Does Electricity Drive Structural Transformation? Evidence from the United States

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Abstract: Electricity was the catalyst for the second industrial revolution in the early twentieth century. Developing countries are currently making huge investments in this general-purpose technology, with a view to achieving structural change. What can history teach us about its impact on the structure of employment? We use U.S. Census data and an identification strategy based on hydroelectric potential to identify the effects of the geographic expansion of higher-voltage electricity lines. We find that, over the period 1910-1940, electrification increased the share of operatives in the average county by 3.5 percentage points and decreased the share of farmers by 2.9 percentage points. These effects are primarily driven by rural electrification, and they can account for more than half of the aggregate increase in operatives, and more than one quarter of the total decrease in farmers. These results suggest that electrification was a key contributor to U.S. structural transformation.

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1. Introduction

For the first time in U.S. history, the federal Census in 1920 reported more than 50% of residents living in urban areas, marking a turning point in a long movement off farms and towards cities, with the accompanying transition to urban occupations and industries. Figure 1 illustrates a massive labor reallocation over the period 1910-1940, from agricultural occupations toward ones more concentrated in sectors such as manufacturing, retail, and wholesale trade. This structural transformation was achieved relatively late in the U.S., due to its status as a young, land-rich nation. The backdrop was an equally dramatic transformation of infrastructure, involving the move from steam to electric power in cities and from horse to electric power on farms. While this kind of structural transformation is one of the most salient features of economic development (Herrendorf, Rogerson and Valentinyi, 2014)—identified as one of Kuznets' stylized facts of development (Kuznets, 1966)—there is still considerable debate about its underlying causes.

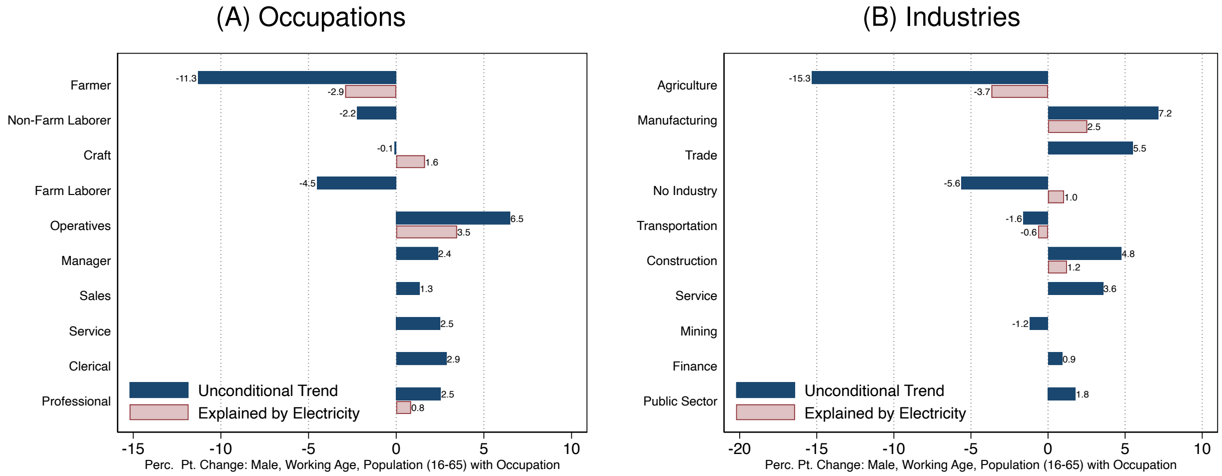
This paper focuses on the specific role played by electrification in this transition from an agriculture intensive to a manufacturing intensive economy.[2] As electricity is a general-purpose technology that drove the second industrial revolution in the developed world (Gordon, 2017) and still plays a crucial role for economic development today (Fried and Lagakos, 2017), this question is not only of interest to economic historians but is also of first order importance for development economists and policymakers. For example, many developing countries are currently witnessing unprecedented investment in electrification as a vehicle for development, in the hope that it will stimulate structural transformation, pushing more workers into modern, higher valued-added sectors. In fact, the World Bank argues that "infrastructure has a central role in the development agenda and is a major contributor to growth" (World Bank, 2005) and it has helped 45 million people to gain access to electricity from 2014 to 2018 and spent over $5 billion on energy programs.[3] Ethiopia is a leading example of a developing nation recently investing heavily in electricity, as its production has increased seven-fold in the 16 years since 2000 (Fried and Lagakos, 2017, 1). Despite these massive investments in electrification, there is still considerable debate on what exactly these economies should expect in response.

We contribute to this debate by exploring the causal effect of electrification on U.S. structural change

[2] Gordon (2017) showed that the second industrial revolution, whose productivity gains still dwarf those of the third, was sparked by the perfection of the steam engine but realized such high productivity gains due to electricity.

[3] https://www.worldbank.org/en/topic/energy/overview#2. Consulted: 10/13/19.

Figure 1: Approximate Contribution of Electrification to Structural Transformation, 1910-1940



Notes: The figure depicts overall changes in the occupational structure over the period 1910-1940 as displayed in Figure 3 and contrasts them with the structural changes due to electrification as implied by our IV estimates (Tables C.22 and C.30) scaled by the average increase in transmission lines within a county (Figure 4). Panel A focuses on occupations while panel B reports results for industries. Bars are sorted from top to bottom by employment share in 1910 and the underlying population are working age men (16-65) with a reported occupation. We only report implied IV estimates for statistically significant coefficients (at least 10% significance level). The underlying data on the occupational and industrial structure are the full count U.S. Censuses. The impact of electrification is estimated using historical maps of the U.S. electricity grid and hydroelectric potential as an instrument. Details are provided in Sections 3 and 4.

from 1910 to 1940. Looking at this historical episode allows us to analyze the long run impacts of electrification over three decades, which is generally not possible in the modern development literature but is important given the lengthy time general-purpose technologies need to unfold their full potential through complementary innovations.[4]

The primary challenge in estimating the impact of electrification is that adoption was endogenous to existing levels of development, skill and industrial composition. We address this concern by appealing to two related observations: first, while coal-powered electricity was widely available in urban areas by 1910, hydroelectric power was limited. The primary benefit of hydroelectric power generation is its low variable cost, while the main downsides are sizable fixed costs (e.g., building a dam in a remote location) and the remoteness of the most suitable sites for power generation. We argue that the latter was the main reason for

[4]See, for example, Rud (2012) and Burlig and Preonas (2016), which look at most over a two decade interval to analyze the effects of electrification in India, and Fried and Lagakos (2017), who look at the period since 2012 because Ethiopia's electrification is so recent. As an example of the long lags and importance of complementary investments to general-purpose technologies, consider Eden and Gaggl (2018), who illustrate that the full effects of information and communication technology (ICT) significantly lagged its first invention and were substantially amplified by complementary non-ICT investments.

the dominance of coal before 1920.[5]

Second, the high-voltage power grid was nonexistent in 1910, and greatly expanded after 1920 (see Figures 2 and 4), due to technological innovations in power transmission.[6] Since coal could be transported to any given location, this new technology was not particularly useful for coal generated power. In stark contrast, this technology allowed hydroelectric power to be transported to end users from remote locations, making massive construction projects such as the Hoover Dam viable. The low variable cost of hydroelectric power combined with high-voltage transmission lines imply that the expansion of the grid led to a significant reduction in the price of electricity in serviced locations and increased adoption in such areas.

Our strategy to estimate the causal impact of electrification exploits the geographic variation in this price shock. While the eventual path of the distribution lines that connected individual places to the grid was almost certainly driven primarily by electricity demand, we argue that places close to highly suitable locations for hydroelectric power generation were effectively exogenously "treated" with high-voltage power lines. To implement this idea, we use geographic variation in "hydroelectric potential"—a measure governed by fixed, exogenous topographic characteristics of a place, inversely related to the cost of building and operating a hydroelectric power station in any given location—to instrument for the observed geographic expansion of the high-voltage power grid. We find that this variation provides a strong and relevant instrument.

Other studies have used similar instruments. For example, Dinkelman (2011) used land gradient—a fixed topographic feature that is inversely related to the cost of building transmission lines—as an instrument for the South African electric grid to analyze the effect of grid expansion to more remote areas. Lipscomb, Mobarak and Barham (2013) simulate a hypothetical electricity grid expansion for the period 1960–2000 in Brazil, to capture how the grid would have evolved had infrastructure investments been based solely on geography-based cost considerations. They use this as an instrument for the actual grid and analyze the impact on growth through various channels including agricultural productivity. Lewis and Severnini (2020) use the distance to new power plants for counties in the U.S., from 1930 to 1960, to identify exogenous variation in electricity cost, which works because rural customers were too small a fraction of the overall

[5] Hughes (1993) outlined the constraints of coal and hydro generation and emphasized that a regional grid started to be formed only from about 1920, facilitated by improved transmission lines.

[6] Feasible transmission voltages increased from under 50 kilovolts in 1900 to over 150 kilovolts around 1920 (Lewis and Severnini, 2020).

customer base to determine plant location. In our study, more rural counties are most affected by our instrument, and farm service made up only 2.6% of nationwide electricity customers in 1932, implying that these counties are very unlikely to have driven transmission line or power plant placement (Kitchens and Fishback, 2015, 1163).

Using this empirical strategy, we investigate the impact of 1910-1940 electrification on the occupational and industrial structure of male county employment in 1940, given initial 1910 conditions.[7] We find that 100 extra kilometers of high-voltage power lines significantly decreased the share of farmers among American men, and significantly increased the share of operatives, a mid-level blue-collar job, usually associated with manufacturing work. In parallel, electrification significantly decreased the share of farming in male employment and increased the share of manufacturing. Given that most of the structural change occurred within regions rather than through migration across regions (Eckert and Peters, 2018), we can use our county-level estimates to project the aggregate effect of electrification on the occupational and industrial structure.[8] The size of our estimates suggests that electrification can account for approximately 54% of the aggregate increase in the share of operatives, and 26% of the aggregate decline in the share of farmers between 1910 and 1940, while at the same time accounting for 24% of the aggregate decline in agriculture and 36% of the aggregate increase in manufacturing. Figure 1 illustrates these results for estimates significant at least at the 10% confidence level, suggesting that electrification was a key driver of structural transformation in the U.S.

Our analysis makes three key contributions to the literature. First, we construct a credible instrument for the expansion of the high-voltage power grid, based on hydroelectric potential. Second, we study the impact of electrification on the entire continental U.S., examining its effects on the structure of employment. To do so, we digitized historical maps from the U.S. Army Corps of Engineers to document the expansion of the high-voltage electricity grid, providing a more accurate picture of electrification than previously available. Earlier studies analyze either the manufacturing sector, using the Census of Manufacturers (Gray, 2013), or the agricultural sector (Census of Agriculture) in isolation (Kitchens and Fishback, 2015), and some focus on

[7]We focus only on men in this paper, as they had the greatest attachment to the labor force. Female labor force participation was only about 22% in 1910 and rose only 2-3 percentage points to 1940, so we have chosen not to analyze this part of the labor market in this paper. Vidart (2020) finds that electricity can account for one third of the increase in female participation, 1880-1960.

[8]This is similar to the structural change identified in Fried and Lagakos (2017) which highlighted an increase in non-agricultural businesses in rural areas.

programs that were only applicable in a few states (Kline and Moretti, 2013). Ours is the first to use detailed exogenous variation in electricity adoption to study potential labor reallocation *between*, rather than *within* sectors. Furthermore, because we use full count Census data, we are able to go beyond agriculture and manufacturing and analyze the impact of electrification on the full occupational and industrial structure. We thus complement the work by Katz and Margo (2014), which identified, in a descriptive manner, the degree of skill bias in the aggregate economy over the longer run from the mid-nineteenth century to 2010.

Third, the extant literature on structural transformation offers a variety of theoretical explanations for its ultimate causes. Gollin, Jedwab, Vollrath et al. (2013) provide a summary, from theories that focus on the increased productivity of manufacturing and services, which creates a "pull" force for labor to exit agriculture, and the "push" theories which investigate the price and income effects influencing the move away from the primary sector.[9] One class of models draws on dominant income effects (through non-homothetic preferences) while another class of models draws on a production structure in which general-purpose technology shocks—through a reduction in the relative price—have differential effects in different sectors (Herrendorf et al., 2014). Our analysis provides evidence that the invention of high-voltage electrical power transmission—a general-purpose technology—directly caused structural transformation of rural America during the period 1910-1940, consistent with the theory of technology-driven structural transformation.

In Section 2, we discuss the role electricity could play in the structure of employment. In Section 3, we describe the data and econometric approach. Section 4 presents the results. Section 5 concludes.

2. What Did Electricity Do?

This section provides a conceptual framework, detailing the potential channels through which electricity can affect employment. It is clear from existing research that electricity had large, positive productivity effects for the U.S. economy as it was gradually rolled out across places and sectors. For example, David and Wright (1999) showed that electricity contributed half of the five-fold increase in TFP growth during the 1920s.

However, this boost in productivity was not distributed evenly across time, economic activities, and

[9] On the latter types of models, see, for example, Herrendorf, Rogerson and Valentinyi (2013). Other creative explanations for the new dominance of the service sector include, for instance, Cravino, Levchenko and Rojas (2019) which suggests that this is a natural result of population aging in the developed world.

space. Specifically, electrification in the U.S. happened in two phases. This paper studies the early phase from 1910–1940, a period in which electrification contributed primarily to the productivity of manufacturing, not only in cities, but also in areas that were mostly rural in 1910. In the subsequent period from 1930–1960, electrification reached farms in rural areas, also increasing their productivity and amenities, and slowing down the rate of structural transformation, as shown by Lewis and Severnini (2020).

The early productivity gains in manufacturing, concentrated in large and medium-sized cities, were partly driven by a host of complementary innovations such as the assembly line. Alexopoulos and Cohen (2016) demonstrated, in a VAR framework for the national economy, that these electric innovations were associated with an increase in total employment and in manufacturing employment per capita. A range of studies have analyzed the impact of electrification within manufacturing, a more detailed summary of which can be found in Gray and Kitchens (2018). Electricity not only changed production processes, but also increased the optimal scale of production dramatically as factories were no longer limited by the capacity of inefficient steam engines. Increased scale in manufacturing had positive spillovers to the distribution and trade sectors. These larger and newly electrified plants resulted in increased demand for clerical, managerial and semi-skilled operative workers. Where previously there had been a huge demand for high-skilled craft workers with knowledge of producing each item from start to finish, now operatives, assisted by new capital goods and energy sources, dominated factory floors that were redesigned to minimize the floor space of each station and maximize efficiency (Gray, 2013).[10] This suggests a considerable expansion in entry-level positions for those new to the manufacturing sector and an increased incentive to move into manufacturing due to the increase in relative productivity compared to agriculture.

The agricultural sector became electrified later, only from 1930, and led to increased productivity in terms of crop output and yields (Kitchens and Fishback, 2015). Early on, farms utilized generators for lighting and were often able to run power tools or small appliances from their diesel-powered cars and trucks. Purchased grid electricity replaced these smaller-scale, less convenient alternatives. Electricity on farms removed the need to draw water from the list of daily chores and facilitated the introduction of complementary technologies such as milking machines, chicken brooders and irrigation systems. Farms in

[10] Goldin and Katz (1998) also argued that manufacturing technology was skill-biased, because the education level of workers was correlated with electricity adoption.

this era adopted more capital and, as in manufacturing, this may have changed the optimal scale of farming and the mix of labor, energy and capital. This was the beginning of a broader mechanization of agriculture which took place throughout the twentieth century in the U.S., with machinery introduced gradually in tasks such as ploughing, planting, and eventually harvesting.[11]

It was only after the New Deal that a full electrification of farmhouses took place, facilitating a new era of appliance adoption at the farm level, which had happened in cities decades earlier. Such amenities included running water, refrigerators and radios. Those initially living in rural areas and working in the farming sector thus may have faced competing forces of the pull towards urban manufacturing and its higher wages amid higher farm productivity and amenity availability. Lewis and Severnini (2020) weighed these issues in their study of the effects of agricultural electrification from 1930 to 1960 across 2162 of the almost 3000 U.S. counties and found that electricity was a countervailing force in the broader decline of the farm population, where increased productivity translated into greater amenities for farm households rather than increased farm incomes/wages.

