46.21 | 48.40 |
| Est. % of dwellings using natural gas for heating, 1949/50 | 9.52 | 16.41 |
| Est. % of dwellings with natural gas from WW2 pipelines, 1949/50 | 4.78 | 12.89 |
| ln(Distance to 50K+ pop. county) | 3.44 | 0.51 |
| ln(Distance to 100K+ pop. county) | 3.82 | 0.59 |
| ln(Distance to 250K+ pop. county) | 4.29 | 0.71 |
| ln(pop.) 1930 | 10.18 | 0.99 |
| ln(pop.) 1940 | 10.25 | 0.99 |
| ln(pop.) 1950 | 10.28 | 1.07 |
| ln(pop. density 1940) | 2.24 | 1.06 |
| Mean temp. Jan. | 3.98 | 2.21 |
| Distance from pipeline | 93.71 | 71.08 |
| Distance from MST pipeline | 94.16 | 71.46 |
| On actual pipeline route | 0.11 | 0.32 |
| On MST pipeline | 0.12 | 0.32 |
| Miles of actual pipelines/county diameter | 0.10 | 0.31 |
| Miles of MST pipelines/county diameter | 0.10 | 0.33 |
| % emp. agriculture, 1940 | 37.47 | 21.08 |
| % emp. manufacturing, 1940 | 16.58 | 11.36 |
| Observations | 1246 | |

- **Est. % dwellings using natural gas for heating, 1949/50** - Given inclusion of manufactured coal gas in 1950 Census of Housing utility gas variables, this is calculated as product of **% of dwellings with utility heating, 1950** and the share of utility gas customers in that county served by utilities that use natural or mixed gas, from AGA (1950).
- **Est. % dwellings with natural gas from WW2 pipelines, 1949/50** this variable is calculated as the product of **Est. % dwellings using natural gas for heating, 1949/50** and **% of residential natural gas customers supplied by WW2 pipelines, 1949**, where the latter is the share of all residential natural gas customers in a county that were customers of a local utility supplied by the WW2 transmission pipelines, using data from AGA (1950) and FPC (1949).
- **Distance to population center** is calculated as the straight-line distance in miles from county centroid to the nearest county with a population above a certain threshold of 50,000, 100,000, or 250,000.
- **Ln(pop.)** and **Ln(pop. density)** - Log of population (in thousands), with latter per $km^2$

- **Mean temperature in January 1939** - calculated using data from NOAA National Centers for Environmental Information
- **Distance from WW2 pipeline** - straight line distance to nearest point on any WW2 pipeline (TETCO Big and Little Inch lines, TN Gas line, or 1949 TN Gas extension) in miles based on actual route or least cost/minimum spanning tree optimal route. Note this variable is at points discussed in terms of proximity and labeled $PipelineProximity_c$, but is measured as *miles from a pipeline*, meaning a smaller value indicates greater proximity. Figure 5 illustrates the actual and least-cost optimal pipeline routes as well as the cost raster.[24]
- **% employed in agriculture or manufacturing, 1940** - share of total county employment of individuals age 16+ in sector in 1940 Census of Population

[24]For more information on least-cost analysis see Section 4.1. Alternative definitions of pipeline presence in a county (as indicator **On pipeline route** and **Miles of pipelines/county diameter** are provided in Appendix Section A.3.2

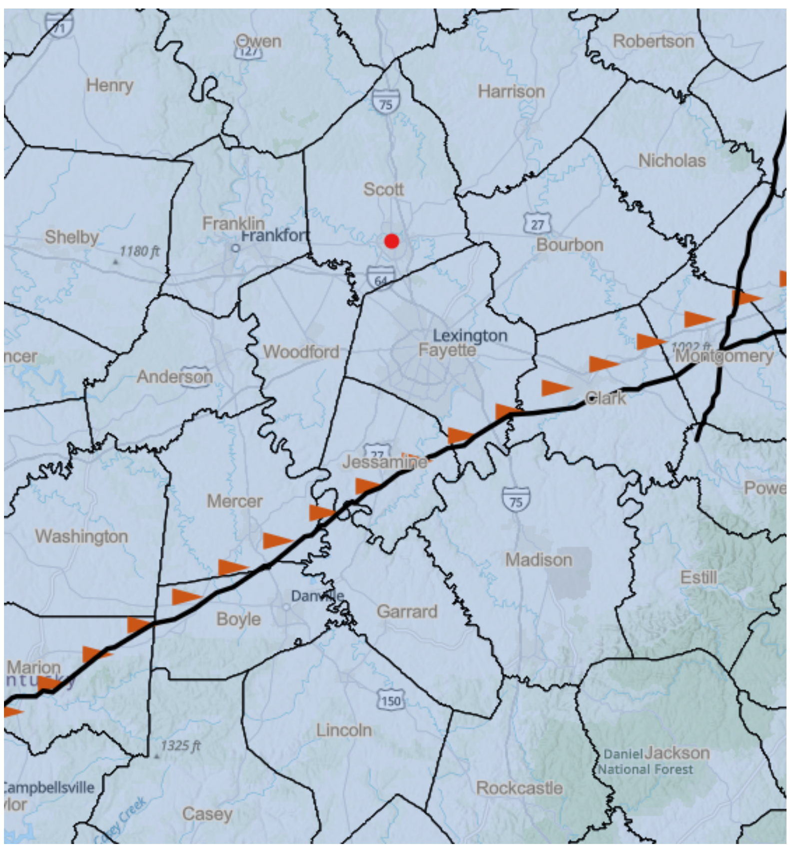
# 4 Identification strategy

We analyze changes in the industrial structure of employment, particularly in energy-intensive industries, among counties within a 250 mile band of the WW2 pipeline routes. Treatment is defined as a continuous measure based on a county's proximity to the WW2 pipeline route, under the rationale that counties closer to the pipeline are more likely to draw on the pipeline for local natural gas supplies given its early installation and high capacity. We also take into account that additional infrastructure investments must be made in a county in order for manufacturing establishments located in the county to consume gas supplied by a nearby transmission pipeline. We argue that communities that had a gas utility before the war, prior to the pipeline construction, were more likely to subsequently experience an increase in local gas access because the 'last mile' distribution infrastructure was already in place. Our county-level treatment is therefore based on counties being both closer to a pipeline route and having a utility in 1941.

It could be a strong ex ante assumption that the pipeline routes are randomly assigned. The historical evidence presented in Section 2 suggests that routes for both pipelines were planned in a technocratic process that sought to build on the fastest possible routes between given end-points while minimizing use of construction inputs severely constrained by wartime requirements (particularly steel, equipment, and skilled labour). However, it is possible that planners incorporated political considerations or potential post-war business opportunities when routing the pipelines. To address these concerns we propose an instrumental variable (IV) strategy based on a hypothetical least cost path/minimum spanning tree pipeline route. These 'optimal routes' correspond to our best estimate of the pipeline routes planners would have selected if the sole policy objective was to connect the end point (and any required midpoint) nodes in a single path (for each pipeline) subject to global construction cost minimization. In steps described below in Section 4.1, we use 'backcasted' remote sensing data on land cover from the time of the pipeline construction and elevation data to compute the least cost paths between the pipeline end/midpoint targeted nodes. This results in the least-cost pipeline routes shown in Figure 5. The distance from each county centroid to the nearest point on these optimal routes was then calculated, and these values were used as an instrument for the distance of the county centroid to the actual pipeline route. The identifying assumption is therefore that counties are near a pipeline if they happen to be near the least-cost construction path of the pipeline.

The example in Figure 4 is illustrative. Within central Kentucky, Lincoln and Scott counties are relatively similar distances from their nearest points on the Tennessee Gas pipeline (21 miles and 27 miles from their respective centroids), with close overlap between the actual and optimal pipeline routes (their respective distances to the optimal pipeline route are 19 and 28 miles). In 1940 both counties had relatively similar levels of total employment (5,473 and 4,989) and employment in top-quartile all gas-intensive industries (33 and 16). However, of the two only Scott County had a gas utility pre-war in 1941, in Georgetown (the red dot in Figure 4).

**Figure 4:** Example of identification strategy: Scott County vs. Lincoln County, KY




*Note:* Illustration of identification strategy with example of two counties in central Kentucky, Scott (at top of map) and Lincoln (bottom of map). Both are similar distances from the actual pipeline route (in orange) and the least cost/minimum spanning tree optimal route (in black), however only Scott County had a gas utility in 1941 (red dot, in Georgetown). Our model predicts a much larger increase in local natural gas supply and energy-intensive employment in Scott County than in Lincoln County. See discussion in Section 4 for details.

After the Tennessee Gas Pipeline arrived in the area in 1944, the local supply of natural gas in Scott County expanded—by 1950 23.6 percent of dwellings were primarily heated by utility gas, up from 1 percent in 1940–but barely increased in Lincoln county (1.7 percent of dwellings in 1950). We also estimate that all 23.6 percent of dwellings in Scott County with natural gas were ultimately supplied by the WW2 pipelines, based on AGA (1950) reporting that all gas customers in the county were served by a local utility (the Central Kentucky Natural Gas Company) that is a '2nd degree customer' of the Tennessee Gas Transmission Company in FPC (1949), supplied via the Equitable Gas Company. In 1950 total employment in top-quartile gas-intensive industries had fallen slightly since 1940 in Lincoln County (from 33 to 25, a -0.13 percentage point change in the share of county employment) but nearly doubled in Scott County (from 16 to 30, a 0.28 percentage point change in the share of county employment). By 1964, when we next observe county-level employment, Scott County had gained 499 jobs in Fabricated steel products (industry 346), resulting in a 17.9 percentage point change in the share of total county employment in top-quartile gas-intensive industries, while Lincoln County had no jobs in top-quartile gas-intensive employment. In 1997, there were 1,282 top-quartile gas-intensive jobs in Scott County—the vast majority in Fabricated steel products, as well as nine jobs each in Cement, concrete, gypsum and plaster products (industry 317) and Miscellaneous chemicals and allied products (industry 469)—compared to 98 jobs in this sector in Lincoln County.

## 4.1 Optimal pipeline route instrument

As discussed above, one potential concern is endogeneity in the routing of the WW2 pipelines. This section details the construction of our method of instrumenting for a county's proximity to the WW2 pipelines using its proximity to a route calculated as the optimal pipeline route in terms of minimizing construction costs (in a least-cost/minimum spanning tree analysis). Similar to Faber (2014), this exploits quasi-random variation in the location of pipelines due to construction considerations. This is particularly relevant in the context of wartime construction of these pipelines from end-to-end as rapidly as possible, as described in Section 2. Appendix Section A.3.2 provides results showing measures of the actual pipeline route in a county are strongly predicted by the least-cost optimal pipeline route instrumental variable.

The least-cost/minimum spanning tree optimal pipeline routes were calculated using ESRI's ArcGIS Pro software for a raster of the costs for a pipeline to cross each 250m x 250m pixel.[25]

The starting point is "back-casted" 1942 land use data from US Geological Survey (Sohl et al., 2016) at 250m resolution, across 14 different land use/land cover categories. Pipeline right of way width was assumed to be 50-100 feet wide based on Jensen and Ellis (1967), helping justify the choice of a 250m pixel size given construction requirements for a wider work site. The average slope gradient of each pixel was calculated, and following the pipeline engineering literature pixels with slopes greater than 30 were considered impassible (Durmaz et al., 2019).

The construction cost of a wartime pipeline crossing each 250m x 250m pixel $i$ is structured similar to highway construction cost function in Faber (2014) as:

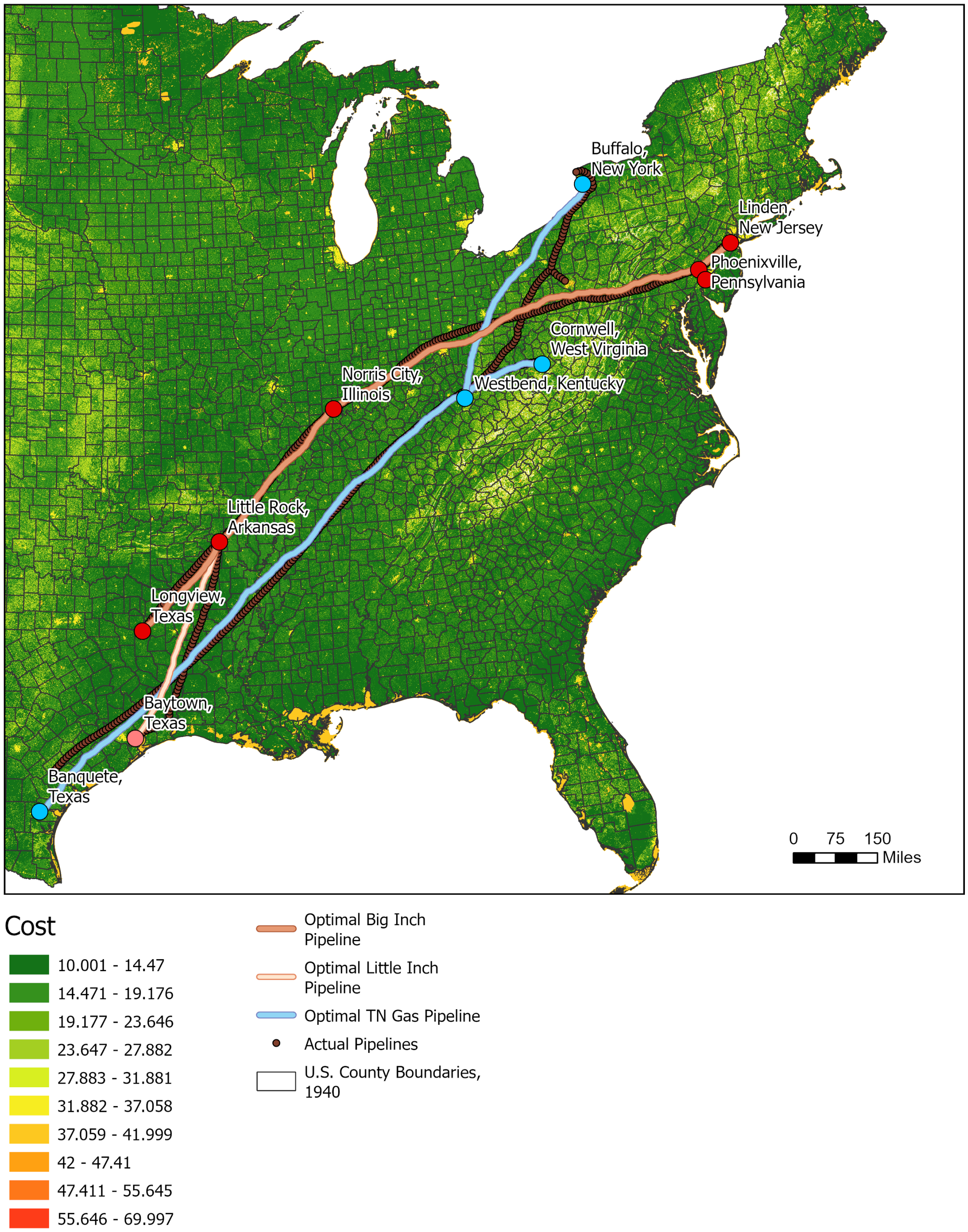
$$Cost_i = 10 + slope_i + lc_i$$

where $slope_i$ is average slope gradient; $lc_i$ is the value of the weighted land cover raster, and an additional fixed cost = 10 represents pipeline construct costs that are constant per pixel crossed (such as steel, other materials, equipment, and skilled workers). The cost value of $lc_i$ differs depending on the land cover type, with weights based qualitatively on historical and contemporary documentation of the wartime pipeline construction (Love, 1944; Casella and Wuebber, 1999) as well as quantitatively on modern studies of least-cost pipeline routes (Abudu and Williams, 2015; Durmaz et al., 2019). These land cover types and the corresponding cost weights are listed in Appendix Table A9.

Figure 5 presents the result of this analysis and the cost raster. Nodes for pipeline endpoints and midpoints are labeled by name. This map shows substantial overlap between the least cost/minimum spanning tree optimal pipeline route and the routes of the actually-constructed pipelines. Notably, the main area of divergence is the 1949 extension of the Tennessee Gas pipeline from West Bend, Kentucky to Buffalo, New York, which was built after WW2 when the constraints on construction costs were less strict and business considerations likely played a larger role.

[25] Specifically, the Distance Accumulation and Optimal Path as Line tool in ArcGIS Pro.

**Figure 5:** Map of least-cost and actual pipeline routes




*Note:* Cost value of crossing a 250m x 250m pixel $Cost_i = 10 + slope_i + lc_i$ is based on sum of a fixed cost for materials (10), the average slope gradient, and a land cover-specific cost: Wetlands (15), Developed/urban (23), Agricultural (7), Forest (15), Open water (30), Rocky land (12), Grassland/brush/pasture (2). Pixels with average slope gradient $\geq 30\%$ were not possible to cross. See Appendix Section A.2 for details.

