Do Relief Programs Compensate Affected Populations? Evidence from the Great Depression and the New Deal

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Abstract

This paper explores the short- and long-run effects of the Great Depression and the New Deal on the well-being of the US population, measured by longevity. We constructed a novel dataset that allows us to track a large number of individuals alive in 1930 until their deaths and match it to information on the severity of the economic crisis and the extent of transfers provided by the New Deal at county level. First, we document the dynamic effects of the Great Depression on survival rates and longevity and show that individuals—in particular, young men—living in the most severely affected locations lived substantially shorter lives as a result of the Great Depression. Second, we assess whether the New Deal compensated individuals for the negative effects of the Depression. To identify the causal effects of New Deal programs, we leverage variation across counties in New Deal spending that was politically motivated. More specifically, we use an instrumental variable strategy that allows us to compare the outcomes of individuals in counties that were equally affected by the Great Depression but who received more money as a result of politicians' desire to be reelected. We find that the New Deal increased longevity and more than offset the negative effects of the Depression. In the absence of the New Deal, on average, individuals would have lived 15 months less. The benefits of the New Deal were larger for men and for those aged 0-25 in 1930.

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1. Introduction

Economists have long been concerned about the effects of recessions on well-being and health. Yet empirical studies disagree whether these effects are positive or negative (Ruhm, 2000; Ruhm, 2005; Arthi et al., 2022). These opposite findings can be partially attributed to the use of different settings and data. For example, recessions appear to be more damaging in poor countries (Doerr and Hofmann, 2022) and over the long run (Schwandt and Von Wachter, 2020). More importantly, previous studies have ignored a crucial aspect: Government responses to recessions might also affect health. Ignoring government responses might lead researchers to underestimate the negative effects of recessions.

We study the short- and long-term effects of the Great Depression and its governmental response—the New Deal—on longevity. The Great Depression was the deepest and longest downturn in modern US history, and since it occurred in the 1930s, only now has enough time passed to analyze its long-term effects.[1] The New Deal featured the first major social welfare programs and the first countercyclical unemployment programs in the US.

We first document whether the Great Depression affected longevity and survival to various ages. Second, we present causal evidence that New Deal relief compensated individuals for the negative effects of the Great Depression. We obtain causal estimates of the impact of New Deal relief on longevity by analyzing whether individuals living in counties that received larger amount of funds lived longer as a result. To identify the causal effects of New Deal relief, we use an instrumental variable approach that leverages an important source of exogeneity in relief funds distribution: political incentives.

We estimate the impact of the Great Depression and New Deal on longevity by creating a novel dataset that follows white native-born individuals alive in 1930 until their deaths. We use the 1930 full-count US Census as a baseline and link it to death dates using information available on family trees from the genealogical site FamilySearch. Since we observe individuals' residence in 1930, we can also match them to county-level data on the severity of the Great Depression and to information on spending on New Deal programs. We focus on relief programs that provided unconditional cash transfers or relief through work; these programs were most directly intended to provide relief, and thus more likely to affect health outcomes.[2] Finally, we can also match individuals to the 1940 Census to investigate potential

[1] It difficult to find exogenous sources of variation to predict the severity of the Depression. Therefore, our analysis of these effects is descriptive.

[2] The programs included in our analysis are the Works Progress Administration (WPA), the Federal Emergency Relief Administration (FERA), Social Security Administration Public Assistance (SSAPA), Civil Works Administration grants (CWA), and Public Work grants.

mechanisms. These data offer many advantages. Because we can track individuals from 1930 until the present, we can compare the short- and long-run effects of the Great Depression and the New Deal on survival. The resulting dataset is very large (27 million observations) and includes a large fraction of women, which allows for detailed heterogeneity analysis.

We estimate causal effects of New Deal relief by employing an instrumental variable approach, since geographic allocation of New Deal relief was not random. The main purpose of New Deal relief was to alleviate the negative effects of the recession; hence, the federal government targeted the states and counties the hardest hit by the crisis (Fishback et al., 2003; Fishback et al., 2007). Thus, individuals in these areas would have likely fared worse even in the absence of the relief, which negatively biases estimates of the relief. For the same reason, estimates of the Great Depression that do not account for the New Deal are also biased and likely underestimate the impact of the Great Depression, since the most affected areas received more relief.