However, these results are not representative for our period of interest from 1910 to 1940. This earlier period is when key complementary innovations in manufacturing, such as the production line, were being perfected, while the full benefits in agricultural production were yet to be devised and the vast majority of farms had not seen an amenity boost. Other factors had started the long run decline of employment in agriculture from the 1910s onwards[12], but the sector was only 33% electrified by 1940 (Kline, 2000, 287), so it is likely that electricity had not yet enacted substantial changes on American farms—indeed the farm population fell at a faster rate from 1940 to 1960 than it had from 1915 to 1940. Further support for this argument comes from Kline and Moretti (2013), in their analysis of the effects of the Tennessee Valley Authority (TVA) program—which, among other things, subsidized electrification. They found that "between 1930 and 1960—the period during which federal transfers were greatest—the TVA generated gains in both agricultural and manufacturing employment" (Kline and Moretti, 2013, 278).

Taken together, the above discussion lays out several channels through which electricity can affect the

[11] See Olmstead and Rhode (2018) for a fuller account of the transformation of American agriculture.

[12] Appendix Table A.1 in Kline (2000) shows that the U.S. farm population declined from 1915, with only a brief blip back upward in the 1930s as people reverted to subsistence on farms during the Great Depression. The number of farms followed this same pattern.

employment structure: increased demand for manufactured goods increases the relative size of that sector nationwide; increased relative productivity in manufacturing increases relative wages and draws workers into that sector; increased farm productivity may retain workers in agriculture, and similarly with increased amenities in farm households. One way that we might expect the first two channels to operate is that factors of production may be reallocated to areas with an initial concentration in manufacturing. This would show up in the historical data as a huge movement of workers into larger cities, such as occurred in the nineteenth century when factory production first appeared.

In this paper, we emphasize the role of reallocation within counties and the emergence of manufacturing even within rural counties that had been predominantly agricultural, and argue that this was one of the main mechanisms through which electricity contributed to structural transformation. We argue that the labor mobility channel discussed above was fairly limited, justifying a local labor market approach to estimate the overall degree of structural transformation, and Section 4.4 discusses the evidence for this assumption.

3. Data and Econometric Specification

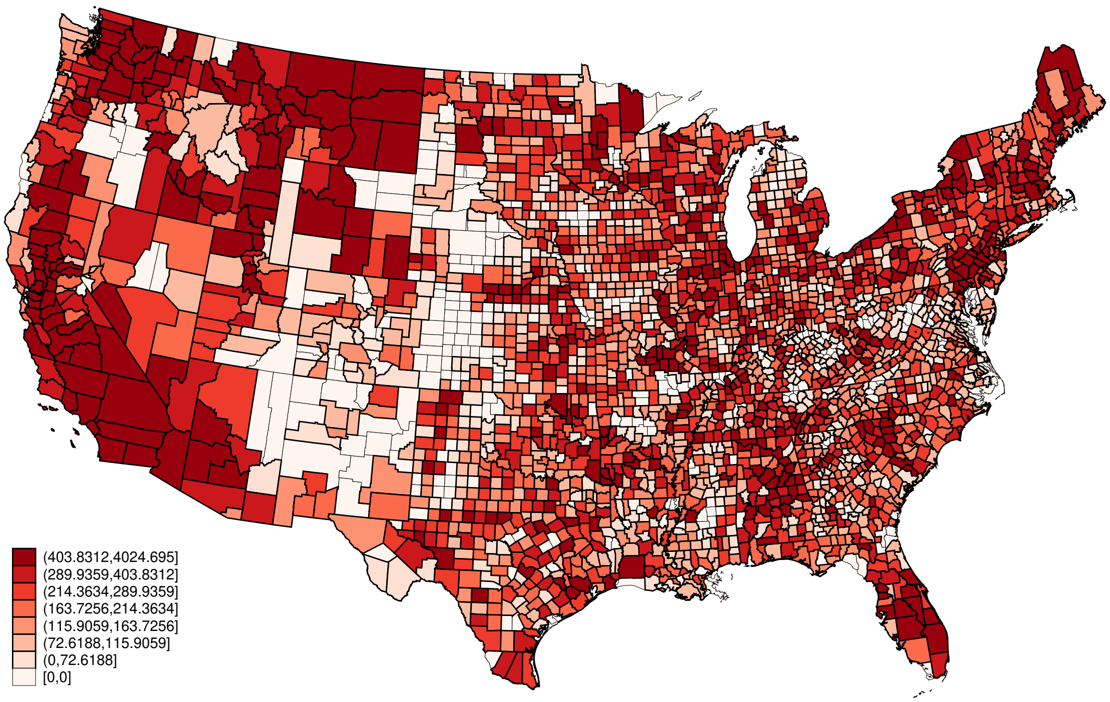
We draw from three main data sources, which we describe in detail below: first, we construct a new measure of electrification based on historical maps of the U.S. electricity grid; second, we use a measure of "hydroelectric potential" as a source of exogenous variation in the expansion of the high-voltage power grid; third, we draw on the full count Census of Population for the years 1910-1940.

3.1. Expansion of the U.S. Electric Grid (U.S. Army Corps of Engineers)

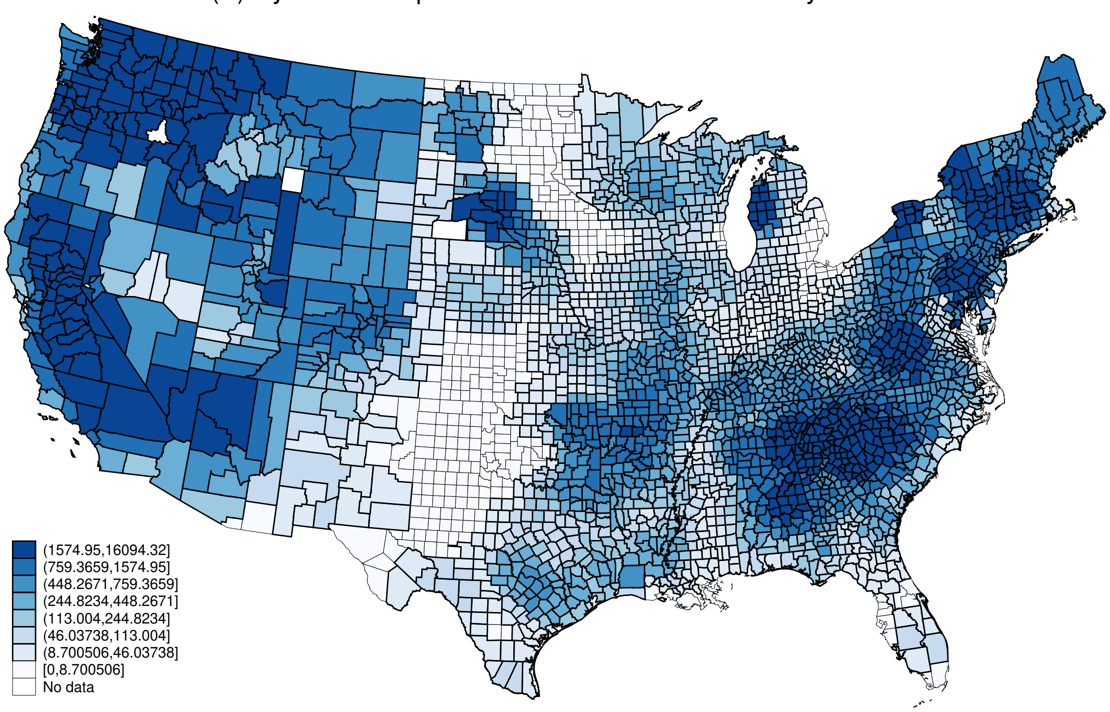
Alternating current (AC) power became the dominant power system in the U.S. from the 1890s, paving the way, with some further innovations, to longer distance power transmission from the 1920s on. City residential and commercial customers gained access to electricity from the 1880s onwards and were highly electrified by 1920. The Censuses of Manufactures show that, at the national level, electric power was more than half of total power used by 1920, overtaking steam power, and by 1930 it was over 80% of total power (Gray, 2013, Figure 1). Early urban electrification was achieved mainly by private utilities and private action by large manufacturers, with a more limited role for municipal-owned plants. Most of this power was derived from coal-burning plants, unless there was easy access to hydroelectric capability, such as at Niaga-

Figure 2: Hydroelectric Potential & High-Voltage Transmission Lines in 1940

(A) High-Voltage Electric Grid in 1940 (km of transmission lines)



(B) Hydroelectric potential within 50 miles of County Centroid



Notes: Panel A shows total kilometers of high-voltage transmission lines within the county in 1940. Panel B shows total hydroelectric potential in Mega Watts within a 50 mile radius of the county centroid.

ra, the site of the first hydro-plant in 1881. Coal plants had the advantage of being built close to the point of use and there was some improvement in the efficiency of these large plants over our period.

For the most rural counties, they remained mostly without electricity by 1930, and in many places the first moves towards electrification were initiated by the government. The earliest adopters were farms in California and the southwest, where the need for irrigation motivated the choice to electrify, perhaps facilitated at least for California by the availability of hydroelectric power. Kitchens and Fishback (2015), Kline and Moretti (2013) and Kitchens (2014) document several New Deal programs which either built infrastructure directly or provided loans to connect rural customers to electricity. These are all towards the end of our sample period, so most of our grid expansion does not reflect these efforts. One program, for example, reported 267,846 miles of lines energized by 1940, servicing 674,495 customers (Kline, 2000, 290).

Using standard GIS software, we digitized maps compiled in 1962 by the U.S. Army Corps of Engineers, which document the expansion of the U.S. electric grid over time, and are the most detailed information used to date on access to electricity across the U.S. We map both plant location and the expanding network of transmission lines over time (we do not have the smaller substations and distribution lines in our grid) at a finer level of geography than has previously been possible, because our maps are more detailed than those of the Edison Electric Institute, for example. As an example, panel A of Figure 2 graphically illustrates the resulting county-level exposure to the high-voltage power grid in 1940, as measured by the total kilometers of high-voltage power lines within the county.

3.2. Hydroelectric Potential (Idaho National Laboratory)

Compared to coal generated electricity, the marginal cost of electricity is lower for hydroelectric power but it has the twin disadvantages of high fixed costs and having to be located wherever geography provides steep enough gradients and sufficient water flow. This implies that, at least initially, the location of hydroelectric power will be closely linked both to hydroelectric potential—defined as the potential amount of hydroelectric energy in megawatts (MW) that could be generated in a given location, if a hydroelectric power station were ever to be installed there—and to lower electricity costs for end users.[13]

We utilize a measure of hydroelectric potential derived from a 10-year data collection effort by the Idaho National Laboratory (Conner and Francfort, 1998), which primarily captures information on land gradient and stream flow across 5677 sites. These sites were chosen using the Federal Energy Regulatory Commission's own database of sites they believed to have hydroelectric potential, along with information from other sub-national agencies. The Idaho National Laboratory then implemented its own more rigorous study, using engineering and environmental factors to construct their final measure of hydroelectric potential at each site, such that the variation in it is driven precisely by the types of geographic and engineering constraints that we consider exogenous. The data collection effort was undertaken in the 1990s, and many locations with high hydroelectric potential had a power station in place at that time. For such locations, the actual power generation at the plant is assumed to capture the potential before the power station was installed. Thus, from the perspective of 1910, when only a handful of locations already had a hydroelectric power station in place (that may itself have been expanded in later years), the map compiled in 1998 captures the potential power generation, if the 5677 surveyed sites were to be developed in the future.

Even though almost twice as many sites than U.S. counties were surveyed, in practice, there are counties that have zero hydroelectric potential. However, given the expanding capability in higher voltage transmission and distribution lines, the local cost advantage of a nearby hydroelectric power generation was not confined to the immediate location of the power station. For example, while Severnini (2014) generally describes the grid as fairly "local" in nature in the first half of the twentieth century, they give the example of the Hoover dam, which transmitted power 200 miles away to Los Angeles as early as 1936. Similarly, the engineering model used in Lipscomb et al. (2013) for Brazil from 1960 assumed that areas within a 50 km radius would connect to the distribution network.

In line with these studies, we focus on hydroelectric potential within a 50 mile radius of the county centroid as our main measure of exogenous variation in the access to electricity.[14] Panel B of Figure 2 graphically illustrates the regional distribution of this measure of hydroelectric potential.

[13] Severnini (2014) showed that this local cost advantage disappeared after 1950, when higher-voltage transmission lines made power distribution away from each plant much more feasible.

[14] While we do not report these results here, we have experimented with differing radii between 0 and 200 miles from the county centroid, finding similar results. However, our instrument is strongest around a 50 mile radius.

3.3. Labor force characteristics (Full count U.S. Census of Population)

We draw on the full count U.S. Census of Population for the years 1910-1940 as provided under a special license by IPUMS (Ruggles, Flood, Goeken, Grover, Meyer, Pacas and Sobek, 2019). The analysis below uses data for the male, non-institutionalized, working age population (16-65), sometimes restricted to those who reported a codeable occupation and industry. The Census of course gives us a range of demographic and location information, along with labor market outcomes for our subsample. Unfortunately, wage and salary income was only reported from 1940 on, so we cannot make specific statements about the income implications of our results because we cannot control for 1910 income.

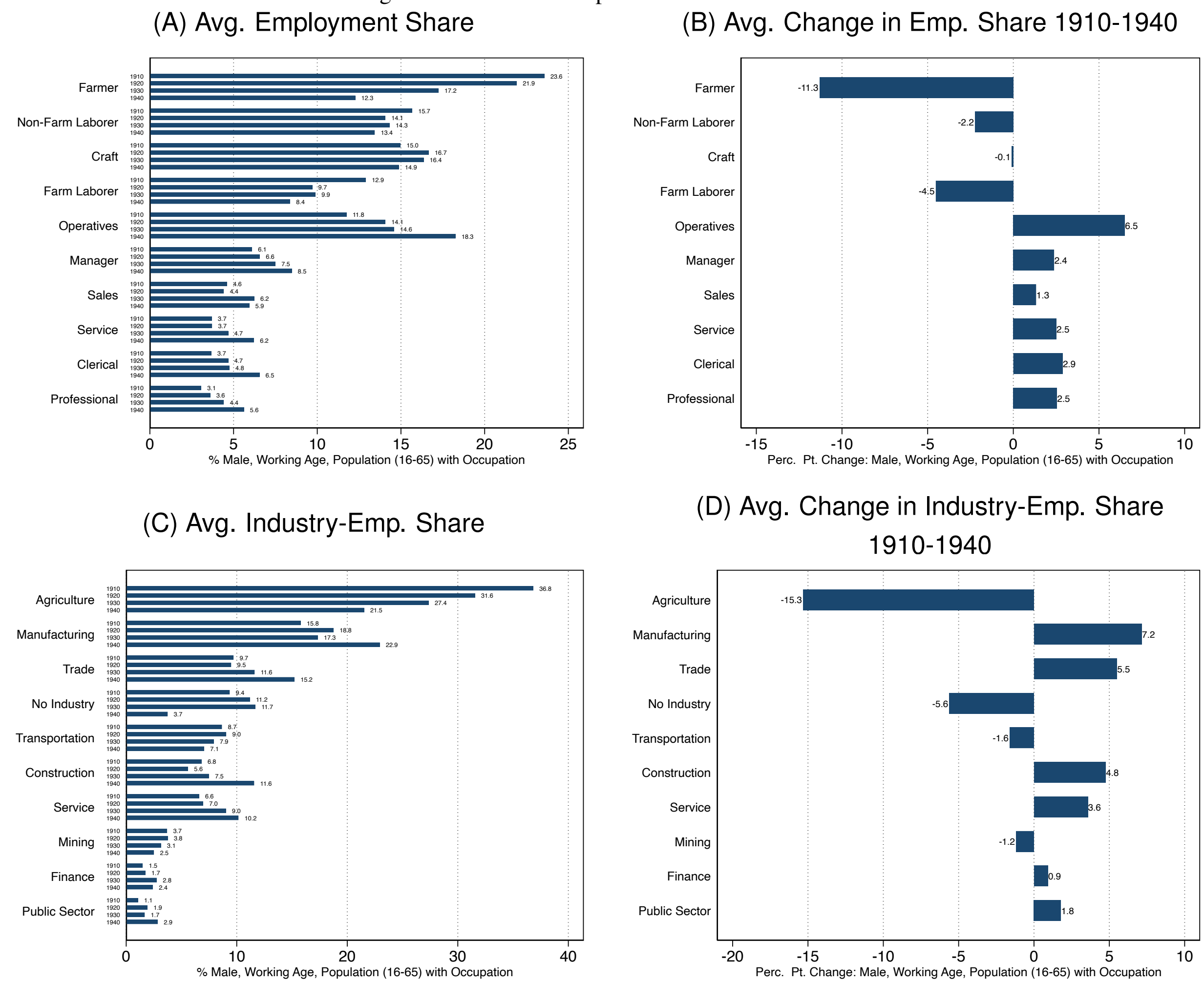
Our main outcomes for quantifying structural changes in the labor market are the occupations and industries recorded in the Census. In particular, we draw on IPUMS's harmonized occupation and industry codes `occ1950` and `ind1950`, which are standard across our sample period. Appendix A describes our methods for ensuring the maximum possible sample which can identify occupation and industry codes and we were able to reduce to 3% the share of observations for which no harmonized code could be produced.