## 4.2 First stage regression results

We run several first stage regressions to test the relevance of our instrument for a post-war increase in local natural gas supply in county $c$ due to the WW2 pipelines. All specifications have on the right-hand side our instrument, a full interaction of $\mathbf{I}(UtilityGas_{1941,c})$, an indicator that county $c$ had a gas utility in 1941, and $PipelineProximity_c$ the distance (in miles) from country $c$ centroid to the nearest point along any WW2 pipeline route. We run three different specifications of the regression model:

$$DV_c = \beta_0 + \beta_1 Utility_{1941,c} + \beta_2 PipelineProximity_c + \beta_3(Utility_{1941,c} \text{ x } PipelineProximity_c) + \beta_x X_c + \beta_r FE_r \epsilon_c \quad (1)$$

where $DV_c$ is one of three dependent variables of interest (described below); $Utility_{1941,c}$ is an indicator that county $c$ had a gas utility as of 1941; $PipelineProximity_c$ is the distance (in miles) from the country $c$ centroid to the nearest point along any WW2 pipeline route; $X_c$ is a vector of control variables including 1940 log population, log distance (in miles) to the nearest 'city' (i.e. county with population $\geq$ 50,000) in 1940, the initial (1940) share of total county $c$ employment in manufacturing or in agriculture; and $FE_r$ are census region fixed effects. All specifications include region fixed effects while even-numbered columns also include all controls.

On the left-hand side, the dependent variables in Columns (1) and (2) is distance from county centroid to actual pipeline route (in miles); Columns (3) and (4) is the percentage point change in the share of occupied dwellings in county with utility gas for heating from 1940 to 1950 (where 1940 is proxied by use of gas for central heating); and Columns (5) and (6) is the estimated share of dwellings in county with natural gas from WW2 pipelines (Product of share of WW2 pipeline-connected gas customers and estimated share of dwellings with natural gas, 1949/50, where the latter is calculated as product of the share of dwellings with utility gas for heating in 1950 and the share of utility gas customers using natural gas in 1949).

The F-statistic from the first-stage regression specifications in Columns (1) and (2) with the dependent variable as the distance from county centroid to actual pipeline route (in miles) are larger than 10, suggesting our instrument is relevant. We also report results to validate this approach. Results in Columns (3) and (4) show that the percentage point change from 1940 to 1950 in the share of occupied dwellings in a given county that primarily use utility gas for heating is strongly predicted by our instrument, with an F-statistic again larger than 10. We focus on this more intensive margin of local gas supply changes due to the WW2 pipelines because, as shown in Figure 1, while the number of counties with a gas utility barely increased between 1941 and 1949, there was a substantial increase in the share of homes in each county that used gas for heating.[26] Finally, the results in Columns (5) and (6) show that counties closer to the WW2 pipeline routes and that had a pre-war gas utility had a much larger share of dwellings that used natural gas from the WW2 pipelines to heat their homes in 1950 (although with an F-statistic below 10).

Table 3. 1st stage regression results

| | DV = PipelineProximity_c | | DV = p.p. Δ % HHs with utility gas | | DV = % HHs with WW2 pipeline gas, 1950 | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | -0.529 | -2.048 | 21.986*** | 19.718*** | 14.700*** | 11.347** |
| | (1.574) | (1.214) | (4.169) | (3.779) | (5.014) | (4.097) |
| Distance from MST route | 0.985*** | 0.981*** | 0.001 | 0.005 | -0.001 | -0.006 |
| | (0.012) | (0.012) | (0.007) | (0.007) | (0.001) | (0.005) |
| Gas utility in 1941=1 × Distance from MST route | 0.000 | 0.003 | -0.065*** | -0.066*** | -0.070*** | -0.064*** |
| | (0.011) | (0.010) | (0.022) | (0.020) | (0.023) | (0.021) |
| ln(pop.) 1940 | | 0.715 | | 1.547 | | -0.223 |
| | | (0.724) | | (1.125) | | (1.130) |
| ln(Distance to 50K+ pop. county) | | -1.620** | | 2.238 | | -1.715 |
| | | (0.644) | | (1.811) | | (1.120) |
| % emp. manufacturing, 1940 | | 0.081 | | -0.199** | | -0.085 |
| | | (0.087) | | (0.083) | | (0.082) |
| % emp. agriculture, 1940 | | 0.019 | | -0.173** | | -0.167** |
| | | (0.046) | | (0.070) | | (0.076) |
| Constant | 2.033 | -0.311 | -2.720 | -15.779 | -0.058 | 17.717 |
| | (2.374) | (9.913) | (2.550) | (14.040) | (2.847) | (13.800) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | 93.712 | 93.712 | 10.043 | 10.043 | 4.785 | 4.785 |
| R-Squared | 0.982 | 0.982 | 0.293 | 0.327 | 0.186 | 0.223 |
| F-statistic | 2267.703 | 1493.057 | 16.409 | 14.792 | 5.014 | 2.979 |

Standard errors clustered by state in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Dependent variable in Columns (1) and (2) is distance from county centroid to actual pipeline route (in miles); Columns (3) and (4) is the percentage point change in the share of occupied dwellings in county with utility gas for heating from 1940 to 1950 (where 1940 is proxied by use of gas for central heating); and Columns (5) and (6) is the estimated share of dwellings in county with natural gas from WW2 pipelines (Product of share of WW2 pipeline-connected gas customers and estimated share of dwellings with natural gas, 1949/50, where the latter is calculated as product of the share of dwellings with utility gas for heating in 1950 and the share of utility gas customers using natural gas in 1949). Explanatory variable of interest is full interaction of indicator that county had gas utility in 1940 (proxied by presence of any dwellings with gas central heating) and measures for minimum spanning tree optimal pipeline route (analogous to measures of actual pipeline route used as dependent variable in Columns (1) to (3)) .

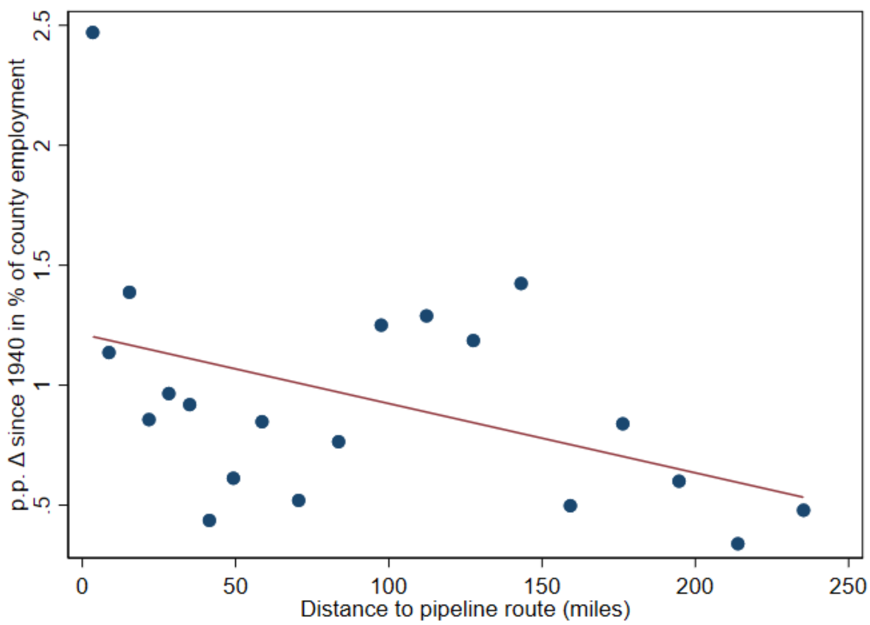
[26] Our ideal intensive-margin measure would incorporate total county consumption levels of natural gas, but we are not aware of any available data for this period.

## 4.3 Validation

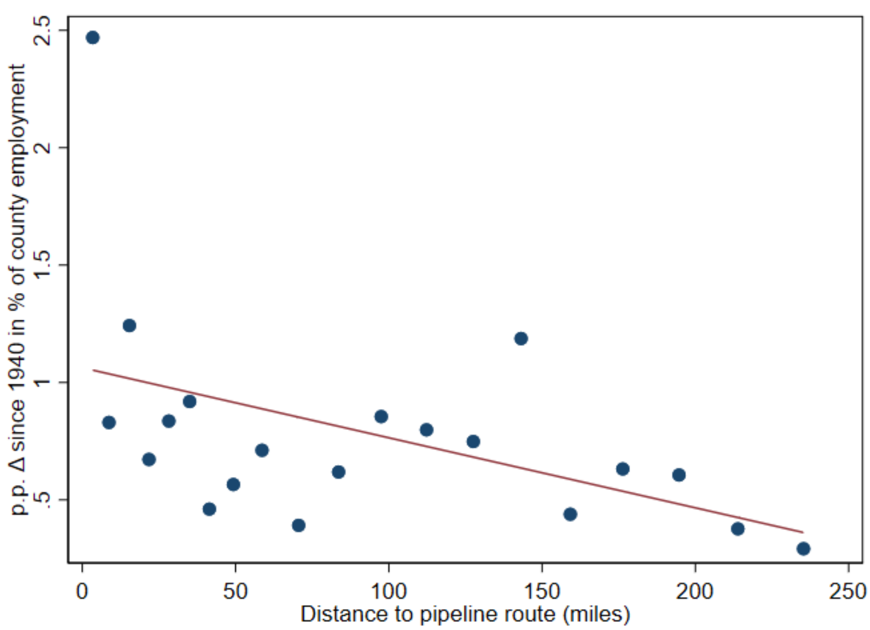
We show further evidence of the relationship of our main explanatory variable, a county's proximity to the WW2 pipelines, and the change in energy-intensive employment unconditionally using binned scatter plots in Figures 6 to 7. These figures indicate there is generally a negative unconditional relationship between a county's distance from the WW2 pipeline routes and the percentage point change from 1940 to 1950 in the share of total county employment in energy-intensive industries. For the measures of top-quartile gas-intensive employment in Figure 6, this relationship appears particularly strong for counties along the pipeline route (with a very small distance between the county centroid and the pipeline). Figure 7 shows a more consistent relationship for top-decile electricity-intensive employment. However, for top-quartile electricity-intensive employment there does not appear to be any clear unconditional relationship.

**Figure 6:** Binscatters of 1940-50 p.p. Δ sector share of county emp. and $PipelineProximity_c$

**(a)** Top quartile all gas-intensive industries



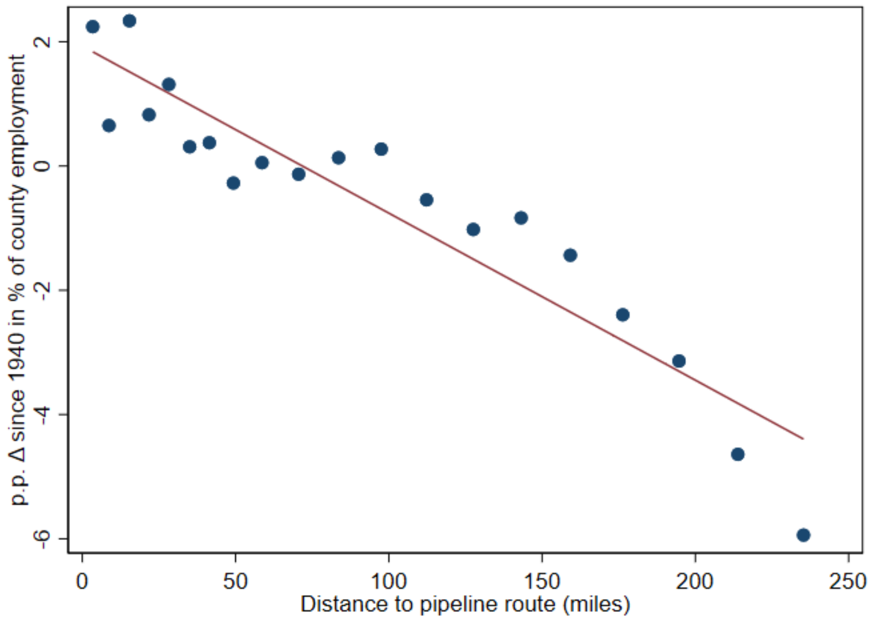

**(b)** Top quartile natural/mixed gas-intensive industries



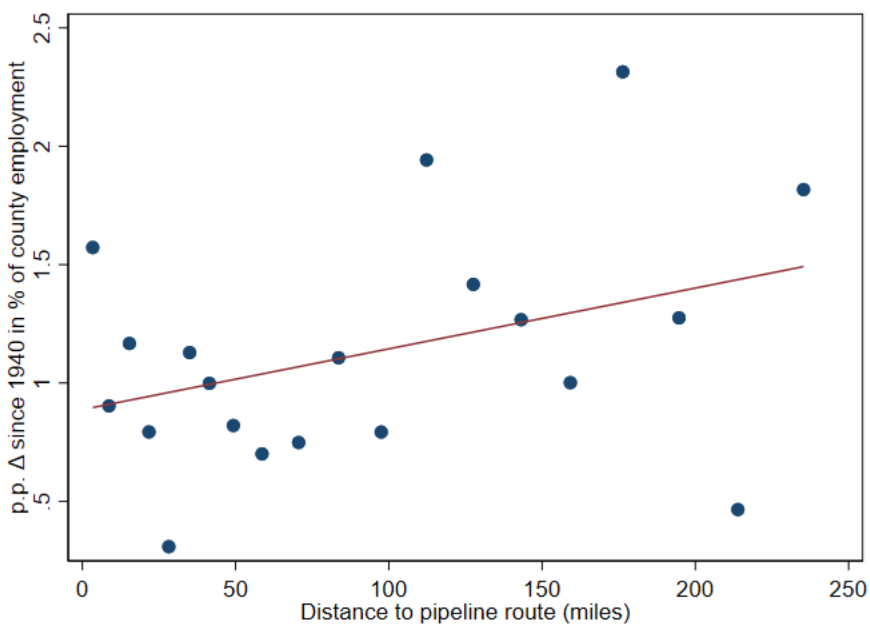

*Notes:* These binscatters show the unconditional relationship between the distance from county centroid to the nearest point on actually-constructed pipeline route (in miles) and the percentage point change from 1940 to 1950 in employment in top-quartile energy-intensive industries. Energy intensity is defined contemporaneously with employment as all types of gas or only natural and mixed gas consumed (in million feet3) per million dollars of value-added

**Figure 7:** Binscatters of 1940-50 p.p. $\Delta$ sector share of county emp. and $PipelineProximity_c$

**(a)** Top decile electricity-intensive industries




**(b)** Top quartile electricity-intensive industries




*Notes:* These binscatters show the unconditional relationship between the distance from county centroid to the nearest point on actually-constructed pipeline route (in miles) and the percentage point change from 1940 to 1950 in employment in top-decile or top-quartile electricity-intensive industries as a share of total county employment. Electricity intensity is defined contemporaneously with employment as cost of purchased electricity as share of value-added.

# 5 Regression results

## 5.1 Specification

We estimate the impact of increased natural gas access via the WW2 pipelines on annual county employment composition in the short-term (1950) and long-term (1964-1990). We model the change since 1940 in county $c$ by year $t$ of measure $s$ on the pipeline gas access as:

$$\Delta Y_{c,1940-t,s} = \beta_0 + \beta_1 Utility_{1941,c} + \beta_2 PipelineProximity_c + \beta_3 (Utility_{1941,c} \text{ x } PipelineProximity_c) + \beta_x X_c + \beta_r FE_r \epsilon_c \quad (2)$$

where $\Delta Y_{c,1940-t,s}$ is the change in county employment between 1940 and year $t$ in sector $s$; $Utility_{1941,c}$ is an indicator that county $c$ had a gas utility as of 1941; $PipelineProximity_c$ is the distance (in miles) from country $c$ centroid to the nearest point along any WW2 pipeline route; $X_c$ is a vector of control variables including 1940 log population, log distance (in miles) to the nearest 'city' (i.e. county with population $\geq$ 50,000) in 1940, and initial (1940) share of total county $c$ employment in manufacturing or in agriculture; and $FE_r$ are census region fixed effects.

We mainly define $\Delta Y_{c,1940-t,s}$ as the percentage point change between 1940 and year $t$ in the share of total employment in county $c$ in sector $s$. Sector $s$ refers to subsets of IND1950 industries, with the primary focus on the group of industries in the top decile or top quartile of energy-intensity as of 1939 (for the baseline sector employment share) or 1947 (for the end-year sector employment share).[27] Industry energy intensity is defined based on consumption of all type of gas (in million cubic feet) per million dollars of value-added; a similar measure for consumption of natural and mixed gas only; and spending on purchased electricity as a share of value-added. The data and measurement of energy-intensity is detailed in Section 3.2. We also define $\Delta Y_{c,1940-t,s}$ for additional sectors of interest: all other manufacturing industries than those in the top quartile or top decile according to each energy-intensity measure; agriculture; and services and all other sectors. This allows us to explore the impact across all groups of employment in a county. We additionally

[27] Appendix Section A.6 presents results where end-year sector employment shares are defined based on 1971 industry energy intensity.

define $\Delta Y_{c,1940-t,s}$ as the change in log population of county $c$ between 1940 and year $t = 1950$ when testing the initial impact of the pipelines.

Results are first presented for this model estimated via ordinary least squares (OLS), where $PipelineProximity_c$ is defined as distance to the actual pipeline route. Full regression results tables are included in Appendix Section A.4.1. Appendix Section A.4.2 also includes results for the reduced form model, where $PipelineProximity_c$ is defined as distance to the MST optimal pipeline route. Finally, results are presented for the model estimated using two-stage least squares (2SLS), where $PipelineProximity_c$ is the distance to the actual pipeline route instrumented by distance to the MST optimal pipeline route. Full regression results tables are included in Appendix Section A.4.3.