We leverage variation in spending that was driven by political considerations to create our instrumental variable. Previous literature has documented that political incentives influenced the distribution of funds: In addition to targeting affected areas, the government favored areas that could help ensure their reelection (Wright, 1974; Wallis, 1998; Fleck, 2001). We use an instrumental variable (IV) approach based on these political incentives to predict where the relief was allocated, while controlling for the severity of the crisis. The novelty of our IV approach relative to prior studies of the New Deal is our use of an IV-LASSO approach. We collect all variables identified as political predictors of New Deal spending (Wright, 1974; Fleck, 2001; Fishback et al., 2005; Fishback et al., 2006; Fishback et al., 2007). These variables, together with their higher terms and interactions, are considered as potential instruments. We then select the best instruments (and set of controls) using a parsimonious IV-LASSO approach following Chernozhukov et al. (2015). The instrument selected, which we term "voting culture exploitability," is a function that combines voter turnout for the 1932 presidential election and the 1928 congressional election. This voting culture exploitability variable takes larger values in areas in which relief funds would be most likely to increase votes.

Our findings suggest that although the Great Depression was bad for the health of the population, New Deal relief more than compensated for its negative effects. First, we find that the Great Depression reduced survival rates in the short and long run, but the effects on survival only become substantial after individuals reach age 50 and decline after age 70. Thus, short-term estimates of the effects of the Great Depression substantially underestimate its negative consequences. Moreover, failure to account for the New Deal and its endogeneity

also substantially biases estimates of the effects of the crisis. Second, we find that on average, the New Deal extended longevity and positively affected survival rates in both the short and long run. Our IV estimates show that a one-standard-deviation increase in relief per capita ($140) extended longevity by 15 months.[3]

We find that primarily men were hurt by the Great Depression and that they also were the main beneficiaries of the New Deal. The Great Depression disproportionately affected blue-collar and unskilled workers, particularly those in manufacturing and construction (Margo, 1991; Wallis, 1989; Chandler, 1970). As in other recessions, youth also suffered larger losses in employment. When we re-estimate our model separately by gender and age, we find that a one-standard-deviation increase in relief extended men's (women's) longevity by 22 (8) months.

We also find that young adults suffered the largest longevity declines from the Great Depression and obtained the greatest benefits from the New Deal for two main reasons. First, men between the ages of 16 and 21 years had large unemployment rates and, as result, were more likely to receive relief.[4] Second, because relief programs were most often provided through employment, these programs could have improved their labor opportunities in the future; this could explain part of the extension in longevity (Schwandt and Von Wachter, 2020). In fact, recent research shows that young men participating in the CCC program (a New Deal employment program that targeted young men) increased their lifetime incomes and longevity (Aizer et al., 2020).

The effects of the Great Depression and the New Deal are also larger among those born during the Great Depression or who were children at the time. This evidence is consistent with observations in the economic literature highlighting the heightened vulnerability of children to adverse shocks during their early years (**?**; **?**; Duque et al., 2020).

We identify two main mechanisms behind the beneficial effects of the New Deal on longevity: increases in income and years of education. We linked our sample to 1940 Census schedules and find that a standard-deviation increase in New Deal relief resulted in a 3% increase in income for those who were teenagers in 1930. We also find increases in years of education for teenagers and young adults, but don't find effects on employment or labor force participation, consistent with Modrek et al. (2022).

This paper mainly contributes to three strands of the literature. First, it studies the

[3] $140 is equivalent to 24% of the average annual income in the 1940 Census. $140 in 1967 is equivalent to approximately $2,000 in 2020. The relief is not in annual terms; it is the total amount of funds from 1933 to 1939.

[4] Individuals aged 15 to 19 had unemployment rates of 60% in 1934 in the State of Pennsylvania (Margo, 1991).

relationship between recessions and health outcomes, specifically mortality and longevity. In this area, studies on developed countries in contemporary times show that in the short run, recessions improve health outcomes and lower mortality rates (Ruhm, 2000; Ruhm and Black, 2002; Dehejia and Lleras-Muney, 2004; Ruhm, 2005; Miller and Urdinola, 2010; Stevens et al., 2015; Strumpf et al., 2017; Tapia Granados and Ionides, 2017).[5] However, in the medium to longer run this procyclicality does not seem to hold. Several studies document negative long-term effects of recessions on life expectancy and disability, as well as on lifetime income (Coile et al., 2014; Thomasson and Fishback, 2014; Cutler et al., 2016; Schwandt and Von Wachter, 2020; Duque et al., 2020). On the other hand, studies in developing countries tend to find that recessions increase mortality, which many authors believe is due to the absence of well-developed safety net programs (Doerr and Hofmann, 2022).