For our main analyses we aggregate the harmonized IPUMS occupation and industry codes to the one digit level, effectively resulting in 10 occupation groups and 9 broad sectors.

3.4. Defining Geography

All of our analyses are at the county level. Since county boundary definitions change over the period 1910-1940 we use Hornbeck's (2010) method to hold 1910 county definitions fixed and proportionately reallocate all county-level aggregates as if the data were uniformly distributed across locations within a county. For example, New York county was split into Manhattan and the Bronx in 1914, which falls between the 1910 and 1920 Censuses. To keep geographic areas comparable over time, we therefore define a synthetic New York county for 1920-1940 which adds the outcomes for 1920-1940 in the Bronx and Manhattan. In other cases, when a newer county definition contains all or portions of multiple 1910 counties, the outcomes are weighted by their respective share in the area of the newer county definition. The changes in county areas are calculated based on historical county definitions using standard GIS software. We note that this adjustment is applied at the county level to all three data sources described above.

Figure 3: Trends in Occupational Structure 1910-1940

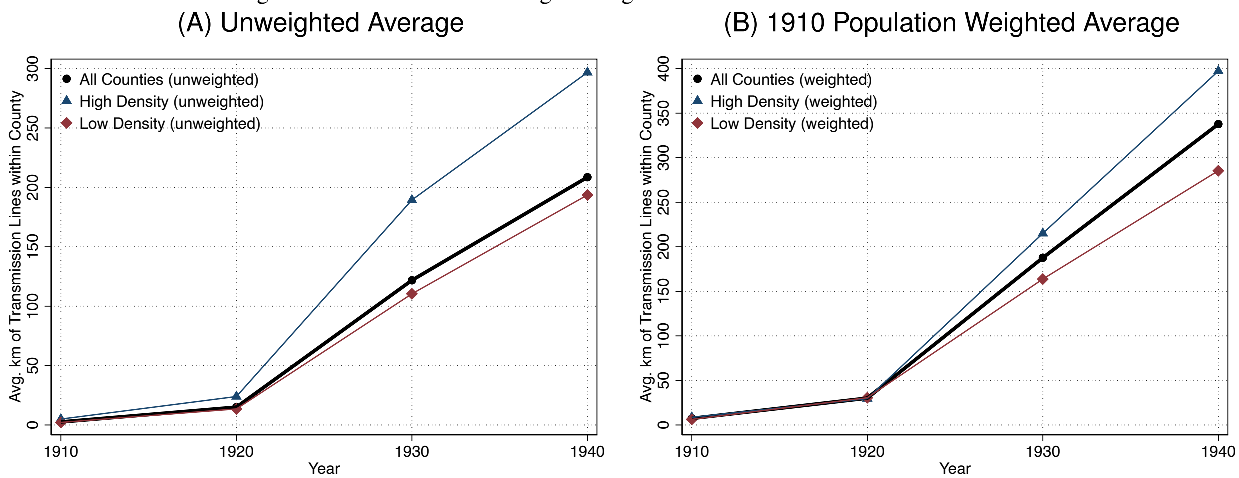


Notes: The figure shows national trends in the occupational structure during 1910-1940 in the United States. Panel A plots fractions of the male, working age population, without inmates and military who reported an occupation. Panel B displays the change from 1910-1940 as displayed in panel A. Panels C and D report analogous charts for 9 broad sectors. "No Industry" refers to individuals with an occupation but no specific/reported industry.

3.5. Unconditional Trends and Descriptive Statistics

How did the U.S. economy change between 1910 and 1940 in terms of its occupation and industry structure? In Figure 3, panel A, we order occupations from the most common to the least common in 1910 among working age men who have an occupation. In 1910, farmer was the most common occupation with 23.6% of men working as farmers. Generally speaking, by 1940, the most common occupations declined while the least common expanded: the most dramatic changes occurred for farmers, whose share declined by 11.3 percentage points and for operatives, whose share increased by 6.5 percentage points (Figure 3,

Figure 4: National Trends in High-Voltage Power Transmission Lines: 1910-1940



Notes: The trends are calculated using a regression of total km of transmission lines on year dummies. Panel B is weighted by county population with occupation in 1910.

panel B)[15]. By 1940, operatives constitute the most common occupation with 18.3% of male employment.

Employment by industry also changed between 1910 and 1940 (Figure 3, panels C and D). While agriculture employed 36.8% of the working male population in 1910, this share declined to 21.5% by 1940. During this same time period, manufacturing jumped up from 15.8% of the working make population to 22.9%. Thus, by 1940, manufacturing replaced agriculture as the most common industry of employment among men. These trends in industrial employment are closely related to the trends in occupations where operative replaced farmer as the most common occupation for an American man between 1910 and 1940. This is broadly in line with figures quoted by Laitner (2000, 547) from the *Historical Statistics of the United States* that showed that U.S. agricultural employment shrank by about half between 1900 and 1960, while manufacturing rose by a factor of almost 3.

Electrification, as measured by high voltage power transmission lines (Figure 4), started after 1910. However, relative to levels achieved in 1940, there was little growth in electrification between 1910 and 1920. Most of the action happens between 1920 and 1940, with an eight fold increase in the length of high-voltage power lines between 1920 and 1930 and another 70% increase between 1930 and 1940.

Interestingly, the timing of electrification seems to coincide with the timing of changes in the share of

[15] These changes in the shares of farmers and operatives are qualitatively similar when we include men without an occupation (Appendix Figure B.5).

farmers and operatives. The decline in farming between 1910 and 1920 was very limited (Figure 3, panel A). The share of farmers declined most strongly between 1920 and 1940, which is also when electrification spread most rapidly. For operatives, the strongest growth occurred between 1930 and 1940. In what follows, we investigate whether this coincidence of timing between electrification and structural change can be interpreted as a causal effect of electrification.

Our primary source of identifying variation is regional differences in the price of electricity, proxied by hydroelectric potential (panel B of Figure 2). Thus, we start our empirical analysis with investigating whether basic demographic and other county characteristics are roughly balanced across different levels of hydroelectric potential in 1910, prior to the rapid expansion of the high voltage power grid. To this end, Table 1 reports basic summary statistics in 1910 for the 2932 counties in our sample, both pooled (panel A) and split by quartiles of hydroelectric potential (panel B).

According to the U.S. Census, 54.5% of the U.S. population in 1910 lived in rural areas, while the remaining 45.5% resided in what we label "high density" areas.[16] These high density areas are approximately accounted for by the 418 (14.3%) counties in the top septile of the population density distribution across U.S. counties. While high density areas are most prevalent in the third quartile of hydropotential (16.3%) even the bottom quartile includes 12.8% high density counties. Unsurprisingly, counties in the top quartile of hydroelectric potential have lower than average population density, as these are typically very remote areas. In terms of basic demographics, the distribution of average age, fraction of white men, as well as agricultural and manufacturing employment are fairly evenly distributed across counties with different hydroelectric potential.

Finally, even counties in the top quartile of hydroelectric potential have fewer than 10km of high voltage power lines in 1910, with a national average of 2.6km. By 1940, the average increase in high voltage power lines is 208.8km, with 166.4km in the lowest and 284.9km in the top quartile of hydroelectic potential. Given that there were almost no high voltage power lines in 1910, the stock of transmission lines in 1940 roughly captures the within county expansion of the high voltage power grid. Thus, the *stock* of power lines in 1940 reported in Figure 2 graphically summarizes the geographic distribution of this grid *expansion* over the period 1910-1940.

[16]See https://www.census.gov/content/dam/Census/library/visualizations/2016/comm/acs-rural-urban.pdf.

Table 1: Summary Statistics in 1910

A. All Counties (n=2932)

	Mean	Std. Dev.
Hydro potential (50 miles)	710.8	1342.4
HV Transmission Lines (km)		
1910	2.6	18.1
1920	15.0	57.4
1930	122.0	143.3
1940	208.8	210.9
% High Density	14.3	35.0
People per square mile	24.1	167.3
% White	86.3	20.6
Avg. age	35.1	1.4
% Farmers	38.7	17.2
% Operatives	6.3	9.3
% Agriculture	58.8	22.4
% Manufacturing	8.2	9.3

B. Counties Grouped by Quartile of Hydroelectric Potential

	1st Quartile		2nd Quartile		3rd Quartile		4th Quartile	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Hydro potential (50 miles)	13.7	14.1	129.2	59.5	467.7	145.5	2252.8	1996.6
HV Transmission Lines (km)								
1910	0.1	2.4	0.7	8.0	1.3	10.9	8.2	33.0
1920	2.0	15.4	4.9	26.0	14.8	47.5	38.4	96.0
1930	96.5	117.7	109.0	118.9	104.7	119.9	177.7	188.8
1940	166.4	150.8	186.7	160.1	196.8	174.4	284.9	301.3
% High Density	12.8	33.5	12.8	33.5	16.3	37.0	15.9	36.6
People per square mile	33.7	235.0	23.6	167.5	26.0	163.7	14.1	55.5
% White	90.6	17.3	84.0	23.7	84.0	21.1	86.3	19.4
Avg. age	35.0	1.4	35.1	1.4	35.1	1.5	35.0	1.5
% Farmers	40.4	17.1	39.7	16.5	39.6	17.0	35.9	17.8
% Operatives	3.9	6.4	5.5	8.4	6.4	9.2	9.1	11.1
% Agriculture	60.7	19.9	60.0	21.5	60.2	23.2	55.2	24.2
% Manufacturing	6.3	8.4	8.0	9.0	8.6	9.4	10.2	9.9

Notes: The table reports unweighted averages and standard deviations across county aggregates in 1910 as well as high voltage transmission lines for the years 1920-1940. Panel A pools all counties. Panels B groups counties by quartiles of hydroelectric potential. High density counties are defined as those in the top septile of population density across U.S. counties in 1910, accounting approximately for the 45.5% of individuals living in “non rural” areas according to the U.S. Census in 1910.

Together with the summary statistics in panel B of Table 1, these basic trends suggest a strong positive correlation between hydroelectric potential and the local expansion of the high voltage power grid. This correlation, together with the relative balance of other county characteristics in 1910, forms the basis of our empirical strategy to identify the causal impact of electrification on structural transformation in the U.S.

3.6. Econometric Specification

In our main analysis, we estimate the following cross sectional regressions for a given Census year t and population group $j \in J$, where J is either the set of occupations or industries:

$$y_{i,t}^j = \beta_{0,t}^j + \beta_{1,t}^j E_{i,t} + \beta_{2,t}^j y_{i,1910}^j + \beta_{3,t}^j X_{i,1910} + \tau_s + \epsilon_{i,t} \text{ for } t = 1920, 1930, 1940 \text{ and } j \in J \qquad (1)$$

The outcome $y_{i,t}^j$ is the share of employment in occupation or industry j, in county i and census year t. $E_{i,t}$ is the number of kilometers of high-voltage power lines in county i at time t, which is a cumulative measure of electrification, capturing the stock of power lines at time t. In addition to state s fixed effects, τ_s, and the initial value of the outcome, $y_{i,1910}^j$, we control for various county characteristics in 1910, $X_{i,1910}$, when there were essentially no high-voltage power lines (see Figures 3 and 4 as well as Table 1 for summary statistics): logged population density, to account for initial differences in levels of development and following recent literature that suggests that there was a nonlinear relationship between initial population density and population growth in the U.S. over 1880-2000 (Michaels, Rauch and Redding, 2012); the fraction of white individuals; the average age; the initial distribution of population groups (either occupations or industries) by either including the share of agriculture and manufacturing or alternatively a complete set of indicators for either detailed occupations or sectors. Observations are weighted by county population in 1910 and we conduct inference allowing for spatial clusters within a 200km radius with Bartlett decay using the methodology by Colella, Lalive, Sakalli and Thoenig (2019).[17]

We note that this specification is essentially equivalent to regressing the change between 1910 and year t in the share of an occupation or industry ($y_{i,t}^j - y_{i,1910}^j$) on the change in electrification over the same period ($E_{i,t} - E_{i,1910}$), and controlling for state fixed effects and initial county characteristics. To see why, note that we control for the 1910 value of the dependent variable, $y_{i,1910}^j$. Furthermore, as illustrated in Figure 4 and Table 1, there were essentially no high voltage transmission lines in 1910, so electrification in year t is effectively the change relative to 1910, i.e. $E_{i,t} - E_{i,1910} \approx E_{i,t}$ because $E_{i,1910} \approx 0$.

We estimate specification (1) separately for years $t = 1920, 1930, 1940$ and each population group

[17]While we do think that spatial clustering is conceptually important in our setting, it turns out that, in practice, the usual heteroskedasticity robust standard errors are only marginally smaller than the spatially clustered version. To save on space we only report the spatially clustered standard errors throughout the manuscript.

$j \in J$, which allows us to trace the short to long-term impact of electrification on the distribution of workers across occupations and industries. Our main focus is the long-run effects ($t = 1940$) and we report the results for $t = 1920, 1930$ in the appendix.

The most likely confound for OLS regressions is that electrification was in large part demand driven: electrification may occur sooner in counties where electricity-intensive occupations and industries were already strong. To get around this potential confound, we use an instrument for electrification that is a plausibly exogenous supply-side shifter: hydroelectric potential in an area decreases the cost of electrification. We therefore implement an instrumental variable strategy, in which we instrument $E_{i,t}$ with hydroelectric potential within 50 miles of the county centroid.

4. Results

While we have already discussed suggestive evidence in favor of our identification strategy in Section 3.5, we start this section by formally investigating the strength of our proposed instrument. In Table 2, we show the first stage regression of length of high-voltage power lines on hydroelectric potential within 50 miles of each county including the same controls as in our most restrictive specifications for major occupation groups. Hydroelectric potential has a positive and significant impact on electrification, and the magnitude of the effect is largest in 1940. The F-statistic for the null that the electrification coefficient is zero is well above 10 for 1930 and 1940, suggesting that the instrument is sufficiently strong for the years with substantial expansion in the electricity grid (see Figure 4 and Table 1).[18]

4.1. Impact of Electrification on the Occupational Structure of Employment

Our main analysis focuses on the 1910-1940 period to capture the long-run effect of electrification on the occupational structure. Tables 3 and 4 summarize the results for the three most affected occupations: farmers, operatives, and craftsmen.[19] We consider four alternative specifications based on equation (1), in which we estimate the effect of 100 km of additional transmission lines using both OLS (columns 1-4) and

[18]The strength of the instrument does not change materially when conditioning on alternative combinations of control variables.

[19]Tables C.10 through C.12 in the appendix report the corresponding regression tables reporting all estimated coefficients, while Tables C.21 and C.22 in the appendix report the coefficient of interest from our preferred specifications (columns 3 and 7) for both OLS and IV estimates and all occupations.