### 5.2 Initial impacts

We first test whether there is any short-run change in energy-intensive employment (by 1950) in more treated counties. Our results are consistent in the OLS estimates in Table 4 and the 2SLS estimates in Table 5 where distance from the pipeline is instrumented using the county distance from the least cost/minimum spanning tree optimal pipeline route. We find that in the short-term, increased local gas access leads to statistically significant increases by 1950 in the share of county employment in top-quartile gas-intensive industries (Columns 3-4) but not top-decile gas-intensive industries. For electricity-intensive employment we find an immediate increase both in the top-decile most electricity-intensive industries as well as a smaller increase in the top-quartile industries. For all energy-intensity measures we also find an immediate increase in non-energy intensive manufacturing, which, as we show below in Section 5.3, does not persist beyond 1950 unlike the increases in energy-intensive employment. Finally, we also find a decrease in the share of county employment in agriculture in counties with greater gas access, suggesting structural transformation as an impact of the pipelines. We do not find any significant changes in shares of employment in services or other sectors or in total county population.

Table 4. OLS regression of 1940 to 1950 percentage point change in sector share of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$

(a) All gas-intensive employment

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 0.520 | 0.466 | 1.550*** | 0.978** | -1.157 | 0.675 |
| | (0.418) | (0.350) | (0.486) | (0.418) | (0.721) | (0.591) |
| Distance from pipeline | -0.000 | -0.000 | 0.004** | 0.002 | 0.015** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.007) |
| Gas utility in 1941=1 × Distance from pipeline | -0.005 | -0.005 | -0.010*** | -0.009*** | -0.017*** | -0.018*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.14 | -0.14 | 0.94 | 0.94 | 2.53 | 2.53 |
| DV Std Dev | 2.54 | 2.54 | 3.04 | 3.04 | 4.99 | 4.99 |
| R-Squared | 0.04 | 0.05 | 0.08 | 0.10 | 0.09 | 0.17 |

Standard errors clustered by state in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01

(b) Natural gas-intensive employment

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 0.381 | 0.445 | 1.302*** | 0.885** | -0.909 | 0.768 |
| | (0.399) | (0.338) | (0.407) | (0.364) | (0.658) | (0.536) |
| Distance from pipeline | -0.000 | -0.000 | 0.004** | 0.003 | 0.015** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941=1 × Distance from pipeline | -0.005 | -0.005 | -0.011*** | -0.010*** | -0.016*** | -0.017*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.35 | -0.35 | 0.78 | 0.78 | 2.69 | 2.69 |
| DV Std Dev | 2.67 | 2.67 | 2.91 | 2.91 | 4.94 | 4.94 |
| R-Squared | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.15 |

Standard errors clustered by state in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as all types of gas or only natural and mixed gas consumed (in million feet$^3$) per million dollars of value-added.

OLS regression of 1940 to 1950 percentage point change in sector share of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$, continued.

(c) Electricity-intensive employment

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 1.534** | 1.595** | 1.670*** | 1.156*** | -1.277** | 0.497 |
| | (0.551) | (0.575) | (0.337) | (0.309) | (0.608) | (0.536) |
| Distance from pipeline | -0.014** | -0.010** | 0.012*** | 0.010*** | 0.007 | 0.009 |
| | (0.006) | (0.004) | (0.002) | (0.003) | (0.005) | (0.006) |
| Gas utility in 1941=1 × Distance from pipeline | -0.022*** | -0.023*** | -0.015*** | -0.014*** | -0.012** | -0.013** |
| | (0.006) | (0.006) | (0.004) | (0.004) | (0.005) | (0.006) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.59 | -0.59 | 1.13 | 1.13 | 2.34 | 2.34 |
| DV Std Dev | 5.83 | 5.83 | 3.07 | 3.07 | 4.86 | 4.86 |
| R-Squared | 0.17 | 0.19 | 0.03 | 0.06 | 0.06 | 0.14 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(d) Other sectors

| | Agriculture | | Services/other | | Δln(population) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | -1.800 | -3.956*** | 1.407** | 2.304*** | 7.349*** | 0.012 |
| | (1.072) | (0.916) | (0.564) | (0.477) | (1.838) | (2.020) |
| Distance from pipeline | -0.024** | -0.025** | 0.005 | 0.006 | 0.044** | 0.017 |
| | (0.009) | (0.009) | (0.005) | (0.005) | (0.017) | (0.011) |
| Gas utility in 1941=1 × Distance from pipeline | 0.024*** | 0.024*** | 0.003 | 0.003 | -0.012 | 0.009 |
| | (0.007) | (0.007) | (0.006) | (0.005) | (0.012) | (0.011) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | Y | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -7.89 | -7.89 | 4.42 | 4.42 | 3.16 | 3.16 |
| DV Std Dev | 5.96 | 5.96 | 6.07 | 6.07 | 15.63 | 15.63 |
| R-Squared | 0.15 | 0.26 | 0.17 | 0.20 | 0.21 | 0.40 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as cost of purchased electricity as share of value-added. In Panel (d) dependent variables are change from 1940 to 1950 in sector share of total county employment (Columns 1-4) or change in log total population (Columns 5-6)

Table 5. 2SLS regression of 1940 to 1950 percentage point change in sector share of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$

(a) All gas-intensive employment

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.000 | -0.001 | 0.004** | 0.002 | 0.015*** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941 | 0.415 | 0.363 | 1.495*** | 0.920** | -1.157 | 0.684 |
| | (0.378) | (0.316) | (0.474) | (0.409) | (0.733) | (0.591) |
| Gas utility in 1941 x distance to pipeline | -0.004 | -0.004 | -0.009*** | -0.009*** | -0.017*** | -0.018*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.14 | -0.14 | 0.94 | 0.94 | 2.53 | 2.53 |
| DV Std Dev | 2.54 | 2.54 | 3.04 | 3.04 | 4.99 | 4.99 |
| R-Squared | 0.04 | 0.05 | 0.08 | 0.10 | 0.09 | 0.17 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3342.2 | 3424.6 |

Standard errors clustered by state in parentheses.
Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(b) Natural gas-intensive employment

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.001 | -0.000 | 0.004** | 0.003 | 0.015*** | 0.016*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941 | 0.277 | 0.344 | 1.246*** | 0.826** | -0.907 | 0.778 |
| | (0.357) | (0.302) | (0.392) | (0.353) | (0.670) | (0.535) |
| Gas utility in 1941 x distance to pipeline | -0.004 | -0.004 | -0.010*** | -0.010*** | -0.016*** | -0.017*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.35 | -0.35 | 0.78 | 0.78 | 2.69 | 2.69 |
| DV Std Dev | 2.67 | 2.67 | 2.91 | 2.91 | 4.94 | 4.94 |
| R-Squared | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.15 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3342.2 | 3424.6 |

Standard errors clustered by state in parentheses.
Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results shown in table. Explanatory variables of interest are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route, where latter is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as cost of purchased electricity as share of value-added. In Panel (d) dependent variables are change from 1940 to 1950 in sector share of total county employment (Columns 1-4) or change in log total population (Columns 5-6)

2SLS regression of 1940 to 1950 percentage point change in sector share of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$, continued.

(c) Electricity-intensive employment

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.013** | -0.009** | 0.011*** | 0.009*** | 0.008 | 0.009 |
| | (0.006) | (0.004) | (0.002) | (0.002) | (0.005) | (0.006) |
| Gas utility in 1941 | 1.532*** | 1.607*** | 1.650*** | 1.130*** | -1.312** | 0.474 |
| | (0.555) | (0.572) | (0.333) | (0.292) | (0.628) | (0.543) |
| Gas utility in 1941 x distance to pipeline | -0.022*** | -0.023*** | -0.015*** | -0.014*** | -0.012** | -0.013** |
| | (0.006) | (0.006) | (0.004) | (0.004) | (0.005) | (0.006) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.59 | -0.59 | 1.13 | 1.13 | 2.34 | 2.34 |
| DV Std Dev | 5.83 | 5.83 | 3.07 | 3.07 | 4.86 | 4.86 |
| R-Squared | 0.17 | 0.19 | 0.03 | 0.06 | 0.06 | 0.14 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3342.2 | 3424.6 |

Standard errors clustered by state in parentheses.
Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(d) Other sectors

| | Agriculture. | | Services/other | | Δln(population) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.025*** | -0.025*** | 0.006 | 0.007 | 0.042** | 0.017 |
| | (0.009) | (0.009) | (0.005) | (0.005) | (0.017) | (0.010) |
| Gas utility in 1941 | -1.898* | -4.055*** | 1.560*** | 2.451*** | 7.344*** | 0.072 |
| | (1.063) | (0.903) | (0.544) | (0.452) | (1.858) | (1.954) |
| Gas utility in 1941 x distance to pipeline | 0.025*** | 0.025*** | 0.001 | 0.001 | -0.013 | 0.009 |
| | (0.007) | (0.007) | (0.005) | (0.005) | (0.012) | (0.010) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | Y | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -7.89 | -7.89 | 4.42 | 4.42 | 3.16 | 3.16 |
| DV Std Dev | 5.96 | 5.96 | 6.07 | 6.07 | 15.63 | 15.63 |
| R-Squared | 0.15 | 0.26 | 0.17 | 0.20 | 0.21 | 0.40 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3624.1 | 3424.6 |

Standard errors clustered by state in parentheses.
Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as cost of purchased electricity as share of value-added. In Panel (d) dependent variables are change from 1940 to 1950 in sector share of total county employment (Columns 1-4) or change in log total population (Columns 5-6)

## 5.3 Long-term impacts

We argue that substantial and early increases in local gas supplies can have persistent impacts on industry location, especially where firms were energy intensive and made large up-front investments specific to one energy type. However, this persistence may have weakened during the 1970s energy crisis. As detailed in Section 2, during this period federal price regulations that applied to interstate but not intrastate gas transmission resulted in substantially reduced gas supplies in Northeast consuming states, leading to well-documented gas shortages that caused manufacturing establishments to lay off workers and close. Contemporary accounts suggest spatial variation in exposure to gas shortages based on which transmission pipelines supplied local distributors. For example, a 1975 report from the Federal Energy Administration predicted localized factory output reductions and shutdowns in areas of Eastern and Midwestern states based on their pipeline-specific gas supplies and industrial concentration (FEA, 1975)

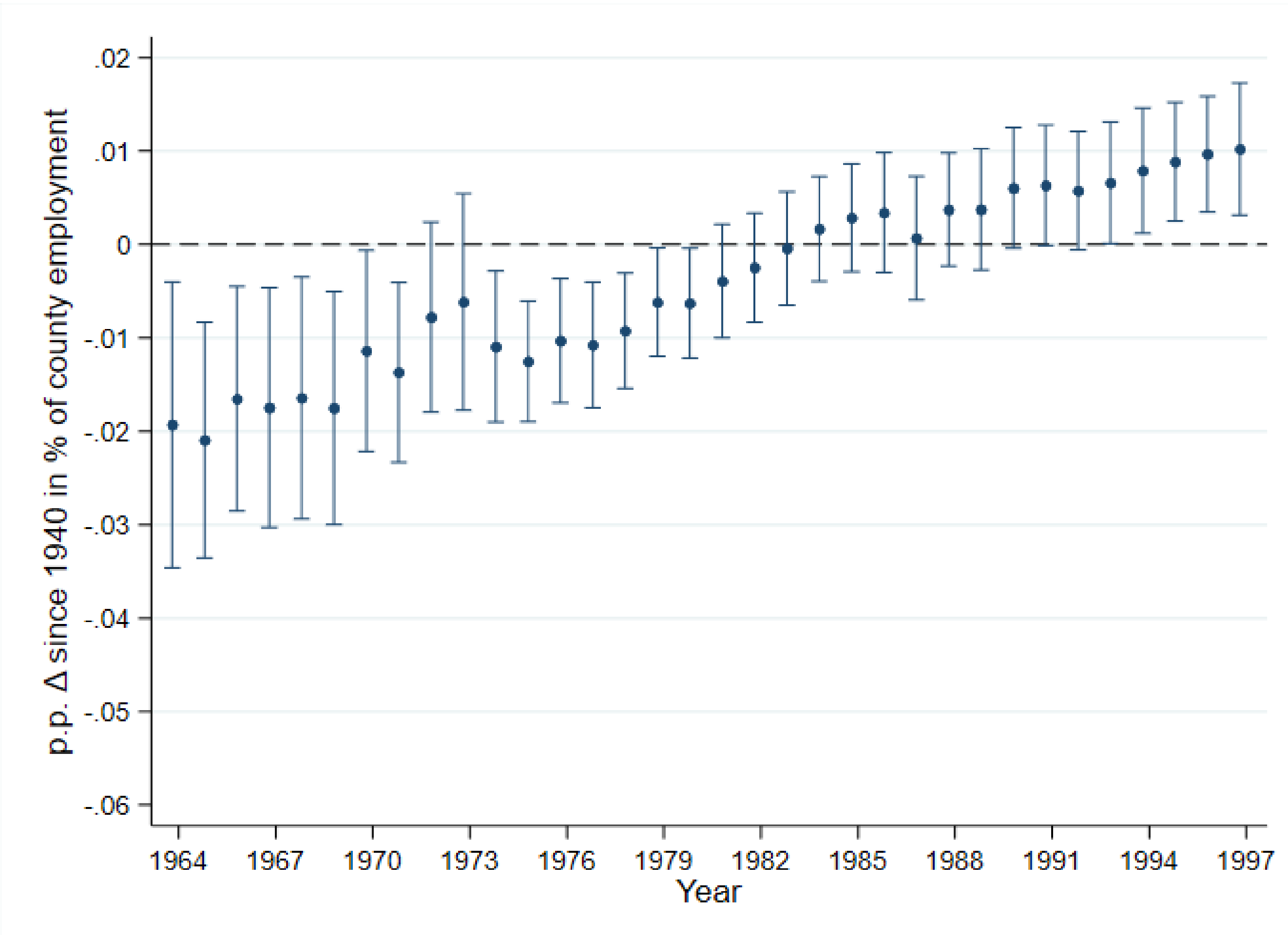
We test for both persistence in industry location due to the pipelines as well as effects of the 1970s energy crisis using the same as specification as the regressions above (detailed in Section 5.1) but with the dependent variable $\Delta Y_{c,1940-t,s}$ now defined for all years $t \in [1964, 1997]$ as the change in county employment between 1940 and year $t$ in sector $s$.[28] We include the same controls for 1940 log population, log distance (in miles) to the nearest 'city' (i.e. county with population $\geq$ 50,000) in 1940, initial (1940) share of total county $c$ employment in manufacturing or in agriculture, and census region fixed effects. The coefficients from these regressions are plotted in Figures 8, 9, 10, and 11. Tables with full regression results are included in Appendix Table A.5.

We find strong evidence of persistence for the most electricity-intensive industries (top decile and top quartile) and for a wider subset of gas-intensive industries (top-quartile) but not for other manufacturing industries that experienced initial employment increases in more treated counties in 1950 (see Appendix Table A.5). We also find substantial attenuation of the pipelines' impact on energy-intensive employment during the 1970s energy crisis. In particular, we find that the effect of pipeline gas access on gas-intensive employment becomes statistically indistinguishable from zero in the mid-1970s. In comparison, there continues to be higher energy-intensive employment

[28] Results presented above for $t = 1950$ are included for comparison.

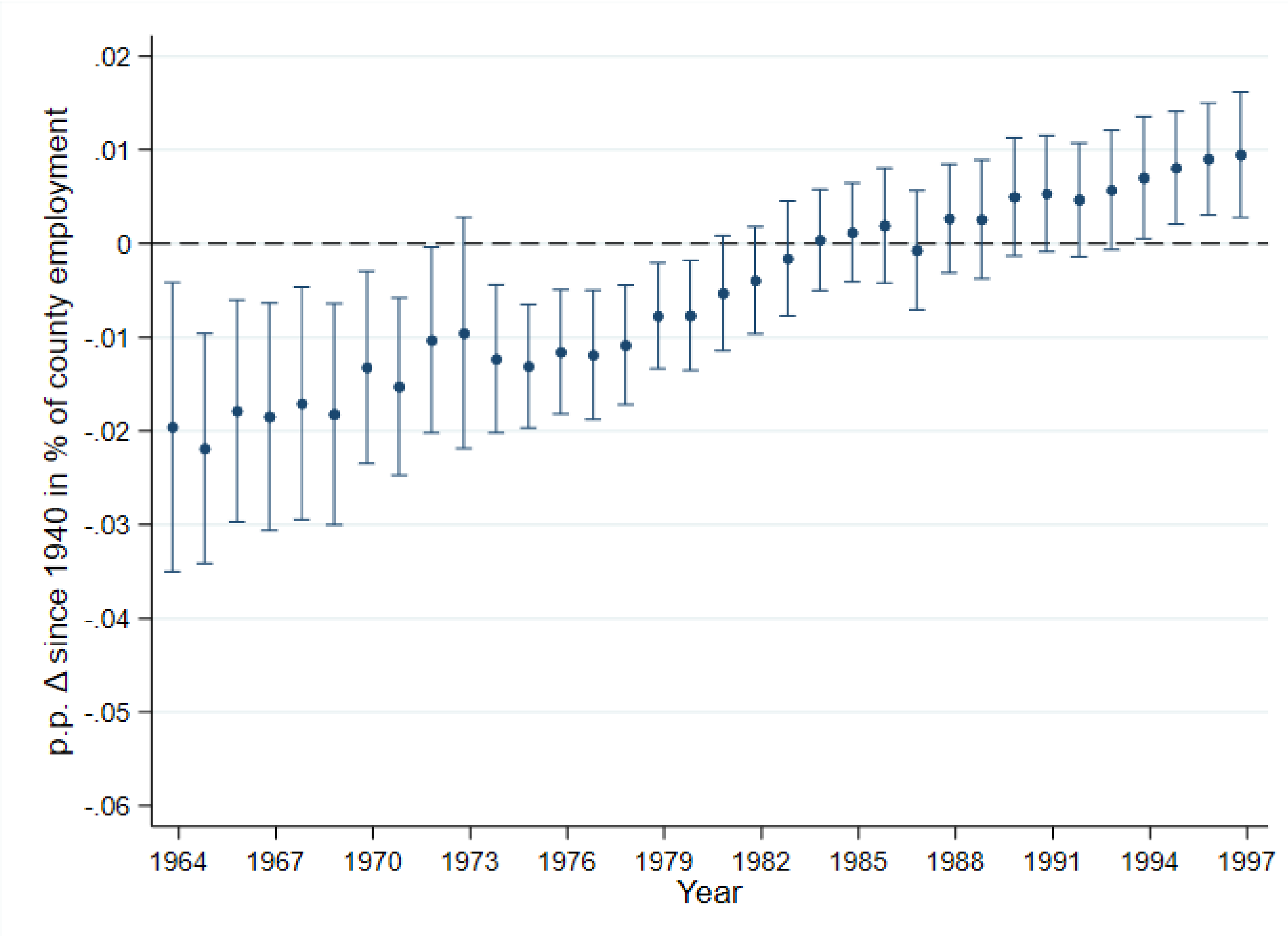
in pipeline-treated counties until the late 1990s, although it does decrease in magnitude during the 1970s. This is consistent with electricity-intensive industries being better able to access energy during a shock to oil and gas due to electrical generators being more able to substitute to alternative fuels (e.g. coal).