A few studies have investigated the effects of the Great Depression on health and mortality. Using aggregate data, the literature finds that the Great Depression resulted in short-term declines in mortality, despite the fact that during this time in the US there were very few safety-net programs available to the population (Tapia Granados and Diez Roux, 2009; Stuckler et al., 2012). Our findings differ from this literature. One reason is that we use individual data, which allow us to track individuals even if they move. Arthi et al. (2022) demonstrate that in settings in which individuals move in response to economic shocks, aggregate mortality rates for a given region will fall artificially because those who might die in badly affected areas die elsewhere. Another reason is that our data might not include all affected populations; it is possible that individuals who are not in our study (immigrants and non-whites) benefited from the Great Depression.

Our study expands on the literature of the effects of recessions on health outcomes by comparing the short- and long-term effects of a recession using individual-level deaths for the same economic shock—the Great Depression—and the same population. We also improve on previous studies by accounting for the effects of anti-recessionary programs, which could be a reason why we find more negative effects of the recession than previous studies that only considered the effects of the Great Depression.

We also contribute to the literature on the effects of the New Deal. Many studies examine the effects of the New Deal on various outcomes (Wallis and Benjamin, 1981; Balkan, 1998; Fleck, 1999; Cole and Ohanian (2004); Fishback et al. (2005); Fishback et al., 2007;

[5]The literature has documented several reasons for these surprising results: Health improves in the short run, because during recessions there is a reduction in alcohol use and smoking (Ruhm, 2000; Ruhm and Black, 2002; Ruhm, 2005; Krüger and Svensson, 2010). Also, during recessions individuals have more time to care for their dependent children and elderly family members (Dehejia and Lleras-Muney, 2004; Aguiar et al., 2013). Finally, the quality of healthcare appears to increase during recessions due to the greater availability of health care workers (Stevens et al., 2015).

Neumann et al., 2010; Stoian and Fishback, 2010; Taylor and Neumann, 2013; Fishback and Kachanovskaya, 2015; Arthi, 2018; Liu and Fishback, 2019). However, few explore the effects of the programs on health (Fishback et al., 2007; Modrek et al., 2022). Fishback et al. (2007) find that the New Deal decreased infant mortality, and Aizer et al. (2020) show that the CCC extended the longevity of young men in Colorado and New Mexico. Modrek et al. (2022) did not find any effects; however, they follow individuals until 2011, many of whom could still be alive. We extend the analysis to all of the mainland US and cohorts alive in 1930, use an IV approach to address potential biases, and follow individuals until 2020, which is critical for the longevity analysis.

Finally, our research also relates to the literature on the effects of social programs and programs to compensate for negative shocks on health outcomes (Aizer et al., 2016; Barham and Rowberry, 2013; Hoynes et al., 2016; Guarín et al., 2022). Our findings are consistent with most of this literature. For example, Aizer et al. (2016) find extensions in longevity when studying the long-term effects of the US mothers' pensions program in the 1920s. Guarín et al. (2022) find positive effects on health outcomes when investigating economic compensation for victims of the Colombian armed conflict.

The paper is organized as follows. Section 2 provides background on New Deal relief and allocation of the funds. Section 3 describes the datasets used. Section 4 explains the identification strategy. Section 5 presents the effects of the Great Depression. Section 6 studies the causal effects of the New Deal. Section 7 discusses potential mechanisms. Section 8 presents some robustness checks, and section 9 concludes.

2. Background: The Great Depression and the New Deal

The Great Depression was the deepest and longest economic decline in modern history. To offset its negative effects, the federal government created the New Deal, which was a set of policies to promote economic growth and help the most affected citizens. This section describes the background of the Great Depression, the New Deal, and the geographic allocation of public funds.