Table 2: First Stage Regression

	100 km of High-Voltage Power Lines		
	1920	1930	1940
Hydro (50m Radius)	0.0001***	0.0005***	0.0007***
	(0.00005)	(0.0001)	(0.0002)
Log. Pop. Dens (1910)	-0.04	-0.10	-0.4*
	(0.06)	(0.09)	(0.2)
Frac. White (1910)	-0.4	-1.5***	-3.0***
	(0.3)	(0.5)	(0.9)
Mean Age (1910)	-0.03	-0.1*	-0.3*
	(0.04)	(0.07)	(0.1)
Detailed Occupation Shares	yes	yes	yes
State Fixed Effects	yes	yes	yes
Obs.	2895	2895	2875
Adj. R^2	0.526	0.461	0.488
F-Stat (Instrument)	8.336	21.293	17.233

Notes: Regression of kilometers of transmission lines on hydroelectric potential within a 50 mile radius. All regressions include a full set of occupation and state fixed effects and are weighted by male, working age individuals with an occupation in 1910 and include the same control variables as our main IV regressions. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

our IV strategy based on hydroelectric potential (columns 5-8). All Specifications control for the initial employment share of the dependent variable (here farmers, operatives, and craftsmen), as well as state fixed effects. Columns 1 and 5 show the most basic specification, without any additional controls. Columns 2-4 as well as 6-8 additionally include demographic controls for 1910 (race, age, population density). Our preferred specification (columns 3 and 7) additionally controls for the initial employment share of agriculture and manufacturing, to capture the initial industrial composition for the most relevant sectors in the context of structural transformation. Finally, as a robustness check, columns 4 and 8 control for the entire occupational distribution by including the initial (1910) share of all detailed occupations (see panel A of Figure 3).

All specifications suggest that electrification had a significantly positive impact on the share of operatives and craftsmen (Table 3). Both occupations are concentrated in the manufacturing sector (48% of operatives and 35% of craftsmen worked in manufacturing in 1940), are medium-skill and high-skill blue-collar jobs, respectively, and together account for 61% of manufacturing employment in 1940 (38% operatives and 23%

Table 3: Electrification and the Share of Operatives and Craftsmen (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
A. Operatives	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	0.269***	0.268***	0.146***	0.086**	1.121***	0.941***	0.862***	0.626***
	(0.052)	(0.057)	(0.047)	(0.043)	(0.359)	(0.258)	(0.212)	(0.210)
Log. Pop. Dens (1910)		0.224*	-0.115	0.382***		0.133	-0.013	0.542***
		(0.117)	(0.104)	(0.143)		(0.147)	(0.139)	(0.173)
Frac. White (1910)		5.239***	5.376***	4.905***		5.960***	5.853***	6.060***
		(1.349)	(1.352)	(1.332)		(1.402)	(1.368)	(1.433)
Mean Age (1910)		0.175	0.548**	0.448*		0.338	0.625**	0.555**
		(0.253)	(0.263)	(0.242)		(0.248)	(0.258)	(0.257)
Agriculture (1910)			-2.529**				0.910	
			(1.037)				(1.593)	
Manufacturing (1910)			16.157***				15.309***	
			(2.674)				(2.987)	
Operative (1910)	59.198***	58.980***	56.572***	46.356***	56.745***	58.276***	59.107***	45.978***
	(3.230)	(3.024)	(3.243)	(3.206)	(3.036)	(2.816)	(3.355)	(3.047)
Detailed Occupations				yes				yes
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.746	0.751	0.780	0.789	0.671	0.705	0.732	0.764

B. Craftsmen	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	0.079*	0.074**	0.075**	0.074**	0.511***	0.404***	0.407***	0.313***
	(0.048)	(0.038)	(0.037)	(0.033)	(0.152)	(0.116)	(0.110)	(0.097)
Log. Pop. Dens (1910)		-0.245***	-0.246***	0.019		-0.176**	-0.178***	0.091
		(0.058)	(0.055)	(0.068)		(0.074)	(0.068)	(0.074)
Frac. White (1910)		1.442***	1.491***	1.823***		1.722***	1.776***	2.335***
		(0.479)	(0.466)	(0.541)		(0.501)	(0.487)	(0.572)
Mean Age (1910)		0.393***	0.585***	0.600***		0.454***	0.650***	0.648***
		(0.091)	(0.085)	(0.093)		(0.085)	(0.080)	(0.093)
Agriculture (1910)			-2.936***				-3.057***	
			(0.606)				(0.626)	
Manufacturing (1910)			4.140***				4.081***	
			(1.118)				(1.267)	
Craft (1910)	57.282***	63.583***	51.973***	56.282***	50.388***	57.544***	45.642***	52.042***
	(1.971)	(1.690)	(2.552)	(3.231)	(3.445)	(2.792)	(3.426)	(3.867)
Detailed Occupations				yes				yes
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.868	0.881	0.887	0.890	0.826	0.856	0.862	0.878

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group is non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

craftsmen).[20] With the exception of the most demanding OLS specification (column 4) our results suggest a statistically significant simultaneous negative effect on farmers (panel A of Table 4).

[20]See Tables C.33 through C.36 in the appendix for a detailed tabulation of the distribution of occupations within and across industries.

Table 4: Electrification and the Share of Farmers (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	-0.149**	-0.152***	-0.131**	-0.069	-0.863***	-0.679***	-0.723***	-0.663***
	(0.060)	(0.055)	(0.058)	(0.059)	(0.289)	(0.245)	(0.252)	(0.256)
Log. Pop. Dens (1910)		0.118	0.293***	0.252*		0.089	0.231*	0.075
		(0.095)	(0.101)	(0.129)		(0.115)	(0.129)	(0.175)
Frac. White (1910)		-5.931***	-4.078**	-3.353*		-6.072***	-4.578**	-4.624**
		(1.733)	(1.803)	(1.819)		(1.796)	(1.864)	(1.913)
Mean Age (1910)		-0.908***	-0.954***	-0.917***		-0.934***	-0.966***	-1.035***
		(0.188)	(0.185)	(0.216)		(0.198)	(0.194)	(0.235)
Agriculture (1910)			14.661***				12.398***	
			(3.262)				(3.501)	
Manufacturing (1910)			-0.688				0.707	
			(1.621)				(2.084)	
Farmer (1910)	71.225***	75.343***	55.810***	68.071***	67.220***	72.300***	55.887***	67.467***
	(1.457)	(1.550)	(4.570)	(2.957)	(2.024)	(1.899)	(4.818)	(3.181)
Detailed Occupations				yes				yes
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.897	0.901	0.903	0.905	0.882	0.893	0.893	0.896

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group is non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Once we instrument for the length of high-voltage power lines with hydroelectric potential, the effect of electrification is not only highly significant for all specifications and all three occupations but the point estimates are more than five times larger than the corresponding OLS estimates. Specifically, our preferred specification (column 7) suggests that an additional 100 kilometers of high-voltage power lines decreases the share of farmers by 0.723 percentage points and increases the share of operatives by 0.862 and that of craftsmen by 0.407 percentage points. The fact that these IV estimates are much larger than the corresponding OLS estimates suggests that increases in electrification occurred in counties where the growth of operatives tended to be otherwise slower, leading to a downward bias in the OLS estimates. The IV estimates suggest that electricity caused counties to shift their economic activities away from agricultural jobs and towards jobs typically required of manufacturing and associated work.

Table 5: Electrification and the Share of Agriculture and Manufacturing (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
A. Agriculture	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	-0.174*	-0.180**	-0.178**	-0.148**	-1.221**	-0.907**	-0.912**	-0.732**
	(0.101)	(0.090)	(0.089)	(0.075)	(0.484)	(0.383)	(0.391)	(0.337)
Log. Pop. Dens (1910)		0.130	0.129	-0.356**		0.052	0.052	-0.427**
		(0.164)	(0.166)	(0.145)		(0.181)	(0.181)	(0.174)
Frac. White (1910)		-10.117***	-10.103***	-10.497***		-10.704***	-10.714***	-10.999***
		(2.244)	(2.241)	(2.224)		(2.294)	(2.295)	(2.257)
Mean Age (1910)		-1.558***	-1.566***	-1.350***		-1.584***	-1.581***	-1.360***
		(0.234)	(0.237)	(0.270)		(0.249)	(0.251)	(0.279)
Agriculture (1910)	74.020***	78.541***	78.232***	62.960***	69.871***	75.363***	75.493***	62.929***
	(1.431)	(1.341)	(1.452)	(8.218)	(2.335)	(1.934)	(1.877)	(8.590)
Manufacturing (1910)			-1.170	-17.990**			0.560	-14.996
			(2.476)	(9.116)			(3.017)	(9.373)
Detailed Industries				yes				yes
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.907	0.912	0.912	0.916	0.892	0.905	0.905	0.912
B. Manufacturing								
TL in 100 km	0.315***	0.328***	0.292***	0.252***	0.698*	0.563*	0.631**	0.457*
	(0.068)	(0.067)	(0.066)	(0.064)	(0.385)	(0.333)	(0.305)	(0.278)
Log. Pop. Dens (1910)		0.523***	0.364***	0.652***		0.511***	0.399***	0.677***
		(0.106)	(0.108)	(0.147)		(0.109)	(0.122)	(0.158)
Frac. White (1910)		3.404**	3.562**	3.582**		3.643**	3.844***	3.759**
		(1.427)	(1.456)	(1.449)		(1.498)	(1.491)	(1.469)
Mean Age (1910)		1.117***	1.234***	1.029***		1.149***	1.241***	1.033***
		(0.156)	(0.158)	(0.172)		(0.169)	(0.154)	(0.174)
Agriculture (1910)			-3.929***	-15.191*			-2.663*	-15.180*
			(1.033)	(7.782)			(1.588)	(7.865)
Manufacturing (1910)	85.791***	86.902***	82.728***	66.943***	82.910***	85.367***	81.929***	65.891***
	(2.346)	(2.553)	(2.805)	(8.207)	(3.464)	(3.161)	(2.884)	(8.247)
Detailed Industries				yes				yes
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.817	0.826	0.828	0.833	0.810	0.823	0.823	0.832

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group is non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

4.2. Impact of Electrification on the Industrial Structure of Employment

This section investigates the impact of electrification on the industrial structure between 1910 and 1940. Our results for the agricultural and manufacturing sectors are reported in Table 5, which is constructed in analogy to the tables reporting the effects on occupations in the previous section.[21] Reassuringly, we find that electrification affected industry employment in line with our results on occupations, significantly reducing the share of males employed in agriculture while simultaneously increasing the share employed in manufacturing.

Specifically, our preferred IV estimates (column 7) suggest that a 100 km increase in high-voltage power lines lowers the share of men employed in agriculture by 0.912 percentage points. The same increase in electrification increases the share of men employed in manufacturing by 0.631 percentage points. Like with occupations, the IV estimates are orders of magnitudes larger than the OLS estimates. Together with our estimates for occupations, these results suggest that electrification likely played a role in structural transformation.

4.3. The Role of Rural Counties

We argued above that our instrumental variable strategy is most believable for rural areas that were initially (in 1910) characterized by agriculture-dominant economies. This is because rural counties were not electrified in 1910 (Figure 4 and Table 1) and because it is unlikely that the primary drivers for their electrification throughout 1910-1940 were the demands and actions of manufacturers. Rather, the ability of these rural areas to electrify in those 30 years was plausibly dominated by natural factors such as hydroelectric potential, which reduced the cost of electricity substantially.

This lower price of electricity shows up in our dataset as an increase in high-voltage transmission lines, and their availability made it easier for industrial activity to spread beyond the largest cities into more rural counties. After 1930 this also allowed farms to start to electrify, but the electrical innovations in agriculture came later and so our sample period is mostly one where manufacturing activities moved into rural counties rather than where farm activities electrified. Our hypothesis, then, is that we should see stronger results in rural rather than urban counties.

To assess this hypothesis, we additionally interact our main electrification measure with a dummy for

[21] In analogy to our analysis for occupations, full regression tables with all estimated coefficients (Tables C.13 and C.14) as well as condensed OLS and IV tables with results for all industries (Tables C.29 and C.30) are reported in the appendix. We note that information on a worker's industry is missing for up to 28% of workers depending on occupation (see Table C.34 in the appendix), so in the condensed tables for all industries we also incorporate the effect of electrification on the "missing industry" category to assess any bias in the data.

Table 6: Effect of Electrification by Population Density (IV, 1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	Occupations			Industries	
	Farmer	Craft	Operatives	Agriculture	Manufacturing
High Density	-9.115***	1.674**	3.382**	-11.01***	8.804***
	(1.843)	(0.709)	(1.450)	(3.362)	(2.962)
TL in 100 km	-1.241***	0.354**	0.785***	-1.608**	1.277**
	(0.442)	(0.149)	(0.298)	(0.799)	(0.629)
TL in 100 km x High Density	1.741***	-0.190	-0.535	1.985**	-1.734**
	(0.517)	(0.191)	(0.396)	(0.952)	(0.858)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.887	0.886	0.771	0.901	0.797
p-value Urban	0.055	0.126	0.349	0.336	0.374

Notes: Baseline regression of county occupation and industry share on kilometers of high-voltage transmission lines (TL), weighted by county population in 1910. The specification additionally includes an indicator for high density counties as well as an interaction of high density with TLs. High density counties are defined as being in the top septile of the population density distribution in 1910. The final row reports the p-value for a joint test of the null that the coefficients on TL and (TL $\times$ high density) sum to zero. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

"high density" counties, defining a county as "high density" if it is in the top septile (top 14.3%) of the population density distribution in 1910 as discussed in Section 3.5. The main results from this exercise are summarized in Table 6, suggesting that the impact of electrification between 1910 and 1940 on farmers, craftsmen, and operatives is driven by "low density" counties, which are overwhelmingly rural and account for approximately 55% of the U.S. population in 1910. We see analogous results for employment in the agricultural and manufacturing sectors.[22] Furthermore, the analysis highlights that the average effects mask the observation that the interaction term for urban counties has the opposite sign and is roughly similar in magnitude to the effect in rural counties. Thus, the overall effect within urban counties is generally not statistically significant, as suggested by a joint test of the null that the sum of the coefficient on transmission lines plus the interaction term with urban areas sums to zero.

These results suggest that electrification accelerated structural transformation *within* rural counties in the U.S. rather than changing the occupational structure in urban counties or merely shifting economic activity towards urban counties. Reassuringly, this is consistent with the results of Michaels et al. (2012) who

[22] See Tables C.23, C.24, C.31, and C.32 in the Appendix for the companion OLS and IV analysis including all occupations and industries.

found that population growth after 1880 was greatest in parts of the U.S. that had initially mid-distribution population densities. Their interpretation was that really rural and agriculture-concentrated areas, with low initial densities withered and failed to grow over the subsequent 120 years, while areas in the middle of the distribution experienced structural transformation and moved away from agricultural occupations. This pattern further fits with the general patterns of U.S. industrial development which tended to take advantage of the abundant natural resources and locate industries close to those inputs Lee and Rhode (2018).

4.4. Implied Effects of Electrification on Structural Transformation

Even though our estimation strategy identifies local average treatment effects, we argue that it is possible to use the estimates from the previous sections to draw reasonable conclusions about possible implications at the aggregate level. Specifically, we draw on recent findings in the spatial structural change and urban economics literature, to argue that spatial reallocation of workers was negligible during 1910-1940 and we can therefore scale our estimated local average treatment effects.

First, Michaels et al. (2012) use U.S. data for a selection of years from 1880 to 2000 to show that structural transformation was occurring, was especially fast before 1960, and that areas in the middle of the initial population distribution experienced faster subsequent population growth than those at the extremes. This suggests that it was not simply suburbanization that drove urbanization but actual transformation in certain rural areas, which grew and became less agricultural. As we illustrate above, our results are driven entirely by rural counties, indicating that transformation was taking place within rural counties rather than through people moving to existing industrialized areas.

Our argument gains further support from Eckert and Peters (2018). They decompose aggregate data for 1880-2000, using an overlapping generations model with moving frictions and non-homothetic preferences, to show that the fall in the share of agriculture in employment from 1880 to 2000 was not driven by spatial reallocation of workers towards urban areas but rather by structural transformation within regions. This suggests that abstracting from potential labor movement across counties in our empirical analysis is likely innocuous, as their decomposition suggests this channel was not crucial.[23]

[23] Their paper shows results across commuting zones, but the same pattern was identified across counties, most relevant for our work here.