**Figure 8:** Coefficients from 2SLS regression of 1940 to end-year p.p. $\Delta$ in top quartile all gas-intensive industries % of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$



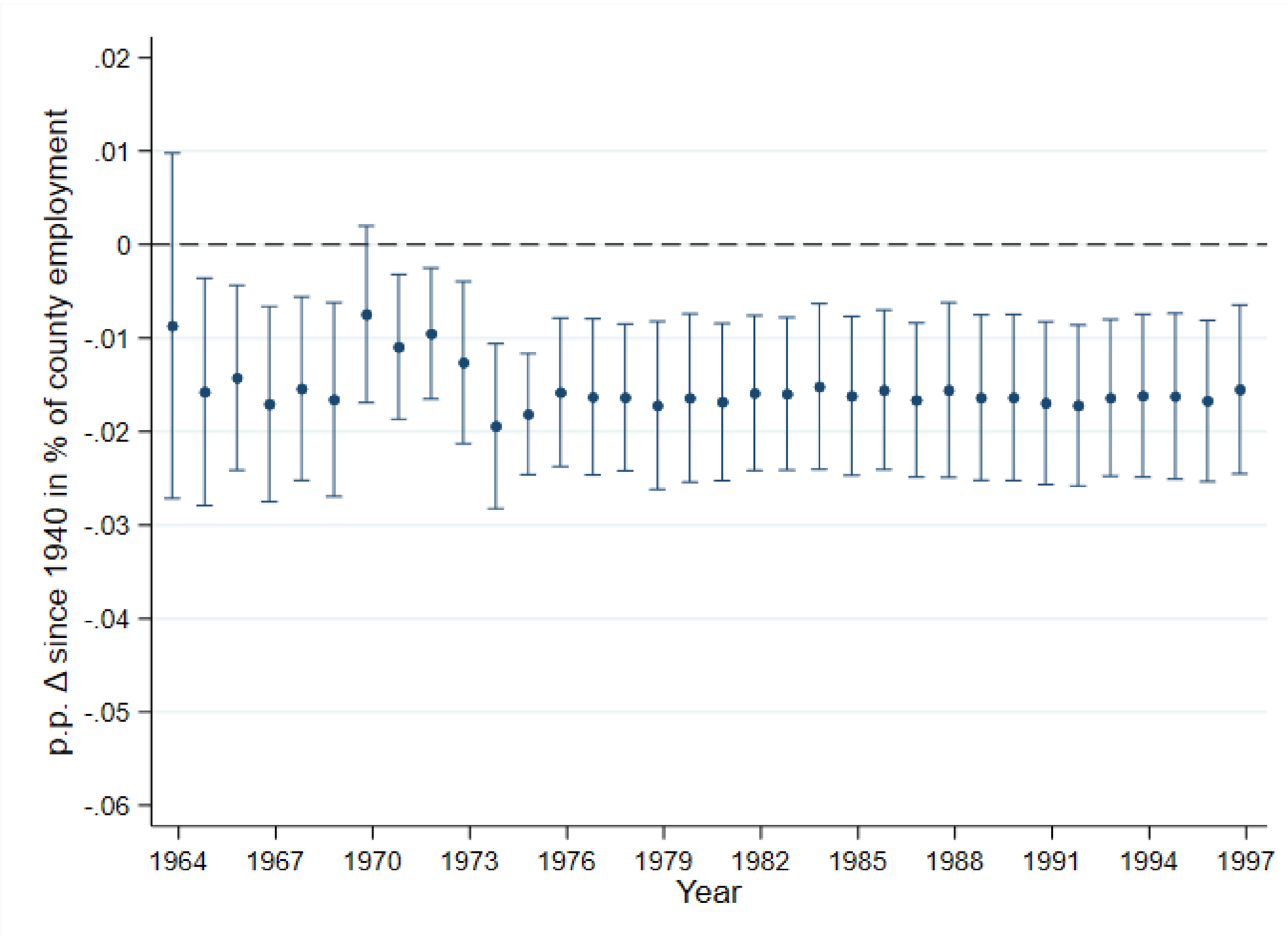

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Plot shows the sum of coefficient estimates on distance from county $c$ centroid to nearest point on actually-constructed pipeline route and its interaction with indicator that county $c$ had a gas utility in 1941, from two stage-least squares regression, with 95% confidence interval. Negative coefficients show increase in employment with decreased distance to pipeline (i.e. increased proximity). Distance to actual pipeline route is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state. Dependent variable on Y-axis is change from 1940 to each year in share of total county employment in top-quartile energy-intensive industries, defined based on industry energy consumption and value-added in 1939 for 1940 employment shares and in 1947 for all post-war employment shares, as all types of gas consumed (in million feet$^3$) per million dollars of value-added. See Appendix Section A.5 for tables of full results.

**Figure 9:** Coefficients from 2SLS regression of 1940 to end-year p.p. $\Delta$ in top quartile natural/mixed gas-intensive industries % of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$



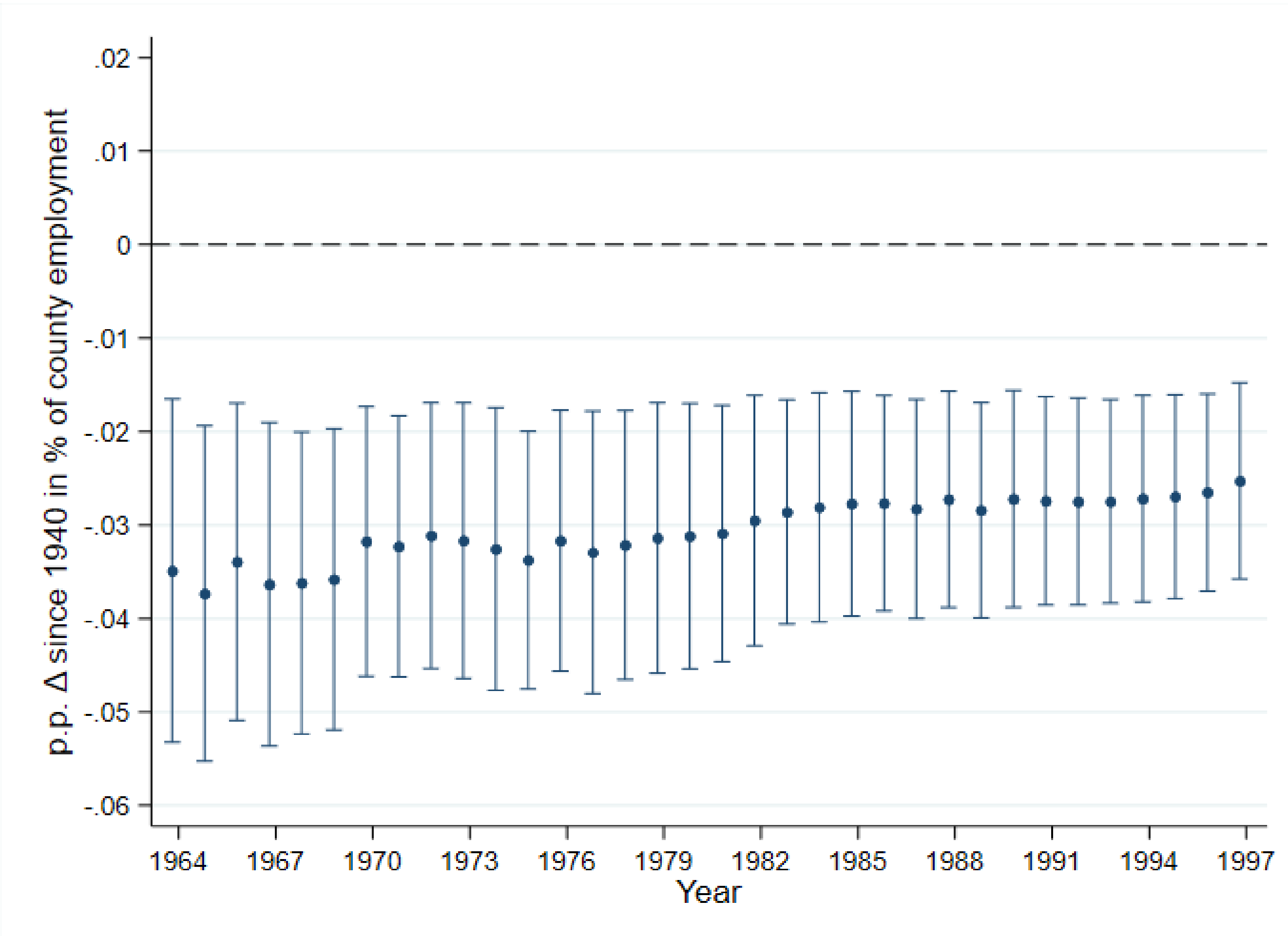

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Plot shows the sum of coefficient estimates on distance from county $c$ centroid to nearest point on actually-constructed pipeline route and its interaction with indicator that county $c$ had a gas utility in 1941, from two stage-least squares regression, with 95% confidence interval. Negative coefficients show increase in employment with decreased distance to pipeline (i.e. increased proximity). Distance to actual pipeline route is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state. Dependent variable on Y-axis is change from 1940 to each year in share of total county employment in top-quartile energy-intensive industries, defined based on industry energy consumption and value-added in 1939 for 1940 employment shares and in 1947 for all post-war employment shares, as natural and mixed gas consumed (in million feet$^3$) per million dollars of value-added. See Appendix Section A.5 for tables of full results.

**Figure 10:** Coefficients from 2SLS regression of 1940 to end-year p.p. $\Delta$ in top quartile electricity-intensive industries % of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$




*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Plot shows the sum of coefficient estimates on distance from county $c$ centroid to nearest point on actually-constructed pipeline route and its interaction with indicator that county $c$ had a gas utility in 1941, from two stage-least squares regression, with 95% confidence interval. Negative coefficients show increase in employment with decreased distance to pipeline (i.e. increased proximity). Distance to actual pipeline route is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state. Dependent variable on Y-axis is change from 1940 to each year in share of total county employment in top-quartile energy-intensive industries, defined based on industry energy consumption and value-added in 1939 for 1940 employment shares and in 1947 for all post-war employment shares, as cost of purchased electricity as share of value-added. See Appendix Section A.5 for tables of full results.

**Figure 11:** Coefficients from 2SLS regression of 1940 to end-year p.p. $\Delta$ in top decile electricity-intensive industries % of county emp. on $\mathbf{I}(UtilityGas_{1941,c})$ x $PipelineProximity_c$




*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Plot shows the sum of coefficient estimates on distance from county $c$ centroid to nearest point on actually-constructed pipeline route and its interaction with indicator that county $c$ had a gas utility in 1941, from two stage-least squares regression, with 95% confidence interval. Negative coefficients show increase in employment with decreased distance to pipeline (i.e. increased proximity). Distance to actual pipeline route is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state. Dependent variable on Y-axis is change from 1940 to each year in share of total county employment in top-quartile energy-intensive industries, defined based on industry energy consumption and value-added in 1939 for 1940 employment shares and in 1947 for all post-war employment shares, as cost of purchased electricity as share of value-added. See Appendix Section A.5 for tables of full results.

# 6 Conclusion

In this paper we study the local employment impacts of a plausibly-exogenous increase in local energy access from counties being more or less proximate to a natural gas pipeline. We find that an increase in local energy access at a time when that energy source (i.e. interstate natural gas in the Northeast) is relatively newly available leads to persistently high employment in energy-intensive industries, though this effect can disappear with negative supply shocks specific to that energy source (as for gas during the 1970s energy crisis).

These results relate to ongoing discussions of the potential local employment impacts of access to energy (Hanson, 2023), especially from clean energy sources (Arkolakis and Walsh, 2023). Our findings may point to a future where locations with plentiful and inexpensive energy can leverage this into growth of energy-intensive manufacturing jobs. This is particularly relevant given challenges building energy transportation infrastructure in the United States (e.g. high-voltage transmission lines). These challenges may increase the localization of energy access and restore what Severnini (2023) calls the "cheap local power advantage."

Our findings also build understanding of the effects of the recent energy price shock in 2022. The substantial attenuation of the energy-intensive employment benefit during the 1970s energy crisis shows that relatively long-established energy-employment relationships can loosen with a significant energy cost shock. Positive shocks to local energy access such as from the WW2 pipelines may increase local dependence ('lock-in') and therefore exposure to later shocks such as the 1970s gas crisis.

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# A Appendix

## Table of Contents

## A.1 Lists of energy-intense industries by year

### A.1.1 1939

Table A1. All-gas-intensive industries ($Mf^3$/$Value-added)

(a) 1939 all-gas-intensive industries

| Top decile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| Blast furnaces, steel works, and rolling mills (336) | 858.9 | 470.9 |
| Misc chemicals and allied products (469) | 526.3 | 125.4 |
| Petroleum refining (476) | 512.1 | 105.2 |
| Misc petroleum and coal products (477) | 387.0 | 36.7 |
| Glass and glass products (316) | 254.6 | 91.5 |
| Cement, concrete, gypsum and plaster products (317) | 244.0 | 56.2 |

| Top quartile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| Primary nonferrous industries (338) | 115.7 | 102.2 |
| Structural clay, pottery, and related products (318; 319) | 86.2 | 175.3 |
| Pulp, paper, and paper-board mills (456) | 55.4 | 178.6 |
| Dairy products (407) | 46.4 | 50.4 |
| Synthetic fibers, drugs, and medicines (466; 467) ( 466) | 44.9 | 239.1 |
| Meat products (406) | 41.6 | 203.8 |

Table A2. Natural/mixed gas-intensive industries ($Mf^3$/\$Value-added)

(a) 1939 natural/mixed gas-intensive industries

| Top decile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| Misc chemicals and allied products (469) | 525.7 | 125.4 |
| Glass and glass products (316) | 246.1 | 91.5 |
| Cement, concrete, gypsum and plaster products (317) | 240.3 | 56.2 |
| Petroleum refining (476) | 223.5 | 105.2 |
| Primary nonferrous industries (338) | 90.1 | 102.2 |
| Blast furnaces, steel works, and rolling mills (336) | 85.1 | 470.9 |

| Top quartile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| Structural clay, pottery, and related products (318; 319) | 83.0 | 175.3 |
| Pulp, paper, and paper-board mills (456) | 55.4 | 178.6 |
| Misc petroleum and coal products (477) | 55.3 | 36.7 |
| Dairy products (407) | 41.8 | 50.4 |
| Meat products (406) | 40.0 | 203.8 |
| Synthetic fibers, drugs, and medicines (466; 467) ( 466) | 34.0 | 239.1 |

Table A3. Electricity-intensive industries ($ Purchases % of Value-added)

(a) 1947 electricity-intensive industries

| Top decile | % | Emp. ('000s) |
|---|---|---|
| primary nonferrous industries (338) | 4.8 | 186.7 |
| cement, concrete, gypsum and plaster products (317) | 4.2 | 105.8 |
| blast furnaces, steel works, and rolling mills (336) | 3.5 | 547.4 |
| not specified metal industries (348) | 2.8 | 22.1 |
| pulp, paper, and paper-board mills (456) | 2.7 | 198.4 |
| other primary iron and steel industries (337) | 2.3 | 267.3 |

| Top quartile | % | Emp. ('000s) |
|---|---|---|
| yarn, thread, and fabric (439) | 2.1 | 606.3 |
| misc chemicals and allied products (469) | 2.0 | 410.8 |
| dairy products (407) | 1.9 | 92.7 |
| rubber products (478) | 1.9 | 518.2 |
| misc nonmetallic mineral and stone products (326) | 1.8 | 90.1 |
| grain-mill products (409) | 1.8 | 113.2 |

### A.1.2 1947

Table A4. All-gas-intensive industries ($Mf^3$/\$Value-added)

(a) 1947 all-gas-intensive industries

| Top decile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| blast furnaces, steel works, and rolling mills (336) | 898.0 | 547.4 |
| misc petroleum and coal products (477) | 554.9 | 66.2 |
| petroleum refining (476) | 272.9 | 145.8 |
| cement, concrete, gypsum and plaster products (317) | 145.3 | 105.8 |
| glass and glass products (316) | 141.6 | 138.9 |
| Structural clay, pottery, and related products (318; 319) | 107.5 | 127.3 |

| Top quartile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| primary nonferrous industries (338) | 61.7 | 186.7 |
| misc chemicals and allied products (469) | 46.8 | 410.8 |
| pulp, paper, and paper-board mills (456) | 46.0 | 198.4 |
| not specified metal industries (348) | 36.5 | 22.1 |
| fabricated steel products (346) | 29.6 | 49.9 |
| meat products (406) | 19.8 | 274.4 |
| other primary iron and steel industries (337) | 19.6 | 267.3 |