2.1 The Great Depression (1929-1941)

The Great Depression is usually defined as the period that started with the stock market crash in October 1929 and lasted until 1941. This period was characterized by 4 years of large economic declines (1929-1933) and 8 years of slow recovery. In the United States,

real GDP dropped by around 30%, prices went down by 27%, unemployment rose to 25%, about one-third of workers were employed only part-time, and one-third of all banks failed (Chandler, 1970; Romer, 2003; Richardson, 2007; US Bureau of Labor Statistics).

The negative effects on the economy had massive consequences for the well-being of the population: increases in poverty, homelessness, hunger and malnutrition, and lack of medical care (Kiser and Stix, 1933; Jacobs, 1933; Chandler, 1970; Poppendieck, 1997; Kusmer, 2002). Moreover, the context of crisis and job loss resulted in negative psychological impacts on a great share of the population (Zivin et al., 2011). The Dust Bowl, a period of drought and dust storms, occurred during the same period. Damage to the American ecology led to an agricultural depression, intensifying the impact on hunger and malnutrition (Phillips, 1999). However, the Great Depression did not affect everybody equally. Young people, the elderly, and non-white individuals faced the largest levels of unemployment. Some sectors, such as construction, iron and steel, durable goods and automobiles, manufacturing, and real estate, were more affected than others (Chandler, 1970; Margo, 1991).

The economic effects of the Great Depression also varied across the country. Figure 1 shows the county variation of an index for the severity of the crisis from 1929-1933 (more details on how this index is constructed are provided below). Some areas in the South and Southwest were more affected: New Mexico, Mississippi, Arkansas, and Oklahoma. In the West, some of the most affected states were Arizona, Utah, and Washington. The east coast and Northeast were less affected. The difference in industrial composition across regions is one reason for the geographic variation in the severity of the crisis, since manufacturing of durable goods and construction fared the worst (Rosenbloom and Sundstrom, 1999). Our analysis exploits this county-level variation to identify the effects of the Great Depression on longevity.

2.2 The New Deal and its geographic allocation

In 1933, President Roosevelt approved a vast set of programs for relief and recovery, commonly known as the New Deal.[6] The New Deal included programs for public assistance, public works, housing, and loans, some of which were precursors of modern welfare programs. Yet most New Deal programs offered relief through employment.

We focus on relief programs, which accounted for 63% of New Deal non-repayable grants, and public works grants, which accounted for 24% (Fishback et al., 2003). These programs operated through direct work contracts and public assistance. They targeted the most af-

[6]New Deal grants between 1933 and 1939 totalled $16 billion (in 1967$).

fected individuals and provided assistance to satisfy basic needs such as food, housing, and health care. Hence, they are the most likely to have direct effects on health outcomes. We analyze these programs together because the distribution of funds is highly spatially correlated, and thus it is hard to separately identify the effects of any single program.[7]

Our analysis includes the following programs: the Federal Emergency Relief Administration (FERA), which involved direct and employment relief payments; the Social Security Administration Public Assistance (SSAPA), which provided public assistance payments, especially for children, single mothers, and people with disabilities; the Works Progress Administration (WPA), which provided work relief with hours and wage limits; and Civil Works Administration grants (CWA), which created jobs for millions of people who were unemployed (Schwartz, 1976; Fishback et al., 2003). The Public Works Grants program focused on the construction of highways and public buildings, which were highly labor-intensive projects. During this period the federal government became the largest employer in the nation, because these programs employed millions of citizens. The programs we concentrate on account for 87% of non-repayable spending. Although we exclude some programs as a robustness check, we investigate whether our results are sensitive to which programs we include.[8]

The geographic allocation of funds was not random, and resulted in geographic variation at both county and state level.[9] Figure 2 shows the spatial distribution of New Deal funds in absolute and per capita terms. By comparing it with Figure 1—which shows the spatial distribution of the severity of the crisis—we find that the government targeted areas with more pronounced economic downturns. Indeed, Figure 3 shows that relief spending and economic severity are highly correlated across counties.

Yet the most affected regions did not always get the largest amounts of money. Previous research shows that in addition to targeting more affected areas, other factors also affected the allocation of funds. For example, southern states received less money (Fishback et al., 2007) because politicians argued that living costs there were lower (Couch and Shughart, 1998). States in the West received more funds because they had more federal land, where more public works and infrastructure could be undertaken (Wallis, 1998; Fleck, 2001). Bureaucratic

[7]For example, the correlation between CWA and WPA is 0.94. Appendix Table 13 shows the geographic correlation across all New Deal programs.