Table 7: Approximate Contribution of Electrification to Structural Transformation

	Occupations				Sectors			
	Farmers		Operatives		Agriculture		Manufacturing	
A. Fraction of Male, Working Age Population (16-65) with Occupation								
Initial	23.5		11.7		36.7		15.8	
Change	-11.3		6.5		-15.4		7.1	
1940	12.2		18.2		21.3		22.9	
B. Transmission Lines in km								
Change	402.6		402.6		402.6		402.6	
1940	410.0		410.0		410.0		410.0	
C. Regression Coefficients								
OLS 1940	-0.13		0.15		-0.18		0.29	
IV 1940	-0.72		0.86		-0.91		0.63	
D. Predicted Changes		% of Trend		% of Trend		% of Trend		% of Trend
OLS	-0.53	4.67	0.59	9.04	-0.7	4.65	1.18	16.56
IV	-2.96	26.23	3.53	54.37	-3.7	23.84	2.54	35.78

Notes: The table reports back of the envelope calculations on the approximate contribution of electrification to the decline in farmers and the rise of operatives. National trends (weighted by initial 1910 population) in panel A are taken from Tables C.8 and C.9. National trends in electrical grid expansion in panel B are taken from the regressions underlying Figure 4. Estimates of the impact of grid expansion on occupational and industrial composition of employment are taken from column 7 of Tables 3, 4, and 5.

Finally, Vidart (2020) uses a completely different measure of electrification during the 1910s and reaches similar conclusions about what parts of the country were most affected. Very large cities were electrified before 1910, while farm electrification occurred only after 1930. In her view, the years 1910 to 1940 are when "Middle America" electrified. This is when smaller cities became larger and more technologically sophisticated, consistent with our finding of changing occupational composition *within* rural counties.

Thus, under the assumption that the changing composition of economic activities within counties is the main channel through which overall change in the economy is occurring, Table 7 summarizes a back of the envelope calculation to gauge the contribution of electrification to structural transformation between 1910 and 1940.[24] Specifically, scaling our IV estimates from Tables 3 and 4 with the average county-level increase in high-voltage transmission lines, we find that electricity would drive a 3.5 percentage point increase in the share of operatives and an almost symmetrical 3 percentage point decrease in the share of farmers. Based on these estimates, electrification could explain 26.2% of the national decline in the employment share of

[24]We do acknowledge, though, that these calculations are simply suggestive and that our approach does not explicitly account for all channels of adjustment of the economy to changes in the relative productivity and final goods prices in each sector.

farmers between 1910 and 1940 and 54.4% of the increase in the employment share of operatives.

An analogous calculation for industries based on Table 5 suggests that electrification accounts for 23.8% of the decline in the employment share of agriculture and 35.8% of the increase in the employment share of manufacturing. Electrification may have a lower impact on industries than on occupations because agriculture and manufacturing are comprised of other occupations besides farmers and operatives respectively (Appendix Tables C.33 and C.35): in agriculture, the share of farmers is about two thirds in 1910, and in manufacturing, operatives constitute only 28% of employment in 1910 (Appendix Table C.33). Furthermore, while farmers are essentially only found in agriculture, one can find operatives in other industries besides manufacturing (Appendix Tables C.34 and C.36): for example, in 1910, 37% of operatives were in manufacturing and 29% were in mining (Appendix Table C.34).

Overall, the picture that emerges from our results is that, within counties, electrification played a causal role in moving American employment away from farmer and toward operatives, and can account for a significant share of the structural transformation in early twentieth century U.S. Figure 1 graphically illustrates these back of the envelope calculations for the entire occupational and industrial structure, displaying the scaled IV estimates of coefficients that are significant at the 10% confidence level.

4.5. Additional Results and Robustness Tests

What are the effects of electrification during different decades? We start with changes between 1910 and 1920. During this decade, there was little increase in electrification (Figure 4 and Table 1) and the instrument is relatively weak (Table 2), so we should not over-interpret the results. In terms of occupations, IV regressions show a significant increase in the share of sales and professional occupations (Appendix Table C.18).[25] In terms of industries, IV results show a significant decline in mining and the public sector and a significant increase in construction, trade, and services (Appendix Table C.26).[26]

Between 1910 and 1930, electrification increases considerably (Figure 4 and Table 1). IV regressions show that electrification significantly increased the share of operatives and craft workers in male employment (Appendix Table C.20), and decreased the share of farmers.[27] The effects tend to be around 60% in

[25]See Appendix Table C.17 for corresponding OLS regressions.
[26]See Appendix Table C.25 for corresponding OLS regressions.
[27]See Appendix Table C.19 for corresponding OLS regressions.

magnitude compared to the estimated effects in 1940, consistent with this being an earlier period with less time to adjust occupations.

As for the impact of electrification on the industry structure in 1930, the IV results show a positive effect on manufacturing and a negative effect on agriculture, though the effect on agriculture is not yet significant (Appendix Table C.28).[28] This is consistent with the historical evidence that agricultural wages only started to collapse in the 1930s (Alston and Hatton, 1991), which would create the largest incentive for workers to change occupation and sector during that decade. We also highlight that the industry data is lower quality than the information on occupation, as explained in our Data section and the appendix.

Overall, electrification spread most vigorously in the 1920s and 1930s in the bulk of our sample counties, and we correspondingly observe a causal significant and positive effect on the share of operatives in male employment in both 1930 and 1940, and a causal significant and negative impact on the share of farmers in both 1930 and 1940. On the industry side, we see a significant positive effect of electrification on manufacturing and a significant negative effect on farming only in 1940. The results suggest that electrification played a causal role in structural transformation by stimulating job creation for operatives and the growth of the manufacturing sector, and subsequently facilitating the decline in farmers and the shrinking of the agriculture sector.

The main results tables focus on the effect of electrification over the long run to 1940, incorporating controls for demographics, initial level of economic activity and occupational (or industrial) structure. In Tables C.15 and C.16, we present additional results showing that regressions in differences rather than levels yield essentially the same results, focusing on farmers and operatives respectively. We discussed the intuition for this in Section 3.6. Furthermore, our results are generally robust to normalizing the length of transmission lines by either county area or county population.[29]

[28] See Appendix Table C.27 for corresponding OLS regressions.

[29] When using length of transmission lines by area as the dependent variable, the effect of electrification on the share of manufacturing is not significant. However, it is significant when we restrict the sample to rural areas, which we argue are responsible for the main effect we document.

5. Conclusion

In this paper, we leverage a new combination of U.S. Census data, data on high-voltage power lines, and hydroelectric potential to examine the impact of electrification on the employment structure in the early twentieth century U.S. We instrument the length of high-voltage power lines in a county with hydroelectric potential within 50 miles of that county. We find that the average increase in the length of high-voltage power lines between 1910 and 1940 increased the share of operatives in male employment in a county by 0.6 percentage points and decreased the share of farmers by 0.7 percentage points. In parallel, electrification caused a 0.7 percentage point decline in agriculture, paired with a 0.5 percentage point increase in manufacturing. A back of the envelope calculation based on these estimates suggests that electrification can account for about 40% of the total increase in the share of operatives in male employment, and 24% of the total decrease in the share of farmers. At the industry level, electrification accounts for 19% of the decline in the share of male agricultural employment and 26% of the increase in the share of manufacturing employment. Moreover, we find that the electrification-driven increase in operatives and decrease in farmers over this period only occurs in rural areas, and not in urban areas. This suggests that structural transformation is not just a movement between rural and urban areas but affects the structure of employment within rural areas.

We conclude by noting that the effects of electrification take a very long time to unfold, illustrating the long time scales involved when trying to understand the impact of a general-purpose technology on the labor market. Only large cities were electrified by 1910. The development of higher-voltage power lines was very slow until 1920, and only accelerated significantly between 1920 and 1940. We show that this acceleration of electrification affected the structure of employment, especially favoring the growth of operative jobs and negatively affecting farmer jobs. The long timescale for the impact of electrification on the labor market suggests that we may see a similarly protracted development of the full impacts of ICT—the latest general-purpose technology—on the labor market.

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Appendix A. Harmonization of Occupation and Industry Codes

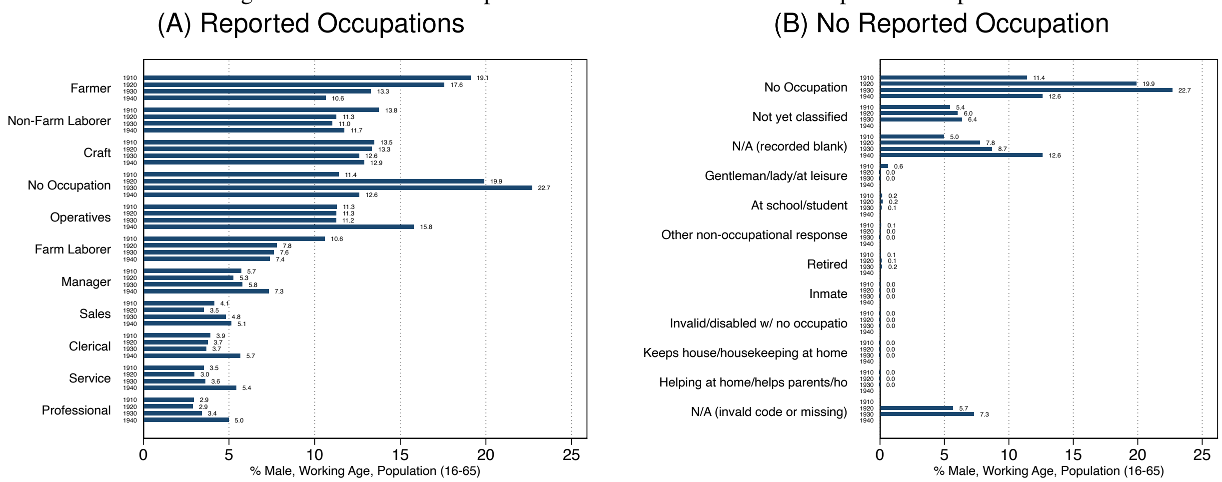
Our occupation and industry information comes from IPUMS and we use the harmonized variables that are consistent across Census years, `occ1950` and `ind1950`. IPUMS assigned these harmonized codes based on the original text recorded by the Census enumerator, which is available to us (with restricted access) in digitized form as `occstr` and `indstr`. Unfortunately, as of October 2018, a non-negligible subset of individuals in the 1910, 1920, and 1930 files receive `occ1950` and `ind1950` code 979, which indicates that IPUMS has "not yet coded" an individual's industry and/or occupation. We develop a simple procedure in order to drastically reduce the number of 979 codes in the original IPUMS files. In the raw IPUMS files, roughly 7% of individuals are coded as 979 in the 1910-1930 files. Our procedure reduces this number to roughly 6% for `occ1950-ind1950` tuples and to less than 3% for occupations (`occ1950`), since `occstr` tended to contain much more information than `indstr`.

Our procedure exploits the fact that IPUMS coded different Census files sequentially, starting with 1940 and working backwards until 1910. We found that there are many instances in which identical string entries for `occstr` and/or `indstr` appear in several Census waves, yet are assigned 979 in one Census and an actual occupation and/or industry in others. We therefore apply the following two-step procedure. First, from all four Census waves 1910-1940, we gather all unique `occstr-indstr` tuples that map into non-979, non-missing `occ1950-ind1950` tuples. If a unique `occstr-indstr` tuple maps into several different `occ1950-ind1950` tuples, we keep the most frequent mapping. In each Census file, we then replace any `occstr-indstr` tuples that are assigned 979 with the non-979, non-missing value found in the comprehensive list of the most frequent mapping from all four Census waves.

While there is some benefit to looking at `occstr-indstr` tuples, we repeat this procedure analogously for any remaining 979 values but using `occstr` by itself. We do not repeat this procedure for `indstr` by itself, as industries are in many cases coded simply as the name of an employer, or a particular location, so it is often not possible to assign an industry based on `indstr` in isolation.

Appendix B. Additional Figures

Figure B.5: Trends in Occupational Structure 1910-1940: No Reported Occupation



Notes: The figure shows national trends in the occupational structure during 1910-1940 in the United States. Panel A plots fractions of the male working age population, without inmates and the military and corresponds to Panel A in Figure 4 of the main paper. Panel B decomposes the fractions of those without a reported occupation (first group of bars labeled ”No Occupation”) into its sub-components based on IPUMS OCC1950 codes.

Appendix C. Additional Tables

Appendix C.1. Unconditional, National Trends

Table C.8: National Trends in Occupation Shares 1910-1940 (County Averages)

	Percent of Male, Working Age Population (16-65) with Occupation				
	Farmer	Farm Lab.	Clerical	Sales	Craft
Level (%) 1910	23.5***	12.9***	3.7***	4.6***	15.0***
	(1.3)	(0.6)	(0.3)	(0.2)	(0.6)
Δ 1920	0.3	-2.5***	0.8*	-0.4	0.9
	(1.8)	(0.8)	(0.4)	(0.3)	(0.8)
Δ 1930	-3.7**	-1.9**	0.7*	1.1***	0.2
	(1.7)	(0.9)	(0.4)	(0.4)	(0.7)
Δ 1940	-8.0***	-3.2***	2.1***	0.7**	-1.3**
	(1.5)	(0.8)	(0.4)	(0.3)	(0.6)
Obs.	11742	11742	11742	11742	11742
	Operatives	Professional	Service	Manager	Non-Farm Lab.
Level (%) 1910	11.7***	3.1***	3.7***	6.1***	15.7***
	(0.5)	(0.1)	(0.3)	(0.2)	(0.4)
Δ 1920	1.8**	0.4***	-0.2	0.3	-2.0***
	(0.7)	(0.2)	(0.4)	(0.2)	(0.5)
Δ 1930	2.3***	1.0***	0.6	1.1***	-1.5***
	(0.7)	(0.2)	(0.4)	(0.2)	(0.5)
Δ 1940	5.6***	2.1***	2.0***	1.9***	-1.9***
	(0.6)	(0.2)	(0.4)	(0.2)	(0.5)
Obs.	11742	11742	11742	11742	11742

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.9: National Trends in Industry Shares 1910-1940 (County Averages)

	Percent of Male, Working Age Population (15-65) with Occupation				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
Constant(1910)	36.8***	3.7***	6.8***	15.8***	8.7***
	(1.9)	(0.4)	(0.2)	(0.7)	(0.3)
△ 1920	-2.7	0.1	-1.5***	1.9**	0.2
	(2.7)	(0.6)	(0.3)	(1.0)	(0.4)
△ 1930	-5.7**	-0.3	0.2	0.3	-0.9***
	(2.6)	(0.6)	(0.3)	(0.9)	(0.3)
△ 1940	-10.8***	-0.9*	4.7***	5.1***	-1.9***
	(2.4)	(0.5)	(0.2)	(0.9)	(0.3)
Obs.	11702	11702	11702	11702	11702
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	Total
Constant(1910)	9.7***	1.5***	6.6***	1.1***	9.4***
	(0.6)	(0.1)	(0.3)	(0.05)	(0.2)
△ 1920	-0.5	0.2	0.2	0.7***	1.4***
	(0.7)	(0.2)	(0.4)	(0.10)	(0.4)
△ 1930	1.3*	0.9***	1.9***	0.5***	1.8***
	(0.7)	(0.2)	(0.4)	(0.07)	(0.3)
△ 1940	4.4***	0.6***	2.9***	1.6***	-5.7***
	(0.7)	(0.2)	(0.4)	(0.09)	(0.3)
Obs.	11702	11702	11702	11702	11702

Notes: Regression of county-industry shares on year dummies, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Appendix C.2. Full Regression Tables for Main Results in 1940

Tables C.10 through C.14 show the full regression tables corresponding to Tables 3 through 5 in the main text.