Table A5. Natural/mixed gas-intensive industries ($Mf^3$/$Value-added)

(a) 1947 natural/mixed gas-intensive industries

| Top decile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| blast furnaces, steel works, and rolling mills (336) | 522.0 | 547.4 |
| petroleum refining (476) | 272.8 | 145.8 |
| glass and glass products (316) | 136.0 | 138.9 |
| cement, concrete, gypsum and plaster products (317) | 128.4 | 105.8 |
| Structural clay, pottery, and related products (318; 319) | 104.3 | 127.3 |
| misc petroleum and coal products (477) | 64.8 | 66.2 |

| Top quartile | $Mf^3/\$M$ | Emp. ('000s) |
|---|---|---|
| primary nonferrous industries (338) | 56.6 | 186.7 |
| pulp, paper, and paper-board mills (456) | 46.0 | 198.4 |
| misc chemicals and allied products (469) | 43.4 | 410.8 |
| fabricated steel products (346) | 27.2 | 49.9 |
| not specified metal industries (348) | 26.7 | 22.1 |
| meat products (406) | 19.1 | 274.4 |
| misc nonmetallic mineral and stone products (326) | 15.5 | 90.1 |

Table A6. Electricity-intensive industries ($ Purchases % of Value-added)

(a) 1947 electricity-intensive industries

| Top decile | % | Emp. ('000s) |
|---|---|---|
| primary nonferrous industries (338) | 4.8 | 186.7 |
| cement, concrete, gypsum and plaster products (317) | 4.2 | 105.8 |
| blast furnaces, steel works, and rolling mills (336) | 3.5 | 547.4 |
| not specified metal industries (348) | 2.8 | 22.1 |
| pulp, paper, and paper-board mills (456) | 2.7 | 198.4 |
| other primary iron and steel industries (337) | 2.3 | 267.3 |

| Top quartile | % | Emp. ('000s) |
|---|---|---|
| yarn, thread, and fabric (439) | 2.1 | 606.3 |
| misc chemicals and allied products (469) | 2.0 | 410.8 |
| dairy products (407) | 1.9 | 92.7 |
| rubber products (478) | 1.9 | 518.2 |
| misc nonmetallic mineral and stone products (326) | 1.8 | 90.1 |
| grain-mill products (409) | 1.8 | 113.2 |

### A.1.3 1971

Note that in the 1972 Census of Manufactures consumption of only natural gas is reported, as manufactured (coal) gas had seemingly declined to irrelevance by this point

Table A7. All-gas-intensive industries (Mf$^3$/\$Value-added)

(a) 1971 all-gas-intensive industries

| Top decile | Mf$^3$/\$$M$ | Emp. ('000s) |
|---|---|---|
| Structural clay, pottery, and related products (318; 319) | 95.5 | 93.2 |
| pulp, paper, and paper-board mills (456) | 91.3 | 216.5 |
| glass and glass products (316) | 71.2 | 168.6 |
| cement, concrete, gypsum and plaster products (317) | 67.9 | 208.2 |
| blast furnaces, steel works, and rolling mills (336) | 60.3 | 556.1 |

| Top quartile | Mf$^3$/\$$M$ | Emp. ('000s) |
|---|---|---|
| misc nonmetallic mineral and stone products (326) | 37.2 | 98.7 |
| dyeing and finishing textiles, except knit goods (437) | 30.4 | 73.5 |
| misc petroleum and coal products (477) | 29.9 | 35.2 |
| misc wood products (308) | 20.6 | 109.5 |
| other primary iron and steel industries (337) | 19.7 | 211.9 |
| grain-mill products (409) | 19.4 | 110.6 |
| Synthetic fibers, drugs, and medicines (466; 467) ( 466) | 17.3 | 299.8 |
| Other foods (408; 416; 417; 419; 426) | 17.2 | 743.7 |

Table A8. Electricity-intensive industries ($ Purchases % of Value-added)

(a) 1971 electricity-intensive industries

| Top decile | % | Emp. ('000s) |
|---|---|---|
| not specified metal industries (348) | 22.2 | 8.1 |
| primary nonferrous industries (338) | 5.6 | 349.7 |
| pulp, paper, and paper-board mills (456) | 4.7 | 216.5 |
| petroleum refining (476) | 4.5 | 94.6 |
| blast furnaces, steel works, and rolling mills (336) | 4.2 | 556.1 |

| Top quartile | % | Emp. ('000s) |
|---|---|---|
| misc chemicals and allied products (469) | 3.4 | 482.9 |
| yarn, thread, and fabric (439) | 3.4 | 459.0 |
| other primary iron and steel industries (337) | 3.2 | 211.9 |
| cement, concrete, gypsum and plaster products (317) | 3.0 | 208.2 |
| misc nonmetallic mineral and stone products (326) | 2.5 | 98.7 |
| misc textile mill products (446) | 2.4 | 61.5 |
| sawmills, planing mills, and mill work (307) | 2.2 | 366.7 |
| misc wood products (308) | 2.1 | 109.5 |

## A.2 Optimal pipeline routes calculation

Figure 5 shows the least-cost/minimum spanning tree optimal pipeline route and the routes of the actual pipeline constructed, mapped on the cost raster.

Processing for pipeline start, mid, and end points was performed by geocoding provided city locations to a points representing the center of the city. These points were:

- Big Inch Pipeline (TETCO)
  1. Start: Longview, TX
  2. Midpoint 1: Little Rock, AR - point of convergence with Little Inch pipeline
  3. Midpoint 2: Norris City, IL - rail junction where pipeline(s) were constructed to in first stage of building, to initially transport oil to northeast via rail while construction on second stage eastward was still ongoing
  4. Midpoint 3 (split in two afterwards): Phoenixville, PA
  5. Endpoints (Chester Junction, PA and Linden, NJ)
- Little Inch Pipeline (TETCO)
  1. Start: Baytown, TX
  2. Midpoint: Little Rock, AR
  3. Same route as Big Inch Pipeline afterward
- TN Gas Pipeline
  1. Start: Banquette, TX
  2. Endpoint (initially): Cornwell Station, WV
- TN Gas Pipeline Extension (built in 1949)
  1. Start: West Bend, KY
  2. Endpoint: Buffalo, NY

Table A9. Pixel cost weights for pipeline construction

| **Pixel characteristic group** | **Land cover classifications (1942)** | **Weight ($lc_i$ value)** | **Source/Notes** |
|---|---|---|---|
| Extreme slope (>30%) | N/A | Impassible | Durmaz et al. (2019) |
| Average slope gradient | N/A | 1 | Weight is linear with average slope gradient, as used in Faber (2014). Jensen and Ellis (1967) document extra construction cost for machinery needed to bend pipe in difficult terrain, and Raley (2008) notes shortage of these machines during WW2 pipeline construction |
| Wetlands | Herbaceous Wetland; Wetland | 15 | Weight is ∼half as much as water streams (Abudu and Williams, 2015) |
| Developed | Urban/Developed | 23 | Average of 'urban centre' weights in different categories in Abudu and Williams (2015) |
| Agricultural | Cultivated Cropland | 7 | Opposition to Tennessee Gas Pipeline from farm owners en-route documented in Raley (2008) |
| Forest | Deciduous Forest; Evergreen Forest; Mixed Forest | 15 | Based on literature has some cost, more than agriculture but less than water likely (e.g. Love (1944); Casella and Wuebber (1999)) |
| Water (major rivers/lakes) | Open Water | 30 | e.g. See list of Tennessee Gas pipeline river crossings in Table 2 of Love (1944). Most are submerged or aerial. Maximum length is 1.04 miles. |
| Rocky land | Mining; Barren | 12 | Weight assumed - Harder to dig ditches in rocky areas for Big Inch pipeline (Casella and Wuebber, 1999) |
| Grassland, brush and pasture | Grassland; Shrubland; Hay/Pasture | 2 | Lowest-cost land to build on |

## A.3 0th stage regression results

These '0th stage' regressions test the validity of the IV for variable $x_c$ (Gas utility in 1940 x on actual pipeline route) by instrumenting each of its component terms.

### A.3.1 Predictors of Gas utility in 1940

First, we regress the extensive and intensive-margin measures of utility gas availability in county $c$ in 1940 on its log population, its distance from the nearest 'population center' (county $k$ with population $pop_{1940,k} \geq x$) and mean January temperature:

$$\mathbf{I}(UtilityGas_{1941,c}) = \alpha_0 + \alpha_1 \ln pop_{1940,c} + \alpha_2 \ln MilesToPopCenter_{cj\chi} + \alpha_3 TempJan_{1940,c} + \epsilon_c$$

where the dependent variable $\mathbf{I}(UtilityGas_{1941,c})$ is the extensive margin indicator of whether any communities in county $c$ had a gas utility in 1941, according to a 1942 report of the Federal Power Commission (FPC, 1942). $\ln MilestoPopCenter_{cj\chi}$ is the log distance in miles between $c$ and the nearest county $k$ with population $pop_{1940,k} \geq \chi$ where $\chi \in$ [50 thousand, 100 thousand, 250 thousand]. This provides a non-parametric approach to estimating the importance of county $c$ market access.

Table A10. Regressing $\mathbf{I}(UtilityGas_{1941,c})$ on distance to population centers and & ln(pop)

| | Pop centers: 50K+ pop | | | Pop centers: 100K+ pop | | | Pop centers: 250K+ pop | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| ln(pop.) 1940 | 0.245*** | | 0.226*** | 0.245*** | | 0.236*** | 0.245*** | | 0.236*** |
| | (0.027) | | (0.032) | (0.027) | | (0.033) | (0.027) | | (0.034) |
| Mean temp. Jan. | | | 0.021 | | | 0.019 | | | 0.014 |
| | | | (0.012) | | | (0.013) | | | (0.012) |
| ln(Distance to 1940 pop. center) | | -0.308*** | -0.167*** | | | | | | |
| | | (0.038) | (0.047) | | | | | | |
| ln(Distance to 1940 pop. center) | | | | | -0.219*** | -0.098*** | | | |
| | | | | | (0.033) | (0.033) | | | |
| ln(Distance to 1940 pop. center) | | | | | | | | -0.179*** | -0.076* |
| | | | | | | | | (0.039) | (0.041) |
| Constant | -1.908*** | 1.661*** | -1.223** | -1.908*** | 1.440*** | -1.525*** | -1.908*** | 1.371*** | -1.547*** |
| | (0.307) | (0.169) | (0.481) | (0.307) | (0.163) | (0.443) | (0.307) | (0.182) | (0.463) |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| R-Squared | 0.25 | 0.10 | 0.27 | 0.25 | 0.07 | 0.26 | 0.25 | 0.07 | 0.26 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX).Log distance to population center is ln(miles) to nearest county of certain population threshold (listed in columns)

### A.3.2 Optimal least-cost/minimum spanning tree pipeline route predicting actual route

We next regress measures of the actual pipeline route's presence in county $c$ on measures of the least-cost/minimum spanning tree optimal pipeline route by estimating the equation:

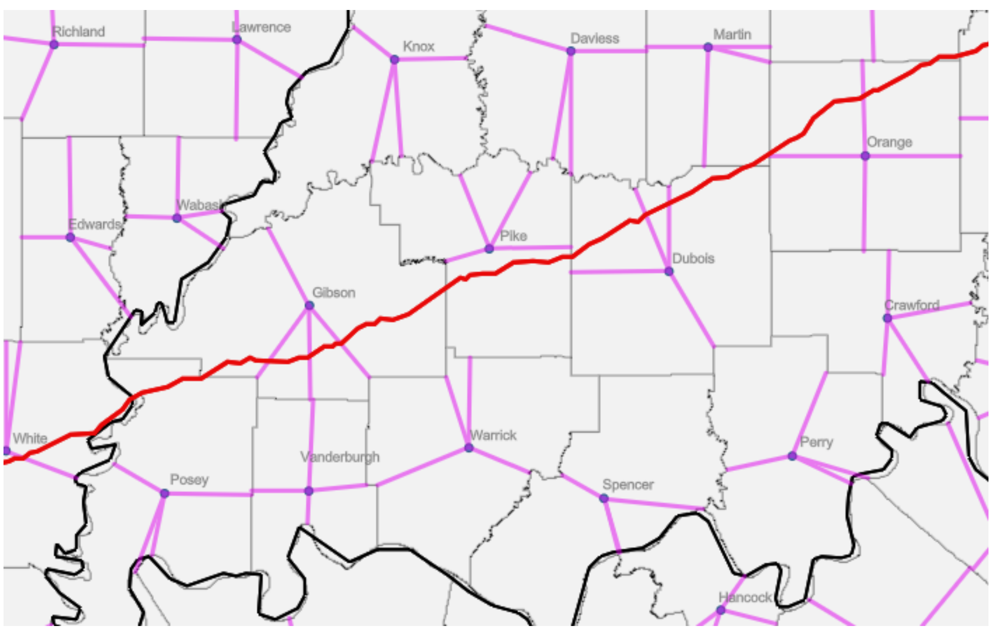
$$ActualRoute_c = \beta_0 + \beta_1 MSTRoute_c + \zeta_i$$

Where $ActualRoute_c$ and $MSTRoute_c$ are one of several analogous measures for the actual and least-cost/minimum spanning tree pipeline routes in county $c$:

1. Indicators for whether county $c$ is crossed by the pipeline route
2. Distance from county $c$ centroid to nearest point on pipeline route (in miles)
3. 'Density' of pipeline route in county $c$, i.e. the miles of pipeline route in county divided by the county diameter (the latter is estimated as twice the average distance (in miles) from county centroid to the four nearest neighboring-county borders; see example in Appendix Figure A1)

The results are provided in Table A11, with measures used in each column numbered as in the list above. Across all extensive and intensive-margin measures, the least-cost route strongly predicts the actual pipeline route.

**Figure A1:** Example of county pipeline density calculation




County pipeline density calculated as ratio of route length (in miles) to estimated county diameter (in miles), where latter is 2 * mean distance from county centroid to the four nearest neighboring-county borders. For pictured example in southwestern Indiana, Pike County is crossed by 14.4 miles of the least-cost/minimum spanning tree optimal route of the Inch Lines (in red). Its county diameter is estimated as 15.4 miles, equal to twice the average of the straight-line distances (in purple) from the Pike County centroid to the four closest county borders, with Gibson (4.7 miles), Knox (8.3 miles), Daviess (9.2 miles), and Dubois (8.6 miles) Counties). The pipeline route density is therefore calculated as $0.935 = 14.4/2 * (\frac{4.7+8.3+9.2+8.6}{4})$.

Table A11. Regressing actual pipeline route on least-cost optimal route

| | Dep Var: Actual Pipeline Route | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| | Presence | Distance | Density |
| I(MST route) | 0.712*** | | |
| | (0.080) | | |
| Distance to MST route | | 0.986*** | |
| | | (0.012) | |
| Density of MST route | | | 0.609*** |
| | | | (0.074) |
| Constant | 0.031** | 0.908 | 0.036*** |
| | (0.012) | (1.507) | (0.012) |
| Obs. | 1246 | 1246 | 1246 |
| DV mean | 0.113 | 93.712 | 0.099 |
| DV Std Dev | 0.317 | 71.082 | 0.309 |
| R-Squared | 0.517 | 0.982 | 0.422 |
| F-statistic | 79.614 | 7264.038 | 66.903 |

Standard errors clustered by state in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX).Dependent variable in Column (1) is indicator for county crossed by actual pipeline route; (2) is distance from county centroid to nearest point on actual pipeline route (in miles); (3) is the miles of actual pipeline route in county divided by (estimated) county diameter. Independent variables are defined analogously for optimal pipeline route calculated through least-cost/minimum spanning tree analysis based on geographic features.

## A.4 Full initial impacts regressions results

### A.4.1 OLS Regressions

Table A12. OLS reg. of 1940 to 1950
$\Delta$ gas-intense % of county emp on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 0.520 | 0.466 | 1.550*** | 0.978** | -1.157 | 0.675 |
| | (0.418) | (0.350) | (0.486) | (0.418) | (0.721) | (0.591) |
| Distance from pipeline | -0.000 | -0.000 | 0.004** | 0.002 | 0.015** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.007) |
| Gas utility in 1941=1 × Distance from pipeline | -0.005 | -0.005 | -0.010*** | -0.009*** | -0.017*** | -0.018*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| ln(pop.) 1940 | | -0.146 | | 0.167 | | -1.018*** |
| | | (0.138) | | (0.159) | | (0.351) |
| ln(Distance to 50K+ pop. county) | | -0.243 | | -0.190 | | 0.036 |
| | | (0.172) | | (0.312) | | (0.283) |
| % emp. manufacturing, 1940 | | -0.002 | | 0.035** | | 0.026 |
| | | (0.018) | | (0.017) | | (0.021) |
| % emp. agriculture, 1940 | | -0.004 | | -0.004 | | 0.059*** |
| | | (0.007) | | (0.007) | | (0.019) |
| Constant | 0.521 | 3.050 | 0.978** | 0.033 | 2.674** | 9.146** |
| | (0.352) | (1.804) | (0.459) | (2.231) | (1.148) | (4.422) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.14 | -0.14 | 0.94 | 0.94 | 2.53 | 2.53 |
| DV Std Dev | 2.54 | 2.54 | 3.04 | 3.04 | 4.99 | 4.99 |
| R-Squared | 0.04 | 0.05 | 0.08 | 0.10 | 0.09 | 0.17 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as all types of gas consumed (in million feet$^3$) per million dollars of value-added.