Table C.10: Electrification and the Share of Farmers (1910-1940)

	Farmers: Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	-0.149**	-0.152***	-0.131**	-0.069	-0.863***	-0.679***	-0.723***	-0.663***
	(0.060)	(0.055)	(0.058)	(0.059)	(0.289)	(0.245)	(0.252)	(0.256)
Log. Pop. Dens (1910)		0.118	0.293***	0.252*		0.089	0.231*	0.075
		(0.095)	(0.101)	(0.129)		(0.115)	(0.129)	(0.175)
Frac. White (1910)		-5.931***	-4.078**	-3.353*		-6.072***	-4.578**	-4.624**
		(1.733)	(1.803)	(1.819)		(1.796)	(1.864)	(1.913)
Mean Age (1910)		-0.908***	-0.954***	-0.917***		-0.934***	-0.966***	-1.035***
		(0.188)	(0.185)	(0.216)		(0.198)	(0.194)	(0.235)
Agriculture (1910)			14.661***				12.398***	
			(3.262)				(3.501)	
Manufacturing (1910)			-0.688				0.707	
			(1.621)				(2.084)	
Farmer (1910)	71.225***	75.343***	55.810***	68.071***	67.220***	72.300***	55.887***	67.467***
	(1.457)	(1.550)	(4.570)	(2.957)	(2.024)	(1.899)	(4.818)	(3.181)
Prof. (1910)				-91.775***				-64.982*
				(30.699)				(33.262)
Manager (1910)				56.080***				32.389
				(15.377)				(23.310)
Clerical (1910)				32.773**				34.746
				(15.437)				(29.738)
Sales (1910)				-7.271				21.696
				(15.771)				(28.893)
Craft (1910)				-21.762***				-11.235
				(5.922)				(7.533)
Operative (1910)				-2.665				-2.249
				(2.448)				(2.452)
Service (1910)				6.725				-21.409
				(9.815)				(20.625)
F Lab. (1910)				13.719***				12.698***
				(3.888)				(4.145)
Constant	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.181)	(0.162)	(0.161)	(0.156)	(0.231)	(0.206)	(0.213)	(0.206)
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.897	0.901	0.903	0.905	0.882	0.893	0.893	0.896

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group is non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.11: Electrification and the Share of Craftsmen (1910-1940)

	Operatives: Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	0.079*	0.074**	0.075**	0.074**	0.511***	0.404***	0.407***	0.313***
	(0.048)	(0.038)	(0.037)	(0.033)	(0.152)	(0.116)	(0.110)	(0.097)
Log. Pop. Dens (1910)		-0.245***	-0.246***	0.019		-0.176**	-0.178***	0.091
		(0.058)	(0.055)	(0.068)		(0.074)	(0.068)	(0.074)
Frac. White (1910)		1.442***	1.491***	1.823***		1.722***	1.776***	2.335***
		(0.479)	(0.466)	(0.541)		(0.501)	(0.487)	(0.572)
Mean Age (1910)		0.393***	0.585***	0.600***		0.454***	0.650***	0.648***
		(0.091)	(0.085)	(0.093)		(0.085)	(0.080)	(0.093)
Agriculture (1910)			-2.936***				-3.057***	
			(0.606)				(0.626)	
Manufacturing (1910)			4.140***				4.081***	
			(1.118)				(1.267)	
Craft (1910)	57.282***	63.583***	51.973***	56.282***	50.388***	57.544***	45.642***	52.042***
	(1.971)	(1.690)	(2.552)	(3.231)	(3.445)	(2.792)	(3.426)	(3.867)
Prof. (1910)				-3.522				-14.313
				(14.569)				(15.497)
Farmer (1910)				-8.441***				-8.198***
				(1.436)				(1.451)
Manager (1910)				-10.184				-0.642
				(8.670)				(11.435)
Clerical (1910)				-30.308***				-31.102**
				(9.134)				(13.654)
Sales (1910)				-8.829				-20.496**
				(7.071)				(9.446)
Operative (1910)				-3.599**				-3.766**
				(1.533)				(1.553)
Service (1910)				-5.310				6.022
				(5.329)				(7.111)
F Lab. (1910)				-5.170***				-4.759***
				(1.599)				(1.662)
Constant	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.115)	(0.082)	(0.073)	(0.064)	(0.125)	(0.100)	(0.094)	(0.078)
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.868	0.881	0.887	0.890	0.826	0.856	0.862	0.878

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group is non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.12: Electrification and the Share of Operatives (1910-1940)

	Operatives: Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	0.269***	0.268***	0.146***	0.086**	1.121***	0.941***	0.862***	0.626***
	(0.052)	(0.057)	(0.047)	(0.043)	(0.359)	(0.258)	(0.212)	(0.210)
Log. Pop. Dens (1910)		0.224*	-0.115	0.382***		0.133	-0.013	0.542***
		(0.117)	(0.104)	(0.143)		(0.147)	(0.139)	(0.173)
Frac. White (1910)		5.239***	5.376***	4.905***		5.960***	5.853***	6.060***
		(1.349)	(1.352)	(1.332)		(1.402)	(1.368)	(1.433)
Mean Age (1910)		0.175	0.548**	0.448*		0.338	0.625**	0.555**
		(0.253)	(0.263)	(0.242)		(0.248)	(0.258)	(0.257)
Agriculture (1910)			-2.529**				0.910	
			(1.037)				(1.593)	
Manufacturing (1910)			16.157***				15.309***	
			(2.674)				(2.987)	
Operative (1910)	59.198***	58.980***	56.572***	46.356***	56.745***	58.276***	59.107***	45.978***
	(3.230)	(3.024)	(3.243)	(3.206)	(3.036)	(2.816)	(3.355)	(3.047)
Prof. (1910)				-38.253				-62.615
				(40.563)				(40.943)
Farmer (1910)				-12.138***				-11.588***
				(1.962)				(2.095)
Manager (1910)				-37.793**				-16.252
				(14.892)				(22.023)
Clerical (1910)				-65.752***				-67.546*
				(22.974)				(34.467)
Sales (1910)				-0.684				-27.023
				(12.456)				(22.105)
Craft (1910)				27.240***				17.668**
				(6.663)				(7.785)
Service (1910)				-35.479**				-9.897
				(13.963)				(21.362)
F Lab. (1910)				-14.904***				-13.975***
				(2.989)				(3.257)
Constant	-0.000	-0.000	0.000	0.000	-0.000	0.000	0.000	0.000
	(0.203)	(0.202)	(0.178)	(0.153)	(0.252)	(0.223)	(0.217)	(0.183)
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.746	0.751	0.780	0.789	0.671	0.705	0.732	0.764

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group is non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.13: Electrification and the Share of Agriculture (1910-1940)

	Agriculture: Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	-0.174*	-0.180**	-0.178**	-0.148**	-1.221**	-0.907**	-0.912**	-0.732**
	(0.101)	(0.090)	(0.089)	(0.075)	(0.484)	(0.383)	(0.391)	(0.337)
Log. Pop. Dens (1910)		0.130	0.129	-0.356**		0.052	0.052	-0.427**
		(0.164)	(0.166)	(0.145)		(0.181)	(0.181)	(0.174)
Frac. White (1910)		-10.117***	-10.103***	-10.497***		-10.704***	-10.714***	-10.999***
		(2.244)	(2.241)	(2.224)		(2.294)	(2.295)	(2.257)
Mean Age (1910)		-1.558***	-1.566***	-1.350***		-1.584***	-1.581***	-1.360***
		(0.234)	(0.237)	(0.270)		(0.249)	(0.251)	(0.279)
Agriculture (1910)	74.020***	78.541***	78.232***	62.960***	69.871***	75.363***	75.493***	62.929***
	(1.431)	(1.341)	(1.452)	(8.218)	(2.335)	(1.934)	(1.877)	(8.590)
Manufacturing (1910)			-1.170	-17.990**			0.560	-14.996
			(2.476)	(9.116)			(3.017)	(9.373)
Mining (1910)				-14.311				-13.273
				(8.892)				(9.066)
Construction (1910)				-63.166***				-49.765***
				(17.330)				(17.938)
Transportation (1910)				-14.700				-11.574
				(9.562)				(9.673)
Trade (1910)				51.001***				49.478**
				(17.878)				(21.792)
Finance (1910)				39.266				74.039
				(34.686)				(62.413)
Service (1910)				-87.392***				-97.249***
				(22.354)				(29.036)
Public (1910)				-70.975*				-82.389*
				(41.095)				(44.636)
Constant	0.000	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000
	(0.268)	(0.234)	(0.233)	(0.215)	(0.348)	(0.300)	(0.301)	(0.263)
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.907	0.912	0.912	0.916	0.892	0.905	0.905	0.912

Notes: Regression of county-industry share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.14: Electrification and the Share of Manufacturing (1910-1940)

	Manufacturing: Percent of Male, Working Age Population (16-65) with Occupation in 1940							
	OLS				IV: Hydroelectric Potential (50m radius)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TL in 100 km	0.315***	0.328***	0.292***	0.252***	0.698*	0.563*	0.631**	0.457*
	(0.068)	(0.067)	(0.066)	(0.064)	(0.385)	(0.333)	(0.305)	(0.278)
Log. Pop. Dens (1910)		0.523***	0.364***	0.652***		0.511***	0.399***	0.677***
		(0.106)	(0.108)	(0.147)		(0.109)	(0.122)	(0.158)
Frac. White (1910)		3.404**	3.562**	3.582**		3.643**	3.844***	3.759**
		(1.427)	(1.456)	(1.449)		(1.498)	(1.491)	(1.469)
Mean Age (1910)		1.117***	1.234***	1.029***		1.149***	1.241***	1.033***
		(0.156)	(0.158)	(0.172)		(0.169)	(0.154)	(0.174)
Manufacturing (1910)	85.791***	86.902***	82.728***	66.943***	82.910***	85.367***	81.929***	65.891***
	(2.346)	(2.553)	(2.805)	(8.207)	(3.464)	(3.161)	(2.884)	(8.247)
Agriculture (1910)			-3.929***	-15.191*			-2.663*	-15.180*
			(1.033)	(7.782)			(1.588)	(7.865)
Mining (1910)				-14.774*				-15.138*
				(7.899)				(7.912)
Construction (1910)				36.826**				32.118*
				(16.863)				(16.788)
Transportation (1910)				-10.549				-11.647
				(8.734)				(8.788)
Trade (1910)				-24.253				-23.718
				(16.204)				(17.281)
Finance (1910)				-79.196**				-91.412**
				(37.924)				(43.326)
Service (1910)				-36.492**				-33.029**
				(15.033)				(16.666)
Public (1910)				-20.766				-16.756
				(24.259)				(24.675)
Constant	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.214)	(0.200)	(0.204)	(0.191)	(0.216)	(0.200)	(0.204)	(0.190)
Obs.	2875	2875	2875	2875	2875	2875	2875	2875
Adj. R^2	0.817	0.826	0.828	0.833	0.810	0.823	0.823	0.832

Notes: Regression of county-industry share on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Appendix C.3. Alternative Specifications for Main Results in 1940

The tables in this appendix illustrate robustness of the main results by considering alternative specifications. In order to save space, we only report the results for the example of farmers and operatives, the two occupations central to our main findings. Tables C.15 and C.16 first illustrate that our main specification in levels (Column 1) is effectively equivalent to a regression of the change in the employment share on the change in transmission lines (Column 3). For illustrative purposes, Column 2 confirms that simply using the change in the occupation share as the dependent variable is mechanically equivalent to our main specification in levels. Column 3 illustrates that the specification "in changes" (where both the share and electrification are taken in changes) is effectively the same, since there were almost no transmission lines in 1910.

Columns 4-6 in Tables C.15 and C.16 consider "normalized" versions of our electricity measure. Instead of the total length of transmission lines in the county, we alternatively consider transmission lines relative to county area (Columns 4 and 5) and transmission lines per person within the county (Column 6). Column 4 (100m of TLs per km^2) shows an insignificant coefficient of the opposite sign. It turns out that this is driven by extreme outliers, which are concentrated in urban areas. If we run the regression with rural counties only (2457 out of 2875 counties with all the relevant data) the results are qualitatively and quantitatively comparable to our main results. Finally, Column 6 (km of TLs per 1000 persons) is again qualitatively and quantitatively comparable to our main specification. A doubling of each measure in the average rural county (which is roughly equivalent to a one standard deviation increase in the average rural county) leads to comparable magnitudes for all three measures of electrification.

Table C.15: Alternative Specifications: Electrification and the Share of Farmers (1910-1940)

	Farmers: Percent of Male, Working Age Population (16-65) with Occupation in 1940 (IV)					
		Change 1910-1940		Normalized Electricity Measures		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Occ. Sh.	Δ Occ. Sh.	Δ Occ. Sh.	Occ. Sh.	Occ. Sh.	Occ. Sh.
TL in 100 km	-0.723***	-0.723***				
	(0.252)	(0.252)				
Δ TL in 100km			-0.760***			
			(0.260)			
TL in 100m/km2				2.268	-4.142**	
				(2.820)	(1.870)	
TL in km/(1000 persons)						-0.142**
						(0.061)
Log. Pop. Dens (1910)	0.231*	0.231*	0.230*	-1.802	1.243**	0.125
	(0.129)	(0.129)	(0.132)	(2.304)	(0.538)	(0.156)
Frac. White (1910)	-4.578**	-4.578**	-4.660**	-4.360	-3.275	0.368
	(1.864)	(1.864)	(1.871)	(3.809)	(2.183)	(3.574)
Mean Age (1910)	-0.966***	-0.966***	-0.975***	-2.003*	-0.298	-0.880***
	(0.194)	(0.194)	(0.195)	(1.204)	(0.272)	(0.206)
Agriculture (1910)	12.398***	12.398***	12.253***	24.554***	22.650***	25.550***
	(3.501)	(3.501)	(3.529)	(9.360)	(4.014)	(8.079)
Manufacturing (1910)	0.707	0.707	0.666	-11.402	1.938	-1.994
	(2.084)	(2.084)	(2.095)	(15.628)	(2.908)	(1.863)
Farmer (1910)	55.887***	-44.113***	-44.050***	49.623***	43.313***	47.689***
	(4.818)	(4.818)	(4.842)	(10.293)	(5.556)	(9.271)
Constant	-0.000	-0.000	-0.000	-0.000	0.000	-0.000
	(0.213)	(0.213)	(0.218)	(0.338)	(0.219)	(0.189)
Obs.	2875	2875	2875	2875	2457	2875
Included Counties	all	all	all	all	rural	all

Notes: Alternative specifications regressing (levels or changes in the) county-occupation share on alternative measures of electrification based on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group are non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.16: Alternative Specifications: Electrification and the Share of Operatives (1910-1940)

	Operatives: Percent of Male, Working Age Population (16-65) with Occupation in 1940 (IV)					
		Change 1910-1940		Normalized Electricity Measures		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Occ. Sh.	Δ Occ. Sh.	Δ Occ. Sh.	Occ. Sh.	Occ. Sh.	Occ. Sh.
TL in 100 km	0.862***	0.862***				
	(0.212)	(0.212)				
Δ TL in 100km			0.905***			
			(0.231)			
TL in 100m/km2				-2.761	5.856***	
				(3.393)	(1.734)	
TL in km/(1000 persons)						0.189**
						(0.094)
Log. Pop. Dens (1910)	-0.013	-0.013	-0.010	2.477	-1.111**	0.076
	(0.139)	(0.139)	(0.142)	(2.802)	(0.503)	(0.171)
Frac. White (1910)	5.853***	5.853***	5.931***	6.464	4.753***	0.927
	(1.368)	(1.368)	(1.386)	(4.392)	(1.697)	(3.413)
Mean Age (1910)	0.625**	0.625**	0.641**	1.832	-0.245	0.244
	(0.258)	(0.258)	(0.260)	(1.555)	(0.274)	(0.325)
Agriculture (1910)	0.910	0.910	1.090	-9.308*	-7.854***	-12.066***
	(1.593)	(1.593)	(1.664)	(5.600)	(1.786)	(4.565)
Manufacturing (1910)	15.309***	15.309***	15.437***	29.187	15.204***	14.990***
	(2.987)	(2.987)	(3.000)	(20.179)	(4.128)	(3.229)
Operative (1910)	59.107***	-40.893***	-40.668***	56.480***	39.635***	47.784***
	(3.355)	(3.355)	(3.389)	(5.753)	(6.333)	(5.684)
Constant	0.000	0.000	0.000	0.000	-0.000	-0.000
	(0.217)	(0.217)	(0.224)	(0.411)	(0.220)	(0.237)
Obs.	2875	2875	2875	2875	2457	2875
Included Counties	all	all	all	all	rural	all

Notes: Alternative specifications regressing (levels or changes in the) county-occupation share on alternative measures of electrification based on kilometers of high-voltage transmission lines (TL) and state fixed effects, weighted by county population in 1910. As occupation shares add up to one, the omitted occupation group are non-farm laborers. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Appendix C.4. Main Results for all Occupations and Industries (1920 - 1940)

Appendix C.4.1. Occupations

Table C.17: OLS: Effect of Electrification on Occupations (1910-1920)