Table A13. OLS reg. of 1940 to 1950
$\Delta$ natural gas-intense % of county emp on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 0.381 | 0.445 | 1.302*** | 0.885** | -0.909 | 0.768 |
| | (0.399) | (0.338) | (0.407) | (0.364) | (0.658) | (0.536) |
| Distance from pipeline | -0.000 | -0.000 | 0.004** | 0.003 | 0.015** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941=1 × Distance from pipeline | -0.005 | -0.005 | -0.011*** | -0.010*** | -0.016*** | -0.017*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| ln(pop.) 1940 | | -0.186 | | 0.138 | | -0.989*** |
| | | (0.140) | | (0.148) | | (0.332) |
| ln(Distance to 50K+ pop. county) | | -0.246 | | -0.088 | | -0.065 |
| | | (0.160) | | (0.279) | | (0.335) |
| % emp. manufacturing, 1940 | | -0.015 | | 0.019 | | 0.042* |
| | | (0.020) | | (0.016) | | (0.023) |
| % emp. agriculture, 1940 | | -0.005 | | -0.006 | | 0.061*** |
| | | (0.007) | | (0.008) | | (0.018) |
| Constant | 0.421 | 3.499* | 0.818** | -0.015 | 2.833** | 9.194** |
| | (0.343) | (1.801) | (0.365) | (2.124) | (1.149) | (4.321) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.35 | -0.35 | 0.78 | 0.78 | 2.69 | 2.69 |
| DV Std Dev | 2.67 | 2.67 | 2.91 | 2.91 | 4.94 | 4.94 |
| R-Squared | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.15 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as natural and mixed gas consumed (in million feet$^3$) per million dollars of value-added.

Table A14. OLS reg. of 1940 to 1950

$\Delta$ electricity-intense % of county emp on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 1.534** | 1.595** | 1.670*** | 1.156*** | -1.277** | 0.497 |
| | (0.551) | (0.575) | (0.337) | (0.309) | (0.608) | (0.536) |
| Distance from pipeline | -0.014** | -0.010** | 0.012*** | 0.010*** | 0.007 | 0.009 |
| | (0.006) | (0.004) | (0.002) | (0.003) | (0.005) | (0.006) |
| Gas utility in 1941=1 × Distance from pipeline | -0.022*** | -0.023*** | -0.015*** | -0.014*** | -0.012** | -0.013** |
| | (0.006) | (0.006) | (0.004) | (0.004) | (0.005) | (0.006) |
| ln(pop.) 1940 | | 0.365 | | 0.055 | | -0.906** |
| | | (0.432) | | (0.146) | | (0.384) |
| ln(Distance to 50K+ pop. county) | | 0.522 | | -0.318 | | 0.164 |
| | | (0.550) | | (0.221) | | (0.362) |
| % emp. manufacturing, 1940 | | -0.118 | | 0.038 | | 0.023 |
| | | (0.113) | | (0.029) | | (0.022) |
| % emp. agriculture, 1940 | | -0.038 | | -0.002 | | 0.056** |
| | | (0.025) | | (0.009) | | (0.022) |
| Constant | 2.744*** | 0.113 | -0.107 | 0.378 | 3.759*** | 8.801* |
| | (0.930) | (5.714) | (0.374) | (1.723) | (1.035) | (5.099) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.59 | -0.59 | 1.13 | 1.13 | 2.34 | 2.34 |
| DV Std Dev | 5.83 | 5.83 | 3.07 | 3.07 | 4.86 | 4.86 |
| R-Squared | 0.17 | 0.19 | 0.03 | 0.06 | 0.06 | 0.14 |

Standard errors clustered by state in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as cost of purchased electricity as share of value-added.

Table A15. OLS reg. of 1940 to 1950
$\Delta$ other sector emp or total pop on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Agriculture | | Services/other | | $\Delta$ln(population) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | -1.800 | -3.956*** | 1.407** | 2.304*** | 7.349*** | 0.012 |
| | (1.072) | (0.916) | (0.564) | (0.477) | (1.838) | (2.020) |
| Distance from pipeline | -0.024** | -0.025** | 0.005 | 0.006 | 0.044** | 0.017 |
| | (0.009) | (0.009) | (0.005) | (0.005) | (0.017) | (0.011) |
| Gas utility in 1941=1 × Distance from pipeline | 0.024*** | 0.024*** | 0.003 | 0.003 | -0.012 | 0.009 |
| | (0.007) | (0.007) | (0.006) | (0.005) | (0.012) | (0.011) |
| ln(pop.) 1940 | | 0.732** | | 0.119 | 5.202*** | 0.538 |
| | | (0.349) | | (0.333) | (0.934) | (1.048) |
| ln(Distance to 50K+ pop. county) | | 1.211*** | | -1.057** | | -7.222*** |
| | | (0.376) | | (0.385) | | (2.140) |
| % emp. manufacturing, 1940 | | -0.084*** | | 0.023 | | 0.073 |
| | | (0.024) | | (0.031) | | (0.109) |
| % emp. agriculture, 1940 | | -0.134*** | | 0.079*** | | -0.350*** |
| | | (0.024) | | (0.023) | | (0.080) |
| Constant | -4.340** | -8.518* | 0.688 | -0.661 | -58.542*** | 31.129 |
| | (1.586) | (4.566) | (0.614) | (4.106) | (10.250) | (19.175) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | Y | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -7.89 | -7.89 | 4.42 | 4.42 | 3.16 | 3.16 |
| DV Std Dev | 5.96 | 5.96 | 6.07 | 6.07 | 15.63 | 15.63 |
| R-Squared | 0.15 | 0.26 | 0.17 | 0.20 | 0.21 | 0.40 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are change from 1940 to 1950 in sector share of total county employment (Columns 1-4) or change in log total population (Columns 5-6)

### A.4.2 Reduced Form Regressions

Table A16. Reduced form reg. of 1940 to 1950
$\Delta$gas-intense % of county emp on I(UtilityGas$_{1941,c}$) x $MSTDistance_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 0.411 | 0.364 | 1.484*** | 0.915** | -1.182 | 0.650 |
| | (0.382) | (0.322) | (0.483) | (0.422) | (0.746) | (0.598) |
| Distance from MST pipeline | -0.000 | -0.001 | 0.004** | 0.002 | 0.015** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941=1 × Distance from MST pipeline | -0.004 | -0.004 | -0.009*** | -0.009** | -0.017*** | -0.018*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| ln(pop.) 1940 | | -0.148 | | 0.164 | | -1.019*** |
| | | (0.139) | | (0.161) | | (0.352) |
| ln(Distance to 50K+ pop. county) | | -0.249 | | -0.192 | | 0.026 |
| | | (0.175) | | (0.315) | | (0.283) |
| % emp. manufacturing, 1940 | | -0.003 | | 0.034* | | 0.026 |
| | | (0.017) | | (0.017) | | (0.020) |
| % emp. agriculture, 1940 | | -0.004 | | -0.004 | | 0.058*** |
| | | (0.007) | | (0.007) | | (0.019) |
| Constant | 0.537 | 3.132 | 0.986** | 0.100 | 2.658** | 9.210** |
| | (0.347) | (1.848) | (0.465) | (2.267) | (1.145) | (4.411) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.14 | -0.14 | 0.94 | 0.94 | 2.53 | 2.53 |
| DV Std Dev | 2.54 | 2.54 | 3.04 | 3.04 | 4.99 | 4.99 |
| R-Squared | 0.04 | 0.04 | 0.07 | 0.10 | 0.09 | 0.17 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as all types of gas consumed (in million feet$^3$) per million dollars of value-added.

Table A17. Reduced form reg. of 1940 to 1950

$\Delta$ natural gas-intense % of county emp on I(UtilityGas$_{1941,c}$) x $MSTDistance_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 0.273 | 0.344 | 1.234*** | 0.820** | -0.932 | 0.745 |
| | (0.361) | (0.308) | (0.400) | (0.365) | (0.682) | (0.543) |
| Distance from MST pipeline | -0.001 | -0.000 | 0.004** | 0.003 | 0.015** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941=1 × Distance from MST pipeline | -0.004 | -0.004 | -0.010*** | -0.009*** | -0.016*** | -0.017*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| ln(pop.) 1940 | | -0.188 | | 0.134 | | -0.990*** |
| | | (0.142) | | (0.150) | | (0.332) |
| ln(Distance to 50K+ pop. county) | | -0.252 | | -0.090 | | -0.075 |
| | | (0.164) | | (0.280) | | (0.335) |
| % emp. manufacturing, 1940 | | -0.017 | | 0.017 | | 0.042* |
| | | (0.019) | | (0.016) | | (0.022) |
| % emp. agriculture, 1940 | | -0.005 | | -0.006 | | 0.060*** |
| | | (0.007) | | (0.008) | | (0.018) |
| Constant | 0.435 | 3.579* | 0.827** | 0.061 | 2.817** | 9.249** |
| | (0.338) | (1.844) | (0.370) | (2.166) | (1.146) | (4.304) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.35 | -0.35 | 0.78 | 0.78 | 2.69 | 2.69 |
| DV Std Dev | 2.67 | 2.67 | 2.91 | 2.91 | 4.94 | 4.94 |
| R-Squared | 0.04 | 0.04 | 0.05 | 0.07 | 0.08 | 0.15 |

Standard errors clustered by state in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as natural and mixed gas consumed (in million feet$^3$) per million dollars of value-added.

Table A18. Reduced form reg. of 1940 to 1950
$\Delta$ electricity-intense % of county emp on I(UtilityGas$_{1941,c}$) x $MSTDistance_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | 1.517** | 1.624** | 1.629*** | 1.111*** | -1.328** | 0.454 |
| | (0.576) | (0.605) | (0.344) | (0.304) | (0.641) | (0.550) |
| Distance from MST pipeline | -0.013* | -0.009** | 0.011*** | 0.009*** | 0.008 | 0.009 |
| | (0.006) | (0.004) | (0.002) | (0.002) | (0.005) | (0.006) |
| Gas utility in 1941=1 × Distance from MST pipeline | -0.022*** | -0.023*** | -0.015*** | -0.014*** | -0.011** | -0.013** |
| | (0.006) | (0.007) | (0.004) | (0.004) | (0.005) | (0.006) |
| ln(pop.) 1940 | | 0.349 | | 0.048 | | -0.903** |
| | | (0.434) | | (0.145) | | (0.384) |
| ln(Distance to 50K+ pop. county) | | 0.556 | | -0.323 | | 0.157 |
| | | (0.560) | | (0.218) | | (0.366) |
| % emp. manufacturing, 1940 | | -0.123 | | 0.038 | | 0.021 |
| | | (0.114) | | (0.029) | | (0.021) |
| % emp. agriculture, 1940 | | -0.039 | | -0.002 | | 0.056** |
| | | (0.025) | | (0.009) | | (0.022) |
| Constant | 2.601*** | 0.090 | -0.045 | 0.526 | 3.689*** | 8.783* |
| | (0.913) | (5.731) | (0.379) | (1.721) | (1.040) | (5.112) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.59 | -0.59 | 1.13 | 1.13 | 2.34 | 2.34 |
| DV Std Dev | 5.83 | 5.83 | 3.07 | 3.07 | 4.86 | 4.86 |
| R-Squared | 0.15 | 0.18 | 0.03 | 0.06 | 0.06 | 0.14 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as cost of purchased electricity as share of value-added.

Table A19. Reduced form reg. of 1940 to 1950
$\Delta$ other sector emp or total pop on I(UtilityGas$_{1941,c}$) x $MSTDistance_c$

| | Agriculture | | Services/other | | $\Delta$ln(population) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Gas utility in 1941=1 | -1.860* | -4.002*** | 1.558*** | 2.437*** | 7.006*** | 0.039 |
| | (1.086) | (0.923) | (0.555) | (0.464) | (1.585) | (2.002) |
| Distance from MST pipeline | -0.025*** | -0.025** | 0.006 | 0.007 | 0.042** | 0.016 |
| | (0.009) | (0.009) | (0.005) | (0.005) | (0.017) | (0.010) |
| Gas utility in 1941=1 × Distance from MST pipeline | 0.025*** | 0.025*** | 0.001 | 0.001 | -0.012 | 0.008 |
| | (0.007) | (0.007) | (0.005) | (0.005) | (0.012) | (0.010) |
| ln(pop.) 1940 | | 0.731** | | 0.125 | 5.123*** | 0.550 |
| | | (0.351) | | (0.334) | (1.015) | (1.048) |
| ln(Distance to 50K+ pop. county) | | 1.220*** | | -1.055** | | -7.250*** |
| | | (0.377) | | (0.388) | | (2.141) |
| % emp. manufacturing, 1940 | | -0.085*** | | 0.025 | | 0.077 |
| | | (0.024) | | (0.031) | | (0.109) |
| % emp. agriculture, 1940 | | -0.134*** | | 0.080*** | | -0.350*** |
| | | (0.025) | | (0.024) | | (0.080) |
| Constant | -4.296** | -8.521* | 0.652 | -0.788 | -56.862*** | 31.128 |
| | (1.582) | (4.546) | (0.607) | (4.127) | (10.638) | (19.045) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | Y | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -7.89 | -7.89 | 4.42 | 4.42 | 3.16 | 3.16 |
| DV Std Dev | 5.96 | 5.96 | 6.07 | 6.07 | 15.63 | 15.63 |
| R-Squared | 0.15 | 0.26 | 0.17 | 0.20 | 0.21 | 0.40 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Independent variables are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are change from 1940 to 1950 in sector share of total county employment (Columns 1-4) or change in log total population (Columns 5-6)

### A.4.3 2SLS Regressions

Table A20. 2SLS reg. of 1940 to 1950

$\Delta$ all gas-intense % of county emp on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.000 | -0.001 | 0.004** | 0.002 | 0.015*** | 0.016** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941 | 0.415 | 0.363 | 1.495*** | 0.920** | -1.157 | 0.684 |
| | (0.378) | (0.316) | (0.474) | (0.409) | (0.733) | (0.591) |
| Gas utility in 1941 x distance to pipeline | -0.004 | -0.004 | -0.009*** | -0.009*** | -0.017*** | -0.018*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| ln(pop.) 1940 | | -0.144 | | 0.169 | | -1.016*** |
| | | (0.135) | | (0.156) | | (0.342) |
| ln(Distance to 50K+ pop. county) | | -0.253 | | -0.196 | | 0.037 |
| | | (0.171) | | (0.307) | | (0.278) |
| % emp. manufacturing, 1940 | | -0.003 | | 0.034** | | 0.026 |
| | | (0.017) | | (0.017) | | (0.020) |
| % emp. agriculture, 1940 | | -0.004 | | -0.004 | | 0.059*** |
| | | (0.006) | | (0.007) | | (0.018) |
| Constant | 0.540 | 3.111* | 0.983** | 0.050 | 2.636** | 9.110** |
| | (0.346) | (1.794) | (0.454) | (2.200) | (1.127) | (4.296) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.14 | -0.14 | 0.94 | 0.94 | 2.53 | 2.53 |
| DV Std Dev | 2.54 | 2.54 | 3.04 | 3.04 | 4.99 | 4.99 |
| R-Squared | 0.04 | 0.05 | 0.08 | 0.10 | 0.09 | 0.17 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3342.2 | 3424.6 |

Standard errors clustered by state in parentheses.

Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results shown in table. Explanatory variables of interest are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route, where latter is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as all types of gas consumed (in million feet$^3$) per million dollars of value-added.

Table A21. 2SLS reg. of 1940 to 1950
$\Delta$ natural gas-intense % of county emp on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.001 | -0.000 | 0.004** | 0.003 | 0.015*** | 0.016*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.006) | (0.006) |
| Gas utility in 1941 | 0.277 | 0.344 | 1.246*** | 0.826** | -0.907 | 0.778 |
| | (0.357) | (0.302) | (0.392) | (0.353) | (0.670) | (0.535) |
| Gas utility in 1941 x distance to pipeline | -0.004 | -0.004 | -0.010*** | -0.010*** | -0.016*** | -0.017*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) |
| ln(pop.) 1940 | | -0.185 | | 0.140 | | -0.987*** |
| | | (0.137) | | (0.145) | | (0.323) |
| ln(Distance to 50K+ pop. county) | | -0.256 | | -0.094 | | -0.065 |
| | | (0.160) | | (0.274) | | (0.329) |
| % emp. manufacturing, 1940 | | -0.017 | | 0.018 | | 0.042* |
| | | (0.019) | | (0.015) | | (0.022) |
| % emp. agriculture, 1940 | | -0.005 | | -0.006 | | 0.061*** |
| | | (0.007) | | (0.008) | | (0.017) |
| Constant | 0.438 | 3.557** | 0.825** | 0.007 | 2.795** | 9.153** |
| | (0.338) | (1.790) | (0.360) | (2.100) | (1.128) | (4.196) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.35 | -0.35 | 0.78 | 0.78 | 2.69 | 2.69 |
| DV Std Dev | 2.67 | 2.67 | 2.91 | 2.91 | 4.94 | 4.94 |
| R-Squared | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.15 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3342.2 | 3424.6 |

Standard errors clustered by state in parentheses.
Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results shown in table. Explanatory variables of interest are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route, where latter is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as natural and mixed gas consumed (in million feet$^3$) per million dollars of value-added.

Table A22. 2SLS reg. of 1940 to 1950
$\Delta$ electricity-intense % of county emp on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Top decile | | Top quartile | | Other manufacturing | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.013** | -0.009** | 0.011*** | 0.009*** | 0.008 | 0.009 |
| | (0.006) | (0.004) | (0.002) | (0.002) | (0.005) | (0.006) |
| Gas utility in 1941 | 1.532*** | 1.607*** | 1.650*** | 1.130*** | -1.312** | 0.474 |
| | (0.555) | (0.572) | (0.333) | (0.292) | (0.628) | (0.543) |
| Gas utility in 1941 x distance to pipeline | -0.022*** | -0.023*** | -0.015*** | -0.014*** | -0.012** | -0.013** |
| | (0.006) | (0.006) | (0.004) | (0.004) | (0.005) | (0.006) |
| ln(pop.) 1940 | | 0.374 | | 0.052 | | -0.900** |
| | | (0.420) | | (0.143) | | (0.373) |
| ln(Distance to 50K+ pop. county) | | 0.521 | | -0.320 | | 0.161 |
| | | (0.536) | | (0.213) | | (0.358) |
| % emp. manufacturing, 1940 | | -0.120 | | 0.038 | | 0.022 |
| | | (0.111) | | (0.028) | | (0.021) |
| % emp. agriculture, 1940 | | -0.039 | | -0.002 | | 0.056*** |
| | | (0.024) | | (0.009) | | (0.021) |
| Constant | 2.638*** | -0.047 | -0.060 | 0.448 | 3.679*** | 8.711* |
| | (0.900) | (5.551) | (0.365) | (1.694) | (1.020) | (4.979) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | N | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -0.59 | -0.59 | 1.13 | 1.13 | 2.34 | 2.34 |
| DV Std Dev | 5.83 | 5.83 | 3.07 | 3.07 | 4.86 | 4.86 |
| R-Squared | 0.17 | 0.19 | 0.03 | 0.06 | 0.06 | 0.14 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3342.2 | 3424.6 |

Standard errors clustered by state in parentheses.
Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results shown in table. Explanatory variables of interest are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route, where latter is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects. Dependent variables are 100 x percentage point change from 1940 to 1950 in employment in top-decile or top-quartile energy-intensive industries or other manufacturing industries as a share of total county employment. Energy intensity is defined contemporaneously with employment as cost of purchased electricity as share of value-added.

Table A23. 2SLS reg. of 1940 to 1950
$\Delta$ other sector % of county emp or total pop on I(UtilityGas$_{1941,c}$) x $PipelineProximity_c$

| | Agriculture. | | Services/other | | $\Delta$ln(population) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Distance from pipeline | -0.025*** | -0.025*** | 0.006 | 0.007 | 0.042** | 0.017 |
| | (0.009) | (0.009) | (0.005) | (0.005) | (0.017) | (0.010) |
| Gas utility in 1941 | -1.898* | -4.055*** | 1.560*** | 2.451*** | 7.344*** | 0.072 |
| | (1.063) | (0.903) | (0.544) | (0.452) | (1.858) | (1.954) |
| Gas utility in 1941 x distance to pipeline | 0.025*** | 0.025*** | 0.001 | 0.001 | -0.013 | 0.009 |
| | (0.007) | (0.007) | (0.005) | (0.005) | (0.012) | (0.010) |
| ln(pop.) 1940 | | 0.729** | | 0.119 | 5.203*** | 0.532 |
| | | (0.340) | | (0.324) | (0.915) | (1.019) |
| ln(Distance to 50K+ pop. county) | | 1.201*** | | -1.042*** | | -7.215*** |
| | | (0.365) | | (0.377) | | (2.091) |
| % emp. manufacturing, 1940 | | -0.084*** | | 0.025 | | 0.075 |
| | | (0.023) | | (0.030) | | (0.107) |
| % emp. agriculture, 1940 | | -0.134*** | | 0.080*** | | -0.350*** |
| | | (0.024) | | (0.023) | | (0.079) |
| Constant | -4.259*** | -8.382* | 0.639 | -0.778 | -58.391*** | 31.183* |
| | (1.552) | (4.434) | (0.594) | (4.009) | (9.999) | (18.641) |
| Census Region FE | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | N | Y | N | Y | Y | Y |
| ln(Dist. to City) | N | Y | N | Y | N | Y |
| 1940 Emp. Shares | N | Y | N | Y | N | Y |
| Obs. | 1246 | 1246 | 1246 | 1246 | 1246 | 1246 |
| DV Mean | -7.89 | -7.89 | 4.42 | 4.42 | 3.16 | 3.16 |
| DV Std Dev | 5.96 | 5.96 | 6.07 | 6.07 | 15.63 | 15.63 |
| R-Squared | 0.15 | 0.26 | 0.17 | 0.20 | 0.21 | 0.40 |
| F-stat | 3342.2 | 3424.6 | 3342.2 | 3424.6 | 3624.1 | 3424.6 |

Standard errors clustered by state in parentheses.

Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results shown in table. Explanatory variables of interest are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route, where latter is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Even-numbered columns include controls for 1940 log population, log distance to closest county with population $\geq$ 50K, share of total county employment in manufacturing or in agriculture, and census region fixed effects.Dependent variables are change from 1940 to 1950 in share of total county employment in agriculture (Columns 1-2), services and other sectors (Columns 3-4), or change in log population (Columns 5-6).

## A.5 Full long-term employment regression results with energy-intense employment defined based on 1947 industry energy intensity

Table A24. Δ % of county emp since 1940 in all gas-intensive industries

(a) Top decile

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | -0.001 | -0.004 | 0.001 | 0.003 | 0.001 | 0.003 | 0.003 | 0.002 | 0.003 | 0.004 | 0.004* |
| | (0.002) | (0.003) | (0.003) | (0.004) | (0.003) | (0.003) | (0.003) | (0.002) | (0.003) | (0.003) | (0.002) |
| Gas utility in 1941 | 0.363 | 0.952** | 1.198*** | 0.444 | 0.596* | 0.829** | 0.547 | -0.029 | -0.407 | -0.260 | -0.392 |
| | (0.316) | (0.485) | (0.388) | (0.398) | (0.344) | (0.370) | (0.381) | (0.309) | (0.349) | (0.375) | (0.404) |
| Gas utility in 1941 x distance to pipeline | -0.004 | -0.004 | -0.005 | -0.003 | -0.002 | -0.002 | -0.000 | 0.003 | 0.005 | 0.004 | 0.006* |
| | (0.003) | (0.004) | (0.003) | (0.004) | (0.003) | (0.003) | (0.004) | (0.003) | (0.003) | (0.003) | (0.003) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | -0.14 | 0.64 | 0.26 | -0.23 | 0.18 | 0.06 | -0.16 | -0.45 | -0.53 | -0.64 | -0.72 |
| DV Std Dev | 2.54 | 5.73 | 5.00 | 4.24 | 3.88 | 3.93 | 3.82 | 3.59 | 4.00 | 3.64 | 3.71 |
| R-Squared | 0.05 | 0.02 | 0.01 | 0.03 | 0.04 | 0.05 | 0.08 | 0.12 | 0.12 | 0.16 | 0.17 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

(b) Top quartile

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.002 | 0.012** | 0.021*** | 0.012* | 0.008 | 0.013*** | 0.012* | 0.016*** | 0.015** | 0.014** | 0.016** |
| | (0.002) | (0.006) | (0.004) | (0.007) | (0.006) | (0.005) | (0.007) | (0.006) | (0.006) | (0.006) | (0.006) |
| Gas utility in 1941 | 0.920** | 7.277*** | 7.722*** | 5.532*** | 5.134*** | 5.538*** | 4.359*** | 3.418*** | 2.858** | 2.740** | 2.595** |
| | (0.409) | (1.423) | (1.231) | (1.146) | (0.977) | (0.989) | (1.246) | (1.177) | (1.120) | (1.321) | (1.296) |
| Gas utility in 1941 x distance to pipeline | -0.009*** | -0.031*** | -0.037*** | -0.023*** | -0.019*** | -0.023*** | -0.014** | -0.013** | -0.008 | -0.006 | -0.006 |
| | (0.003) | (0.007) | (0.006) | (0.007) | (0.005) | (0.004) | (0.007) | (0.006) | (0.006) | (0.006) | (0.006) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 0.94 | 5.09 | 5.46 | 4.51 | 5.06 | 4.76 | 4.37 | 3.69 | 3.67 | 3.39 | 3.32 |
| DV Std Dev | 3.04 | 11.52 | 11.53 | 10.14 | 9.40 | 9.21 | 8.90 | 8.80 | 9.05 | 8.98 | 9.01 |
| R-Squared | 0.10 | 0.05 | 0.04 | 0.04 | 0.05 | 0.06 | 0.07 | 0.09 | 0.11 | 0.14 | 0.14 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county *c* had a gas utility in 1941 and distance from county *c* centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in % of total county employment in

(c) Other manufacturing

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.016** | 0.028 | -0.010 | -0.007 | -0.013 | -0.006 | 0.001 | -0.023 | -0.032 | -0.037** | -0.032** |
| | (0.006) | (0.048) | (0.036) | (0.032) | (0.027) | (0.030) | (0.027) | (0.022) | (0.020) | (0.018) | (0.014) |
| Gas utility in 1941 | 0.684 | -2.825 | -4.946 | -2.872 | -3.035 | -2.985 | -2.047 | -3.735 | -4.470* | -3.798* | -3.063* |
| | (0.591) | (4.948) | (4.689) | (4.373) | (3.436) | (3.868) | (3.720) | (2.872) | (2.430) | (2.237) | (1.692) |
| Gas utility in 1941 x distance to pipeline | -0.018*** | -0.014 | 0.007 | -0.004 | -0.000 | -0.001 | -0.009 | 0.010 | 0.016 | 0.019 | 0.011 |
| | (0.005) | (0.042) | (0.036) | (0.033) | (0.028) | (0.031) | (0.028) | (0.022) | (0.021) | (0.019) | (0.015) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 2.53 | 21.08 | 20.49 | 20.55 | 20.48 | 17.80 | 15.47 | 13.56 | 11.64 | 10.27 | 8.55 |
| DV Std Dev | 4.99 | 20.85 | 19.20 | 18.57 | 17.93 | 17.36 | 16.80 | 16.81 | 16.91 | 16.54 | 15.64 |
| R-Squared | 0.17 | 0.25 | 0.24 | 0.27 | 0.38 | 0.38 | 0.41 | 0.43 | 0.47 | 0.48 | 0.46 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

Standard errors clustered by state in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(d) Services/other sectors

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.007 | -0.034 | -0.011 | -0.005 | 0.005 | -0.008 | -0.013 | 0.007 | 0.017 | 0.021 | 0.014 |
| | (0.005) | (0.043) | (0.033) | (0.030) | (0.029) | (0.030) | (0.028) | (0.024) | (0.022) | (0.020) | (0.016) |
| Gas utility in 1941 | 2.451*** | -2.808 | -2.717 | -2.378 | -2.263 | -2.777 | -2.457 | 0.284 | 1.578 | 0.936 | 0.247 |
| | (0.452) | (4.369) | (4.696) | (4.005) | (4.042) | (4.351) | (4.170) | (3.562) | (2.997) | (2.872) | (2.198) |
| Gas utility in 1941 x distance to pipeline | 0.001 | 0.035 | 0.030 | 0.027 | 0.020 | 0.024 | 0.023 | 0.002 | -0.008 | -0.011 | -0.003 |
| | (0.005) | (0.034) | (0.032) | (0.029) | (0.029) | (0.030) | (0.028) | (0.024) | (0.022) | (0.020) | (0.016) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 4.42 | 9.55 | 10.24 | 11.14 | 11.57 | 14.52 | 17.10 | 19.67 | 21.54 | 23.23 | 24.93 |
| DV Std Dev | 6.07 | 20.47 | 19.32 | 18.43 | 17.22 | 16.85 | 16.09 | 15.61 | 14.92 | 14.82 | 15.14 |
| R-Squared | 0.20 | 0.35 | 0.39 | 0.41 | 0.35 | 0.32 | 0.31 | 0.26 | 0.24 | 0.25 | 0.30 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in % of total county employment in specified sector (top-decile or top-quartile energy-intensive industries or other manufacturing industries or service and other industries). Energy-intense employment defined based on

## Table A25. Δ % of county emp since 1940 in natural/mixed gas-intensive industries

### (a) Top decile

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | -0.000 | -0.004 | 0.001 | 0.003 | 0.001 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004* |
| | (0.002) | (0.003) | (0.003) | (0.004) | (0.003) | (0.003) | (0.003) | (0.002) | (0.003) | (0.003) | (0.002) |
| Gas utility in 1941 | 0.344 | 0.933** | 1.179*** | 0.425 | 0.577* | 0.810** | 0.528 | -0.047 | -0.426 | -0.279 | -0.411 |
| | (0.302) | (0.472) | (0.382) | (0.395) | (0.344) | (0.369) | (0.386) | (0.321) | (0.359) | (0.383) | (0.413) |
| Gas utility in 1941 x distance to pipeline | -0.004 | -0.004 | -0.006 | -0.003 | -0.002 | -0.002 | -0.001 | 0.003 | 0.005 | 0.004 | 0.005* |
| | (0.003) | (0.004) | (0.004) | (0.004) | (0.003) | (0.003) | (0.004) | (0.003) | (0.003) | (0.004) | (0.003) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | -0.35 | 0.43 | 0.05 | -0.44 | -0.03 | -0.15 | -0.37 | -0.66 | -0.74 | -0.85 | -0.92 |
| DV Std Dev | 2.67 | 5.80 | 5.07 | 4.33 | 3.99 | 4.06 | 3.95 | 3.73 | 4.14 | 3.79 | 3.86 |
| R-Squared | 0.05 | 0.02 | 0.02 | 0.04 | 0.05 | 0.06 | 0.09 | 0.14 | 0.14 | 0.19 | 0.20 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

### (b) Top quartile

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.003 | 0.013** | 0.021*** | 0.010 | 0.008 | 0.014*** | 0.010 | 0.014** | 0.013** | 0.013** | 0.014** |
| | (0.002) | (0.006) | (0.004) | (0.008) | (0.006) | (0.005) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| Gas utility in 1941 | 0.826** | 7.206*** | 7.472*** | 5.613*** | 5.267*** | 5.618*** | 4.225*** | 3.230*** | 2.588** | 2.598** | 2.408* |
| | (0.353) | (1.236) | (1.047) | (1.143) | (0.938) | (0.935) | (1.217) | (1.169) | (1.091) | (1.275) | (1.249) |
| Gas utility in 1941 x distance to pipeline | -0.010*** | -0.033*** | -0.038*** | -0.023*** | -0.020*** | -0.024*** | -0.014** | -0.012* | -0.008 | -0.006 | -0.005 |
| | (0.003) | (0.007) | (0.006) | (0.008) | (0.005) | (0.005) | (0.007) | (0.007) | (0.006) | (0.006) | (0.006) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 0.78 | 5.10 | 5.39 | 4.83 | 5.13 | 4.63 | 4.24 | 3.64 | 3.62 | 3.31 | 3.23 |
| DV Std Dev | 2.91 | 11.53 | 11.46 | 10.33 | 9.33 | 9.08 | 8.79 | 8.76 | 9.01 | 8.93 | 8.93 |
| R-Squared | 0.07 | 0.04 | 0.04 | 0.04 | 0.05 | 0.06 | 0.07 | 0.09 | 0.11 | 0.14 | 0.14 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in % of total county employment in

(c) Other manufacturing

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.016*** | 0.027 | -0.010 | -0.005 | -0.013 | -0.006 | 0.002 | -0.021 | -0.030 | -0.036** | -0.031** |
| | (0.006) | (0.047) | (0.036) | (0.033) | (0.027) | (0.030) | (0.027) | (0.022) | (0.020) | (0.018) | (0.015) |
| Gas utility in 1941 | 0.778 | -2.754 | -4.696 | -2.954 | -3.168 | -3.065 | -1.913 | -3.548 | -4.200* | -3.656 | -2.876* |
| | (0.535) | (4.922) | (4.626) | (4.539) | (3.449) | (3.922) | (3.795) | (2.938) | (2.530) | (2.307) | (1.706) |
| Gas utility in 1941 x distance to pipeline | -0.017*** | -0.012 | 0.008 | -0.004 | 0.001 | 0.001 | -0.009 | 0.010 | 0.016 | 0.019 | 0.011 |
| | (0.005) | (0.042) | (0.035) | (0.033) | (0.028) | (0.031) | (0.028) | (0.022) | (0.021) | (0.019) | (0.015) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 2.69 | 21.08 | 20.56 | 20.23 | 20.41 | 17.93 | 15.60 | 13.61 | 11.69 | 10.36 | 8.64 |
| DV Std Dev | 4.94 | 20.79 | 19.11 | 18.64 | 17.92 | 17.31 | 16.81 | 16.84 | 16.92 | 16.56 | 15.66 |
| R-Squared | 0.15 | 0.24 | 0.23 | 0.27 | 0.38 | 0.37 | 0.40 | 0.42 | 0.46 | 0.47 | 0.45 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

Standard errors clustered by state in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in % of total county employment in specified sector (top-decile or top-quartile energy-intensive industries or other manufacturing industries or service and other industries). Energy-intense employment defined based on industry energy consumption and value-added in 1939 for 1940 employment shares and in 1947 for all post-war employment shares, as natural and mixed gas consumed (in million feet$^3$) per million dollars of value-added.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A26. Δ % of county emp since 1940 in electricity-intensive industries