	Percent of Male, Working Age Population (16-65) with Occupation in 1920				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	-0.3*	-0.2**	-0.04	0.08***	0.3***
	(0.1)	(0.10)	(0.05)	(0.03)	(0.08)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	1.0	0.9	1.0	0.9	1.0
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.3***	0.1***	0.03	0.07**	-0.2
	(0.08)	(0.03)	(0.03)	(0.03)	(0.1)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.9	0.9	1.0	0.9	0.8

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.18: IV: Effect of Electrification on Occupations (1910-1920)

	Percent of Male, Working Age Population (16-65) with Occupation in 1920				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	0.08	0.3	-0.2	0.2	0.6
	(0.8)	(0.7)	(0.2)	(0.1)	(0.6)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.957	0.872	0.970	0.939	0.952
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.4	0.3**	0.1	-0.1	-0.3
	(0.7)	(0.1)	(0.2)	(0.2)	(0.7)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.924	0.908	0.960	0.912	0.812

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. High-voltage transmission lines are instrumented with hydroelectric potential within 50 miles of the county centroid. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.19: OLS: Effect of Electrification on Occupations (1910-1930)

	Percent of Male, Working Age Population (16-65) with Occupation in 1930				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	-0.4***	-0.2***	-0.002	0.07***	0.2***
	(0.07)	(0.07)	(0.03)	(0.02)	(0.05)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.9	0.9	1.0	0.9	0.9
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.3***	0.06***	0.04**	0.07***	-0.2***
	(0.07)	(0.01)	(0.02)	(0.02)	(0.06)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.9	0.9	0.9	0.9	0.7

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.20: IV: Effect of Electrification on Occupations (1910-1930)

	Percent of Male, Working Age Population (16-65) with Occupation in 1930				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	-0.4*	0.09	-0.06	0.003	0.4***
	(0.2)	(0.2)	(0.06)	(0.04)	(0.1)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.938	0.881	0.958	0.940	0.942
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.6***	0.09**	0.06	-0.0004	-0.4*
	(0.2)	(0.04)	(0.06)	(0.06)	(0.2)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.872	0.874	0.945	0.881	0.746

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. High-voltage transmission lines are instrumented with hydroelectric potential within 50 miles of the county centroid. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.21: OLS: Effect of Electrification on Occupations (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	-0.1**	-0.04	0.03	0.03	0.07**
	(0.06)	(0.05)	(0.02)	(0.02)	(0.04)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.9	0.8	0.9	0.9	0.9
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.1***	0.04***	0.02	0.04**	-0.2***
	(0.05)	(0.01)	(0.01)	(0.02)	(0.04)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.8	0.8	0.9	0.8	0.6

Notes: Regression of county occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.22: IV: Effect of Electrification on Occupations (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	-0.7***	-0.1	0.02	0.01	0.4***
	(0.3)	(0.2)	(0.06)	(0.04)	(0.1)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.893	0.838	0.933	0.900	0.862
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.9***	0.2***	0.06	-0.05	-0.2
	(0.2)	(0.06)	(0.08)	(0.07)	(0.1)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.732	0.739	0.908	0.786	0.577

Notes: Regression of county occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. High-voltage transmission lines are instrumented with hydroelectric potential within 50 miles of the county centroid. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.23: OLS/Urban/Rural: Effect of Electrification on Occupations (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	-0.2***	-0.08	0.01	0.01	0.1***
	(0.08)	(0.06)	(0.03)	(0.02)	(0.03)
TL in 100 km x High Density	0.2**	0.10	0.04	0.03	-0.2***
	(0.1)	(0.08)	(0.03)	(0.03)	(0.06)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.9	0.8	0.9	0.9	0.9
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.2***	0.02**	0.03*	0.02	-0.2***
	(0.05)	(0.010)	(0.01)	(0.01)	(0.04)
TL in 100 km x High Density	-0.2***	0.03	-0.03	0.04	-0.02
	(0.08)	(0.02)	(0.03)	(0.04)	(0.08)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.8	0.8	0.9	0.8	0.6

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.24: IV/Urban/Rural: Effect of Electrification on Occupations (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	Farmer	Farm Lab.	Clerical	Sales	Craft
TL in 100 km	-1.2***	-0.2	0.02	0.001	0.4**
	(0.4)	(0.3)	(0.07)	(0.05)	(0.1)
TL in 100 km x High Density	1.7***	-0.03	-0.04	-0.05	-0.2
	(0.5)	(0.3)	(0.1)	(0.08)	(0.2)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.887	0.843	0.943	0.909	0.886
	Operatives	Professional	Service	Managerial	Non-Farm Lab.
TL in 100 km	0.8***	0.2**	0.1	-0.07	0.01
	(0.3)	(0.08)	(0.08)	(0.06)	(0.2)
TL in 100 km x High Density	-0.5	-0.06	-0.2*	0.09	-0.7**
	(0.4)	(0.1)	(0.1)	(0.1)	(0.3)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.771	0.770	0.912	0.809	0.579

Notes: Regression of county-occupation share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Appendix C.4.2. Industries

Table C.25: OLS: Effect of Electrification on Industries (1910-1920)

	Percent of Male, Working Age Population (16-65) with Occupation in 1920				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	-0.5***	0.002	0.06	0.2**	-0.1
	(0.2)	(0.07)	(0.06)	(0.1)	(0.1)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	1.0	0.9	0.8	0.9	0.9
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	0.3***	-0.03	0.2**	-0.3**	0.2
	(0.05)	(0.02)	(0.07)	(0.1)	(0.1)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.9	0.9	0.9	0.2	0.8

Notes: Regression of county-industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.26: IV: Effect of Electrification on Industries (1910-1920)

	Percent of Male, Working Age Population (16-65) with Occupation in 1920				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	0.1	-1.1*	0.4	0.5	-1.0
	(1.2)	(0.6)	(0.3)	(0.9)	(0.7)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.965	0.905	0.781	0.933	0.850
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	0.4	-0.09	0.4*	-1.4**	-0.03
	(0.3)	(0.07)	(0.2)	(0.6)	(0.5)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.949	0.922	0.926	0.088	0.824

Notes: Regression of county-industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. High-voltage transmission lines are instrumented with hydroelectric potential within 50 miles of the county centroid. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.27: OLS: Effect of Electrification on Industries (1910-1930)

	Percent of Male, Working Age Population (16-65) with Occupation in 1930				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	-0.6***	0.06	-0.007	0.3***	-0.06
	(0.1)	(0.06)	(0.03)	(0.1)	(0.05)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.9	0.9	0.8	0.9	0.8
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	0.1***	-0.03	0.07**	0.01	0.1***
	(0.03)	(0.02)	(0.03)	(0.01)	(0.04)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.9	0.9	0.9	0.8	0.8

Notes: Regression of county industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.28: IV: Effect of Electrification on Industries (1910-1930)

	Percent of Male, Working Age Population (16-65) with Occupation in 1930				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	-0.5	-0.1	0.08	0.5*	-0.1
	(0.4)	(0.1)	(0.09)	(0.3)	(0.1)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.947	0.864	0.816	0.864	0.823
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	-0.03	-0.1***	0.06	0.02	0.2**
	(0.09)	(0.05)	(0.07)	(0.03)	(0.1)
Obs.	2895	2895	2895	2895	2895
Adj. R^2	0.936	0.921	0.914	0.796	0.812

Notes: Regression of county industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. High-voltage transmission lines are instrumented with hydroelectric potential within 50 miles of the county centroid. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.29: OLS: Effect of Electrification on Industries (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	-0.2**	-0.02	-0.09**	0.3***	-0.04*
	(0.09)	(0.03)	(0.04)	(0.07)	(0.02)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.9	0.8	0.3	0.8	0.8
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	0.08**	-0.001	0.04**	-0.01	-0.002
	(0.04)	(0.02)	(0.02)	(0.007)	(0.02)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.9	0.9	0.8	0.5	0.5

Notes: Regression of county industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.30: IV: Effect of Electrification on Industries (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	-0.9**	-0.003	0.3**	0.6**	-0.2*
	(0.4)	(0.09)	(0.2)	(0.3)	(0.09)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.905	0.785	0.223	0.823	0.792
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	-0.002	-0.05	0.07	-0.04	0.3***
	(0.09)	(0.04)	(0.06)	(0.05)	(0.09)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.892	0.889	0.830	0.523	0.402

Notes: Regression of county industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. High-voltage transmission lines are instrumented with hydroelectric potential within 50 miles of the county centroid. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.31: OLS/Urban/Rural: Effect of Electrification on Industries (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	-0.3***	-0.02	-0.05*	0.3***	-0.04
	(0.09)	(0.03)	(0.03)	(0.09)	(0.03)
TL in 100 km x High Density	0.3**	0.002	-0.09	-0.1	0.001
	(0.1)	(0.05)	(0.08)	(0.1)	(0.04)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.9	0.8	0.3	0.8	0.8
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	0.1***	-0.03*	0.06***	-0.01*	0.008
	(0.03)	(0.02)	(0.02)	(0.009)	(0.01)
TL in 100 km x High Density	-0.1*	0.08***	-0.04	0.009	-0.03
	(0.07)	(0.02)	(0.04)	(0.01)	(0.03)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.9	0.9	0.8	0.5	0.5

Notes: Regression of county industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table C.32: IV/Urban/Rural: Effect of Electrification on Industries (1910-1940)

	Percent of Male, Working Age Population (16-65) with Occupation in 1940				
	1. Ag.	2. Mining	3. Const.	4. Manu.	5. Transp.
TL in 100 km	-1.6**	0.03	0.7**	1.3**	-0.3
	(0.8)	(0.2)	(0.3)	(0.6)	(0.2)
TL in 100 km x High Density	2.0**	-0.06	-0.9**	-1.7**	0.2
	(1.0)	(0.3)	(0.4)	(0.9)	(0.3)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.901	0.784	0.096	0.797	0.781
	6. Trade.	7. Fin.	8. Serv.	9. Pub.	10. No Ind.
TL in 100 km	-0.2	-0.04	0.07	-0.1	0.1
	(0.2)	(0.05)	(0.10)	(0.08)	(0.1)
TL in 100 km x High Density	0.3	-0.01	-0.02	0.1	0.2
	(0.3)	(0.08)	(0.1)	(0.1)	(0.2)
Obs.	2875	2875	2875	2875	2875
Adj. R^2	0.884	0.887	0.831	0.506	0.382

Notes: Regression of county industry share on kilometers of high-voltage transmission lines (TL) and additional control variables discussed in the text, weighted by county population in 1910. Standard errors are reported in parentheses below each coefficient and inference is robust to spatial clusters of 200 km radius with Bartlett kernel decay based on Colella et al. (2019). Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Appendix C.5. Distribution of Occupations & Industries: Male, Working Age Population with Occupation

Table C.33: Distribution of Occupations Within Industries: Male, Working Age Population with Occupation

		Occupation's Share within Industry (%): Male, Working Age Population with Occupation											
	Sum	Prof.	Farm.	Man.	Cler.	Sales	Craft	Oper.	Serv.	F Lab	NF Lab	Mil.	No Occ.
A. 1910													
Agriculture	100.0	0.1	64.0	0.0	0.0	0.0	0.0	0.0	0.0	35.0	0.9	0.0	0.0
Mining	100.0	0.1	0.0	0.8	0.6	0.0	5.3	92.8	0.1	0.0	0.2	0.0	0.0
Construction	100.0	0.1	0.0	5.2	0.3	0.0	76.5	1.4	0.1	0.0	16.3	0.0	0.0
Manufacturing	100.0	1.1	0.0	2.4	3.2	0.2	29.4	27.9	0.8	0.0	35.0	0.0	0.0
Transportation	100.0	0.7	0.0	6.9	11.0	0.2	21.7	17.7	2.2	0.0	39.5	0.0	0.0
Trade	100.0	2.1	0.0	29.9	3.7	32.8	8.4	9.3	8.6	0.0	5.1	0.0	0.0
Finance	100.0	0.9	0.0	16.4	24.5	44.5	1.1	0.6	10.2	0.0	1.8	0.0	0.0
Service	100.0	36.6	0.0	4.2	5.9	0.4	14.9	6.5	28.0	0.0	3.5	0.0	0.0
Public Sector	100.0	2.8	0.0	7.8	40.5	0.0	2.2	1.3	31.1	0.0	14.4	0.0	0.0
No Industry	100.0	1.5	0.0	12.9	6.9	7.3	12.4	9.7	2.4	0.0	46.8	0.0	0.0
B. 1920													
Agriculture	100.0	0.1	68.4	0.0	0.0	0.0	0.1	0.1	0.0	30.1	1.2	0.0	0.0
Mining	100.0	0.4	0.0	1.5	0.9	0.0	8.0	86.0	0.2	0.0	2.9	0.0	0.0
Construction	100.0	0.6	0.0	7.0	0.4	0.0	74.2	1.2	0.1	0.0	16.3	0.0	0.0
Manufacturing	100.0	1.4	0.0	2.6	4.3	0.3	31.2	26.7	1.0	0.0	32.5	0.0	0.0
Transportation	100.0	1.2	0.0	6.1	11.1	0.1	24.3	22.7	2.6	0.0	31.9	0.0	0.0
Trade	100.0	2.2	0.0	31.3	3.6	32.8	7.6	9.2	6.3	0.0	7.0	0.0	0.0
Finance	100.0	2.0	0.0	21.2	25.2	40.0	1.1	0.6	8.3	0.0	1.7	0.0	0.0
Service	100.0	32.9	0.0	5.9	5.7	0.6	20.9	7.4	22.7	0.0	4.0	0.0	0.0
Public Sector	100.0	2.7	0.0	6.0	27.8	0.0	1.5	1.4	20.6	0.0	11.3	28.7	0.0
No Industry	100.0	5.2	3.1	10.6	9.9	4.1	16.6	20.4	5.5	1.5	22.5	0.6	0.0
C. 1930													
Agriculture	100.0	0.1	62.4	0.1	0.0	0.0	0.1	0.2	0.0	35.8	1.4	0.0	0.0
Mining	100.0	0.9	0.0	1.8	0.8	0.1	9.9	86.1	0.3	0.0	0.2	0.0	0.0
Construction	100.0	1.4	0.0	6.7	0.6	0.1	63.6	2.7	0.2	0.0	24.7	0.0	0.0
Manufacturing	100.0	2.3	0.0	3.3	4.9	1.1	28.2	28.8	1.1	0.0	30.3	0.0	0.0
Transportation	100.0	2.1	0.0	6.3	12.4	0.4	24.4	25.5	2.8	0.0	26.2	0.0	0.0
Trade	100.0	2.4	0.0	29.6	3.4	35.8	4.8	12.0	7.4	0.0	4.5	0.0	0.0
Finance	100.0	2.3	0.0	17.1	24.0	42.2	0.9	0.6	11.1	0.0	1.8	0.0	0.0
Service	100.0	29.2	0.0	6.8	4.6	1.2	21.4	7.9	22.8	0.0	6.0	0.0	0.0
Public Sector	100.0	4.6	0.0	7.4	35.0	0.1	2.8	3.5	32.8	0.0	13.7	0.1	0.0
No Industry	100.0	5.6	1.4	10.1	6.8	4.8	15.8	20.9	4.3	0.8	29.3	0.3	0.0
B. 1940													
Agriculture	100.0	0.7	56.4	0.3	0.1	0.0	0.3	0.7	0.1	38.4	3.1	0.0	0.0
Mining	100.0	1.2	0.0	1.4	0.7	0.0	9.6	86.5	0.3	0.0	0.2	0.0	0.0
Construction	100.0	2.9	0.1	2.8	1.7	0.1	39.2	6.1	0.7	0.1	46.3	0.0	0.0
Manufacturing	100.0	3.2	0.0	4.5	7.5	3.8	22.8	38.3	1.6	0.0	18.2	0.0	0.0
Transportation	100.0	2.1	0.0	6.3	13.4	0.7	23.1	34.4	2.9	0.0	17.2	0.0	0.0
Trade	100.0	1.7	0.0	30.8	6.1	25.4	5.7	16.5	10.3	0.0	3.5	0.0	0.0
Finance	100.0	0.7	0.0	22.3	26.1	33.2	1.5	0.5	14.0	0.0	1.9	0.0	0.0
Service	100.0	32.0	0.0	6.3	5.3	1.0	16.3	8.8	26.8	0.0	3.6	0.0	0.0
Public Sector	100.0	10.9	0.0	15.9	39.6	0.2	4.9	1.5	25.2	0.0	1.9	0.0	0.0
No Industry	100.0	10.6	2.4	6.4	11.6	5.9	11.9	14.6	5.7	2.5	28.4	0.0	0.0

Notes: The table reports the fraction of each occupation within nine broad sectors. "No Industry" refers to individuals who do not work in a specific industry or where information on industry was not reported. The underlying population includes male, working age (16-65) individuals with a reported occupation.