(a) Top decile

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | -0.009** | -0.000 | 0.002 | 0.001 | -0.001 | -0.000 | -0.001 | -0.001 | 0.001 | -0.000 | -0.002 |
| | (0.004) | (0.005) | (0.005) | (0.006) | (0.006) | (0.006) | (0.007) | (0.007) | (0.005) | (0.007) | (0.007) |
| Gas utility in 1941 | 1.607*** | 3.874*** | 4.505*** | 3.464*** | 3.488*** | 3.675*** | 3.043*** | 2.602*** | 2.733*** | 2.536*** | 2.057** |
| | (0.572) | (1.031) | (0.936) | (0.802) | (0.614) | (0.756) | (0.702) | (0.609) | (0.553) | (0.594) | (0.561) |
| Gas utility in 1941 x distance to pipeline | -0.023*** | -0.034*** | -0.038*** | -0.033*** | -0.031*** | -0.032*** | -0.028*** | -0.026*** | -0.028*** | -0.027*** | -0.024** |
| | (0.006) | (0.007) | (0.006) | (0.006) | (0.006) | (0.006) | (0.007) | (0.006) | (0.005) | (0.006) | (0.006) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | -0.59 | 0.60 | 0.68 | 0.19 | 0.76 | 0.67 | 0.43 | 0.16 | -0.14 | -0.23 | -0.29 |
| DV Std Dev | 5.83 | 8.81 | 8.71 | 8.00 | 8.01 | 8.02 | 7.72 | 7.46 | 7.21 | 6.99 | 6.88 |
| R-Squared | 0.19 | 0.09 | 0.10 | 0.13 | 0.11 | 0.12 | 0.14 | 0.16 | 0.18 | 0.20 | 0.21 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

(b) Top quartile

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.009*** | 0.038*** | 0.041*** | 0.034*** | 0.023*** | 0.027*** | 0.024*** | 0.017** | 0.019*** | 0.018** | 0.016** |
| | (0.002) | (0.010) | (0.010) | (0.011) | (0.008) | (0.007) | (0.009) | (0.007) | (0.007) | (0.007) | (0.007) |
| Gas utility in 1941 | 1.130*** | 6.452*** | 6.686*** | 5.274*** | 4.920*** | 5.435*** | 4.724*** | 3.123*** | 3.472*** | 3.510*** | 3.013** |
| | (0.292) | (1.483) | (1.468) | (1.341) | (1.041) | (1.180) | (1.160) | (1.007) | (1.051) | (1.018) | (0.935) |
| Gas utility in 1941 x distance to pipeline | -0.014*** | -0.047*** | -0.057*** | -0.041*** | -0.042*** | -0.043*** | -0.040*** | -0.033*** | -0.036*** | -0.034*** | -0.032** |
| | (0.004) | (0.014) | (0.012) | (0.013) | (0.010) | (0.008) | (0.010) | (0.008) | (0.008) | (0.008) | (0.009) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 1.13 | 4.35 | 4.16 | 3.93 | 3.69 | 3.21 | 2.43 | 1.62 | 1.09 | 0.78 | 0.52 |
| DV Std Dev | 3.07 | 11.43 | 10.97 | 10.18 | 9.13 | 9.12 | 8.53 | 8.16 | 8.04 | 7.80 | 7.80 |
| R-Squared | 0.06 | 0.05 | 0.06 | 0.05 | 0.06 | 0.08 | 0.11 | 0.14 | 0.18 | 0.22 | 0.24 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in % of total county employment in

(c) Other manufacturing

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.009 | 0.003 | -0.030 | -0.029 | -0.028 | -0.019 | -0.011 | -0.024 | -0.037* | -0.040** | -0.033** |
| | (0.006) | (0.046) | (0.031) | (0.029) | (0.025) | (0.027) | (0.025) | (0.021) | (0.019) | (0.019) | (0.015) |
| Gas utility in 1941 | 0.474 | -2.001 | -3.911 | -2.614 | -2.821 | -2.882 | -2.412 | -3.440 | -5.083* | -4.568* | -3.481 |
| | (0.543) | (4.822) | (4.415) | (4.433) | (3.637) | (3.941) | (3.858) | (3.169) | (2.803) | (2.746) | (2.155) |
| Gas utility in 1941 x distance to pipeline | -0.013** | 0.002 | 0.026 | 0.014 | 0.023 | 0.019 | 0.017 | 0.030 | 0.044** | 0.046** | 0.037*** |
| | (0.006) | (0.042) | (0.032) | (0.030) | (0.026) | (0.027) | (0.025) | (0.021) | (0.019) | (0.019) | (0.014) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 2.34 | 21.83 | 21.79 | 21.13 | 21.85 | 19.35 | 17.41 | 15.62 | 14.21 | 12.89 | 11.36 |
| DV Std Dev | 4.86 | 20.46 | 18.89 | 18.01 | 17.50 | 17.13 | 16.91 | 17.33 | 17.53 | 17.31 | 16.27 |
| R-Squared | 0.14 | 0.22 | 0.23 | 0.26 | 0.37 | 0.37 | 0.39 | 0.41 | 0.46 | 0.46 | 0.42 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

Standard errors clustered by state in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in % of total county employment in specified sector (top-decile or top-quartile energy-intensive industries or other manufacturing industries or service and other industries). Energy-intense employment defined based on industry energy consumption and value-added in 1939 for 1940 employment shares and in 1947 for all post-war employment shares, as cost of purchased electricity as share of value-added.

* p < 0.10, ** p < 0.05, *** p < 0.01

## A.6 Long-term employment regression results with energy-intense employment defined based on 1971 industry energy intensity

# Table A27. Δ % of county emp since 1940 in all gas-intensive industries

## (a) Top decile

| | Initial | Pre-Crisis | | | | | Energy crisis | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | -0.001 | 0.001 | 0.006 | 0.008* | 0.008* | 0.009** | 0.011** | 0.011** | 0.011*** | 0.011** | 0.011** |
| | (0.002) | (0.005) | (0.004) | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) | (0.004) | (0.005) | (0.005) |
| Gas utility in 1941 | 0.363 | 1.227** | 1.490*** | 0.681 | 1.024* | 1.223** | 1.176* | 0.609 | 0.391 | 0.408 | 0.226 |
| | (0.316) | (0.615) | (0.533) | (0.491) | (0.537) | (0.554) | (0.643) | (0.602) | (0.623) | (0.672) | (0.665) |
| Gas utility in 1941 x distance to pipeline | -0.004 | -0.007 | -0.010* | -0.006 | -0.008 | -0.007 | -0.008 | -0.005 | -0.004 | -0.004 | -0.002 |
| | (0.003) | (0.006) | (0.005) | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) | (0.005) | (0.005) | (0.005) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | -0.14 | 1.06 | 0.66 | 0.09 | 0.60 | 0.48 | 0.30 | 0.02 | -0.17 | -0.23 | -0.33 |
| DV Std Dev | 2.54 | 6.39 | 5.63 | 4.79 | 4.98 | 5.06 | 5.07 | 4.96 | 4.85 | 4.83 | 4.77 |
| R-Squared | 0.05 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.05 | 0.08 | 0.09 | 0.11 | 0.13 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

## (b) Top quartile

| | Initial | Pre-Crisis | | | | | Energy crisis | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.003 | 0.006 | 0.010 | 0.010 | 0.010 | 0.014** | 0.017** | 0.013* | 0.016** | 0.015** | 0.015** |
| | (0.002) | (0.007) | (0.007) | (0.008) | (0.006) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.006) |
| Gas utility in 1941 | 0.826** | 1.494* | 2.395*** | 1.312 | 1.967*** | 1.491* | 1.373* | 0.687 | 0.400 | 0.601 | 0.272 |
| | (0.353) | (0.859) | (0.771) | (1.023) | (0.676) | (0.766) | (0.741) | (0.709) | (0.798) | (0.774) | (0.752) |
| Gas utility in 1941 x distance to pipeline | -0.010*** | -0.005 | -0.008 | -0.005 | -0.005 | -0.006 | -0.009 | -0.004 | -0.005 | -0.004 | -0.002 |
| | (0.003) | (0.008) | (0.008) | (0.009) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 0.78 | 3.50 | 2.87 | 3.39 | 2.75 | 2.17 | 1.65 | 1.14 | 0.78 | 0.58 | 0.45 |
| DV Std Dev | 2.91 | 9.12 | 8.23 | 7.99 | 6.86 | 6.83 | 6.56 | 6.49 | 6.51 | 6.33 | 6.37 |
| R-Squared | 0.07 | 0.01 | 0.02 | 0.03 | 0.04 | 0.06 | 0.09 | 0.12 | 0.14 | 0.16 | 0.18 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state

(c) Other manufacturing

| | Initial | Pre-Crisis | Energy crisis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.016*** | 0.034 | 0.001 | -0.005 | -0.016 | -0.006 | -0.005 | -0.020 | -0.034 | -0.037* | -0.031** |
| | (0.006) | (0.051) | (0.038) | (0.037) | (0.029) | (0.030) | (0.028) | (0.024) | (0.021) | (0.019) | (0.016) |
| Gas utility in 1941 | 0.778 | 2.957 | 0.381 | 1.347 | 0.132 | 1.062 | 0.939 | -1.004 | -2.012 | -1.659 | -0.740 |
| | (0.535) | (5.615) | (5.351) | (5.070) | (4.069) | (4.321) | (4.111) | (3.453) | (2.855) | (2.626) | (2.021) |
| Gas utility in 1941 x distance to pipeline | -0.017*** | -0.040 | -0.022 | -0.023 | -0.014 | -0.017 | -0.014 | 0.001 | 0.013 | 0.016 | 0.008 |
| | (0.005) | (0.044) | (0.038) | (0.037) | (0.030) | (0.031) | (0.029) | (0.025) | (0.023) | (0.020) | (0.017) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 2.69 | 22.68 | 23.08 | 21.67 | 22.79 | 20.39 | 18.19 | 16.10 | 14.53 | 13.08 | 11.43 |
| DV Std Dev | 4.94 | 21.19 | 19.51 | 18.09 | 17.95 | 17.69 | 17.37 | 17.55 | 17.83 | 17.64 | 16.77 |
| R-Squared | 0.15 | 0.20 | 0.20 | 0.22 | 0.36 | 0.36 | 0.39 | 0.41 | 0.46 | 0.48 | 0.45 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:*

Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results shown in table. Explanatory variables of interest are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route, where latter is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in share of total county employment in specified sector (top-decile or top-quartile energy-intensive industries or other manufacturing industries or service and other industries). Energy-intense employment is defined based on industry energy consumption and value-added in 1939 for 1940 employment shares, in 1947 for 1950 employment, and 1971 for all later-year employment shares, as all types of gas consumed (in million feet$^3$) per million dollars of value-added.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A28. Δ % of county emp since 1940 in electricity-intensive industries

(a) Top decile

| | Initial | Pre-Crisis | | | | | Energy crisis | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | -0.009** | -0.001 | 0.001 | 0.001 | -0.001 | -0.001 | -0.001 | -0.001 | 0.001 | -0.001 | -0.003 |
| | (0.004) | (0.005) | (0.005) | (0.006) | (0.006) | (0.006) | (0.007) | (0.006) | (0.005) | (0.006) | (0.006) |
| Gas utility in 1941 | 1.607*** | 3.472*** | 3.970*** | 3.124*** | 3.256*** | 3.353*** | 3.011*** | 2.639*** | 2.682*** | 2.482*** | 2.016** |
| | (0.572) | (0.928) | (0.834) | (0.758) | (0.627) | (0.707) | (0.713) | (0.610) | (0.532) | (0.595) | (0.505) |
| Gas utility in 1941 x distance to pipeline | -0.023*** | -0.035*** | -0.038*** | -0.034*** | -0.033*** | -0.032*** | -0.030*** | -0.028*** | -0.029*** | -0.027*** | -0.024** |
| | (0.006) | (0.007) | (0.007) | (0.006) | (0.006) | (0.006) | (0.007) | (0.006) | (0.005) | (0.006) | (0.005) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | -0.59 | -0.00 | 0.02 | -0.29 | 0.01 | -0.03 | -0.24 | -0.40 | -0.67 | -0.73 | -0.84 |
| DV Std Dev | 5.83 | 8.44 | 8.36 | 7.75 | 7.82 | 7.82 | 7.48 | 7.32 | 7.07 | 6.87 | 6.69 |
| R-Squared | 0.19 | 0.09 | 0.11 | 0.14 | 0.12 | 0.13 | 0.15 | 0.17 | 0.19 | 0.21 | 0.22 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

(b) Top quartile

| | Initial | Pre-Crisis | | | | | Energy crisis | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.009*** | 0.062*** | 0.057*** | 0.050*** | 0.035*** | 0.039*** | 0.031*** | 0.028*** | 0.026*** | 0.024** | 0.021** |
| | (0.002) | (0.016) | (0.011) | (0.012) | (0.010) | (0.009) | (0.010) | (0.010) | (0.010) | (0.010) | (0.010) |
| Gas utility in 1941 | 1.130*** | 8.366*** | 8.929*** | 6.652*** | 5.294*** | 5.523*** | 4.776*** | 3.442*** | 3.284*** | 3.382*** | 2.904** |
| | (0.292) | (1.541) | (1.260) | (1.317) | (1.150) | (1.236) | (1.465) | (1.311) | (1.256) | (1.101) | (0.986) |
| Gas utility in 1941 x distance to pipeline | -0.014*** | -0.082*** | -0.082*** | -0.066*** | -0.061*** | -0.060*** | -0.051*** | -0.047*** | -0.047*** | -0.044*** | -0.041** |
| | (0.004) | (0.012) | (0.010) | (0.011) | (0.009) | (0.008) | (0.011) | (0.011) | (0.010) | (0.010) | (0.010) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 1.13 | 7.16 | 6.24 | 6.22 | 5.95 | 4.74 | 3.81 | 3.03 | 2.61 | 2.19 | 1.95 |
| DV Std Dev | 3.07 | 13.85 | 12.46 | 11.95 | 10.35 | 9.90 | 9.34 | 9.07 | 9.00 | 8.57 | 8.61 |
| R-Squared | 0.06 | 0.10 | 0.10 | 0.10 | 0.15 | 0.16 | 0.17 | 0.21 | 0.24 | 0.28 | 0.29 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results shown in table. Explanatory variables of interest are full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to nearest point on actually-constructed pipeline route, where latter is instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed

(c) Other manufacturing

| | Initial | Pre-Crisis | | | | | Energy crisis | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| | 1950 | 1964 | 1968 | 1970 | 1974 | 1978 | 1982 | 1986 | 1990 | 1994 | 1997 |
| Distance from pipeline | 0.009 | -0.021 | -0.046 | -0.045 | -0.040 | -0.031 | -0.018 | -0.034 | -0.044** | -0.046** | -0.038** |
| | (0.006) | (0.043) | (0.034) | (0.032) | (0.026) | (0.027) | (0.027) | (0.022) | (0.020) | (0.020) | (0.016) |
| Gas utility in 1941 | 0.474 | -3.914 | -6.154 | -3.993 | -3.195 | -2.970 | -2.464 | -3.759 | -4.896* | -4.440 | -3.372 |
| | (0.543) | (5.317) | (4.985) | (4.800) | (3.806) | (4.003) | (3.992) | (3.168) | (2.779) | (2.846) | (2.283) |
| Gas utility in 1941 x distance to pipeline | -0.013** | 0.037 | 0.051 | 0.039 | 0.041 | 0.036 | 0.028 | 0.044** | 0.055*** | 0.057*** | 0.047*** |
| | (0.006) | (0.039) | (0.034) | (0.032) | (0.026) | (0.028) | (0.027) | (0.021) | (0.020) | (0.019) | (0.015) |
| Census Region FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 ln(Pop). | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| ln(Dist. to City) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| 1940 Emp. Shares | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Obs. | 1246 | 1245 | 1244 | 1245 | 1245 | 1244 | 1245 | 1245 | 1245 | 1245 | 1245 |
| DV Mean | 2.34 | 19.01 | 19.71 | 18.84 | 19.59 | 17.82 | 16.03 | 14.22 | 12.70 | 11.48 | 9.92 |
| DV Std Dev | 4.86 | 19.87 | 18.71 | 17.66 | 16.68 | 16.32 | 16.30 | 16.59 | 16.74 | 16.64 | 15.63 |
| R-Squared | 0.14 | 0.15 | 0.16 | 0.18 | 0.28 | 0.30 | 0.33 | 0.36 | 0.41 | 0.42 | 0.38 |
| F-stat | 3424.6 | 3424.1 | 3779.9 | 3424.1 | 3424.1 | 3441.6 | 3442.2 | 3442.2 | 3442.2 | 3442.2 | 3442.2 |

*Notes:* Sample is 1,246 counties within 250 miles of any pipeline route, excluding those in the three major gas-producing states (LA, OK, and TX). Two stage-least squares regression, with second stage results in table. Explanatory variables include full interaction of indicator that county $c$ had a gas utility in 1941 and distance from county $c$ centroid to actually-constructed pipeline route, with latter instrumented with least-cost/minimum spanning tree optimal pipeline route (in miles). Includes census region fixed effects and controls for 1940 log population, log distance to closest county with population $\geq$ 50K, and share of county employment in manufacturing and in agriculture. Standard errors clustered by state in parentheses. Cluster-robust Kleibergen-Paap Wald rk F statistic from 1st stage reported. Dependent variables are change from 1940 to each year in % of total county employment in specified sector (top-decile or top-quartile energy-intensive industries or other manufacturing industries or service and other industries). Energy-intense employment defined based on industry energy consumption and value-added in 1939 for 1940 employment shares and in 1947 for all post-war employment shares, as cost of purchased electricity as share of value-added.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$