Table C.34: Distribution of Industries Within Occupations: Male, Working Age Population with Occupation

	Sum	Industry's Share within Occupation (%): Male, Working Age Population with Occupation									
		Ag.	Min.	Con.	Man.	Trans.	Trade	Fin.	Serv.	Pub.	No Ind.
A. 1910											
Professional	100.0	0.7	0.2	0.3	5.6	1.9	6.7	0.4	78.6	1.0	4.6
Farmer	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manager	100.0	0.0	0.5	5.8	6.3	9.8	47.7	4.0	4.6	1.4	19.8
Clerical	100.0	0.0	0.6	0.5	13.5	25.8	9.8	9.9	10.5	11.9	17.5
Sales	100.0	0.0	0.0	0.0	0.8	0.4	69.1	14.4	0.5	0.0	14.8
Craft	100.0	0.1	1.3	34.9	31.0	12.6	5.5	0.1	6.6	0.2	7.8
Operative	100.0	0.1	29.1	0.8	37.5	13.1	7.7	0.1	3.7	0.1	7.7
Service	100.0	0.1	0.1	0.1	3.2	5.2	22.5	4.1	49.7	9.0	6.0
Farm Laborer	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Farm Laborer	100.0	2.0	0.0	7.1	35.2	21.8	3.2	0.2	1.5	1.0	28.0
B. 1920											
Professional	100.0	0.7	0.4	1.0	7.1	3.0	5.8	1.0	63.5	1.5	16.0
Farmer	100.0	98.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
Manager	100.0	0.2	0.9	5.9	7.3	8.5	45.3	5.6	6.3	1.8	18.2
Clerical	100.0	0.1	0.7	0.5	17.0	21.4	7.2	9.3	8.4	11.8	23.5
Sales	100.0	0.0	0.0	0.0	1.5	0.3	70.9	15.8	0.9	0.0	10.5
Craft	100.0	0.1	1.8	24.9	35.2	13.3	4.4	0.1	8.8	0.2	11.2
Operative	100.0	0.2	22.8	0.5	35.4	14.7	6.2	0.1	3.7	0.2	16.3
Service	100.0	0.1	0.2	0.2	4.7	6.1	15.9	3.8	42.0	10.8	16.2
Farm Laborer	100.0	98.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
Non-Farm Laborer	100.0	2.6	0.8	6.5	43.2	20.6	4.7	0.2	2.0	1.6	17.9
Military	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.3	10.7
C. 1930											
Professional	100.0	0.6	0.6	2.3	8.8	3.7	6.4	1.5	59.7	1.8	14.7
Farmer	100.0	99.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Manager	100.0	0.2	0.7	6.7	7.6	6.6	46.0	6.4	8.2	1.7	15.8
Clerical	100.0	0.1	0.5	1.0	17.7	20.6	8.3	14.0	8.7	12.5	16.6
Sales	100.0	0.0	0.0	0.1	2.9	0.5	66.8	18.8	1.8	0.0	9.0
Craft	100.0	0.1	1.9	29.1	29.8	11.9	3.5	0.1	11.9	0.3	11.4
Operative	100.0	0.3	18.4	1.4	34.1	13.9	9.6	0.1	4.9	0.4	16.8
Service	100.0	0.1	0.2	0.3	4.1	4.7	18.1	6.5	43.6	11.8	10.7
Farm Laborer	100.0	99.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Non-Farm Laborer	100.0	2.6	0.0	12.9	36.5	14.5	3.7	0.3	3.8	1.6	23.9
Military	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	95.9
B. 1940											
Professional	100.0	2.6	0.5	5.9	12.8	2.7	4.6	0.3	57.9	5.7	7.1
Farmer	100.0	99.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Manager	100.0	0.7	0.4	3.8	12.1	5.2	55.4	6.4	7.6	5.5	2.8
Clerical	100.0	0.3	0.3	3.1	25.9	14.3	14.2	9.6	8.2	17.7	6.6
Sales	100.0	0.1	0.0	0.2	14.7	0.8	65.2	13.5	1.7	0.1	3.8
Craft	100.0	0.4	1.6	30.6	35.1	11.0	5.8	0.2	11.2	1.0	3.0
Operative	100.0	0.8	11.8	3.9	48.0	13.4	13.9	0.1	5.0	0.2	3.0
Service	100.0	0.3	0.1	1.4	5.9	3.3	24.9	5.4	43.5	11.8	3.4
Farm Laborer	100.0	98.7	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Non-Farm Laborer	100.0	4.9	0.0	39.9	30.8	9.0	4.0	0.3	2.7	0.4	7.9

Notes: The table reports the fraction of each industry within ten broad occupation groups. "No Industry" refers to individuals who do not work in a specific industry or where information on industry was not reported. The underlying population includes male, working age (16-65) individuals with a reported occupation.

Table C.35: Distribution of Occupations Within Industries: Male, Working Age Population

	Occupation's Share within Industry (%): Male, Working Age Population												
	Sum	Prof.	Farm.	Man.	Cler.	Sales	Craft	Oper.	Serv.	F Lab	NF Lab	Mil.	No Occ.
A. 1910													
Agriculture	100.0	0.1	63.7	0.0	0.0	0.0	0.1	0.0	0.0	35.2	0.9	0.0	0.0
Mining	100.0	0.2	0.0	1.0	0.7	0.0	5.8	91.9	0.2	0.0	0.2	0.0	0.0
Construction	100.0	0.3	0.0	5.3	0.3	0.0	76.0	1.5	0.1	0.0	16.5	0.0	0.0
Manufacturing	100.0	1.2	0.0	2.5	3.5	0.3	29.4	28.1	0.8	0.0	34.1	0.0	0.0
Transportation	100.0	0.8	0.0	6.9	11.4	0.2	21.8	17.9	2.3	0.0	38.8	0.0	0.0
Trade	100.0	2.2	0.0	29.9	4.0	32.3	8.5	9.4	8.5	0.0	5.2	0.0	0.0
Finance	100.0	1.0	0.0	16.5	24.7	44.1	1.2	0.7	10.0	0.0	1.8	0.0	0.0
Service	100.0	36.1	0.0	4.4	5.9	0.4	15.0	6.6	27.8	0.0	3.7	0.0	0.0
Public Sector	100.0	2.6	0.0	7.3	32.2	0.0	1.8	1.1	25.2	0.0	11.3	18.5	0.0
No Industry	100.0	1.8	0.9	6.2	4.9	3.5	7.8	8.7	2.3	0.6	17.5	0.1	45.8
B. 1920													
Agriculture	100.0	0.1	68.4	0.0	0.0	0.0	0.1	0.1	0.0	30.1	1.2	0.0	0.0
Mining	100.0	0.4	0.0	1.5	0.9	0.0	8.0	86.0	0.2	0.0	2.9	0.0	0.0
Construction	100.0	0.6	0.0	7.0	0.4	0.0	74.2	1.2	0.1	0.0	16.3	0.0	0.0
Manufacturing	100.0	1.4	0.0	2.6	4.3	0.3	31.2	26.7	1.0	0.0	32.5	0.0	0.0
Transportation	100.0	1.2	0.0	6.1	11.1	0.1	24.3	22.7	2.6	0.0	31.9	0.0	0.0
Trade	100.0	2.2	0.0	31.3	3.6	32.8	7.6	9.2	6.3	0.0	7.0	0.0	0.0
Finance	100.0	2.0	0.0	21.2	25.2	40.0	1.1	0.6	8.3	0.0	1.7	0.0	0.0
Service	100.0	32.9	0.0	5.9	5.7	0.6	20.9	7.4	22.7	0.0	4.0	0.0	0.0
Public Sector	100.0	2.7	0.0	6.0	27.8	0.0	1.5	1.4	20.6	0.0	11.3	28.7	0.0
No Industry	100.0	1.6	1.0	3.3	3.1	1.3	5.2	6.4	1.7	0.5	7.0	0.2	68.9
C. 1930													
Agriculture	100.0	0.1	62.4	0.1	0.0	0.0	0.1	0.2	0.0	35.8	1.4	0.0	0.0
Mining	100.0	0.9	0.0	1.8	0.8	0.1	9.9	86.1	0.3	0.0	0.2	0.0	0.0
Construction	100.0	1.4	0.0	6.7	0.6	0.1	63.6	2.7	0.2	0.0	24.7	0.0	0.0
Manufacturing	100.0	2.3	0.0	3.3	4.9	1.1	28.2	28.8	1.1	0.0	30.3	0.0	0.0
Transportation	100.0	2.1	0.0	6.3	12.4	0.4	24.3	25.5	2.8	0.0	26.2	0.0	0.0
Trade	100.0	2.4	0.0	29.6	3.4	35.8	4.8	12.0	7.4	0.0	4.5	0.0	0.0
Finance	100.0	2.3	0.0	17.1	24.0	42.2	0.9	0.6	11.1	0.0	1.8	0.0	0.0
Service	100.0	29.2	0.0	6.8	4.6	1.2	21.4	7.9	22.8	0.0	6.0	0.0	0.0
Public Sector	100.0	3.8	0.0	6.1	28.8	0.1	2.3	2.9	27.0	0.0	11.3	17.9	0.0
No Industry	100.0	1.6	0.4	2.9	2.0	1.4	4.5	6.0	1.3	0.2	8.3	0.1	71.2
B. 1940													
Agriculture	100.0	0.7	56.0	0.3	0.1	0.0	0.3	0.7	0.1	38.7	3.1	0.0	0.0
Mining	100.0	1.2	0.0	1.4	0.7	0.0	9.5	86.7	0.3	0.0	0.2	0.0	0.0
Construction	100.0	2.9	0.1	2.8	1.7	0.1	39.2	6.0	0.7	0.1	46.4	0.0	0.0
Manufacturing	100.0	3.2	0.0	4.5	7.5	3.9	22.8	38.3	1.6	0.0	18.3	0.0	0.0
Transportation	100.0	2.1	0.0	6.3	13.3	0.6	23.0	34.4	2.9	0.0	17.3	0.0	0.0
Trade	100.0	1.7	0.0	30.7	6.1	25.4	5.7	16.5	10.3	0.0	3.5	0.0	0.0
Finance	100.0	0.7	0.0	22.3	26.0	33.2	1.4	0.5	14.0	0.0	1.9	0.0	0.0
Service	100.0	32.6	0.0	6.2	5.2	1.0	16.0	8.7	26.9	0.0	3.5	0.0	0.0
Public Sector	100.0	9.0	0.0	13.0	32.3	0.1	4.0	1.2	20.6	0.0	1.5	18.3	0.0
No Industry	100.0	2.2	0.6	1.3	2.4	1.2	2.5	3.1	1.2	0.6	6.0	0.0	78.8

Notes: The table reports the fraction of each occupation within nine broad sectors. “No Industry” refers to individuals who do not work in a specific industry or where information on industry was not reported. The underlying population includes all male, working age (16-65) individuals.

Table C.36: Distribution of Industries Within Occupations: Male, Working Age Population

	Sum	Industry's Share within Occupation (%)									
		Ag.	Min.	Con.	Man.	Trans.	Trade	Fin.	Serv.	Pub.	No Ind.
A. 1910											
Professional	100.0	0.8	0.2	0.5	5.4	1.9	5.9	0.4	68.0	1.0	15.9
Farmer	100.0	98.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Manager	100.0	0.0	0.5	5.2	5.8	8.7	42.3	3.7	4.2	1.5	28.0
Clerical	100.0	0.0	0.5	0.5	11.8	20.7	8.2	7.9	8.4	9.4	32.5
Sales	100.0	0.0	0.0	0.0	0.8	0.4	63.0	13.5	0.6	0.0	21.7
Craft	100.0	0.1	1.3	31.7	28.8	11.6	5.1	0.1	6.2	0.2	15.0
Operative	100.0	0.1	24.5	0.8	33.0	11.4	6.8	0.1	3.3	0.1	20.1
Service	100.0	0.1	0.2	0.1	3.0	4.7	19.5	3.6	43.7	8.2	17.0
Farm Laborer	100.0	98.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
Non-Farm Laborer	100.0	1.9	0.0	6.7	32.6	20.2	3.1	0.2	1.5	1.0	32.8
Military	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.8	10.2
No Occupation	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
B. 1920											
Professional	100.0	0.7	0.4	1.0	7.1	3.0	5.8	1.0	63.5	1.5	16.0
Farmer	100.0	98.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
Manager	100.0	0.2	0.9	5.9	7.3	8.5	45.3	5.6	6.3	1.8	18.2
Clerical	100.0	0.1	0.7	0.5	17.0	21.4	7.2	9.3	8.4	11.8	23.5
Sales	100.0	0.0	0.0	0.0	1.5	0.3	70.9	15.8	0.9	0.0	10.5
Craft	100.0	0.1	1.8	24.9	35.2	13.3	4.4	0.1	8.8	0.2	11.2
Operative	100.0	0.2	22.8	0.5	35.4	14.7	6.2	0.1	3.7	0.2	16.3
Service	100.0	0.1	0.2	0.2	4.7	6.1	15.9	3.8	42.0	10.8	16.2
Farm Laborer	100.0	98.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
Non-Farm Laborer	100.0	2.6	0.8	6.5	43.2	20.6	4.7	0.2	2.0	1.6	17.9
Military	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.3	10.7
No Occupation	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
C. 1930											
Professional	100.0	0.6	0.6	2.3	8.8	3.7	6.3	1.4	59.4	1.8	15.0
Farmer	100.0	99.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Manager	100.0	0.2	0.7	6.7	7.6	6.6	45.8	6.3	8.2	1.7	16.1
Clerical	100.0	0.1	0.5	1.0	17.7	20.5	8.3	13.9	8.7	12.5	16.9
Sales	100.0	0.0	0.0	0.1	2.9	0.5	66.7	18.8	1.8	0.0	9.1
Craft	100.0	0.1	1.9	29.1	29.8	11.8	3.4	0.1	11.9	0.3	11.5
Operative	100.0	0.3	18.4	1.4	34.0	13.9	9.6	0.1	4.9	0.4	17.0
Service	100.0	0.1	0.2	0.3	4.1	4.7	18.1	6.5	43.5	11.8	10.9
Farm Laborer	100.0	99.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Non-Farm Laborer	100.0	2.6	0.0	12.9	36.4	14.5	3.7	0.3	3.8	1.6	24.1
Military	100.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.7	8.2
No Occupation	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
B. 1940											
Professional	100.0	2.6	0.5	5.9	12.5	2.6	4.5	0.3	58.4	5.6	7.1
Farmer	100.0	99.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Manager	100.0	0.7	0.4	3.8	12.0	5.2	55.4	6.4	7.6	5.5	2.9
Clerical	100.0	0.3	0.3	3.1	25.8	14.2	14.1	9.5	8.2	17.7	6.8
Sales	100.0	0.1	0.0	0.2	14.8	0.8	65.1	13.5	1.7	0.1	3.9
Craft	100.0	0.4	1.6	30.8	34.9	11.0	5.8	0.2	11.2	1.0	3.1
Operative	100.0	0.8	11.9	3.8	47.9	13.3	13.9	0.1	4.9	0.2	3.1
Service	100.0	0.3	0.1	1.4	5.9	3.2	24.7	5.3	43.8	11.7	3.5
Farm Laborer	100.0	98.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.3
Non-Farm Laborer	100.0	4.9	0.0	39.9	30.6	9.0	3.9	0.3	2.7	0.4	8.1
Military	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	98.9	0.8
No Occupation	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0

Notes: The table reports the fraction of each industry within ten broad occupation groups. "No Occupation" refers to individuals who do not work in a specific industry or where information on industry was not reported. The underlying population includes all male, working age (16-65) individuals.