[8]Programs not included are the Agricultural Adjustment Administration (AAA), which accounts for 12.1% of grants; Farm Security Administration (FSA), 0.6%; and US Housing Authority (USHA), 0.8%. We also exclude loans. See Appendix Table 14 for robustness checks.

[9]The federal government distributed funds across states, and states distributed funds across counties and municipalities.

hurdles also affected where some programs received more funding.[10]

Finally, more funds were sent to areas as a function of political considerations, which we use as an exogenous determinant of the geographic allocation of funds. An extensive literature documents that political incentives partly determined where funds were disbursed. Wright (1974) finds that voter turnout was an important determinant of funds distribution. Anderson and Tollison (1991) find that indicators of relative political influence are strongly correlated to spending patterns. More recently, Fleck (2001) shows that the fraction of loyal and swing voters across counties affected the allocation of New Deal spending, as predicted by a model of political choice. The underlying mechanism in the model is that the government uses the relief to try to ensure reelection. Fishback et al. (2005) and Fishback et al. (2007) find that different electoral variables, such as voter turnout in different elections, the fraction of votes for Democrats, and the variance in Democrats' votes over time, are strongly correlated with New Deal spending per capita. In summary, it is well established by previous research that political variables predict the allocation of New Deal relief.[11] We consider all these variables as potential instruments for New Deal funds.

3. Data

To study the long-term effects of the Great Depression and New Deal relief on longevity, we match individual-level data from the 1930 and 1940 US Censuses with family tree data from FamilySearch, county-level data on New Deal spending, county-level data on the severity of the crisis, and election results.

3.1 Individual-level data

3.1.1 US Census

We use the 1930 and 1940 Censuses in this analysis. The baseline sample is the 1930 Census, which provides the county of residence of all individuals living in the US at the very beginning of the Great Depression and 3 years prior to the New Deal. We use the full count, which includes 120 million individuals. The 1930 Census also includes various predetermined characteristics of individuals, such as age, gender, race, nationality, and marital status.

[10] For some programs, the state's governor had to sign a statement justifying the need for relief and provide diverse information. Other programs had funding requirements the state had to match, and this could result in richer states' receiving more funds.

[11] We discuss the instrument and necessary assumptions in Section 4.

We link the 1930 Census to the 1940 Census using the Census Tree linking set developed by Price et al. (2021). The 1940 Census includes information on intermediate outcomes, such as income, education, employment, number of children, and marital status.[12] By matching both censuses, we also know whether a person moved between 1930 and 1940. We use these variables to understand the mechanisms behind the effects of New Deal relief on longevity.

3.1.2 FamilySearch—The Family Tree

To compute individual longevity, we match the 1930 census with family tree data from FamilySearch. FamilySearch hosts both the world's largest single family tree platform and an archive of historical records that contains information on billions of deceased individuals. Instead of creating their own personal family trees, FamilySearch's users connect their genealogies to the public, Wiki-style Family Tree by creating profiles for their deceased ancestors, attaching historical records to those profiles, and linking them to the profiles of those ancestors' relatives.[13] The sources users can attach to these profiles include various types of death records, including death certificates, obituaries, gravestones, funeral home records, and Social Security records. Appendix Figure 1 shows an example view of the Family Tree from the point of view of a regular user.[14] Whereas anyone can access individual records on Family Search's website, the large-scale compilation of the dataset used in this paper is maintained by the Record Linking Lab at Brigham Young University (BYU). Using this dataset, we are able to link 30% of the population in the 1930 Census to their death data, which is comparable to or higher than that achieved in other historical studies.[15] Appendix B explains the linking process from the 1930 Census to FamilySearch deaths in detail.

The resulting dataset has two main advantages. First, our data includes almost 50% women. Because women tend to change their last name after marriage, they are more difficult to link across years and not usually included in similar historical studies using Census or Social Security data. As a result, the study of women has been notably scant in the economic history literature (Abramitzky et al., 2014; Feigenbaum, 2016; Bailey et al., 2017; Bailey et al., 2020; Abramitzky et al., 2021). Because the Family Tree includes information on

[12] As a robustness check, we also link the two Census years using the MLP linking method (Helgertz et al., 2022).

[13] A machine algorithm uses the user-made links to suggest potential record links to other profiles, increasing the number of profiles linked to death records.

[14] www.familysearch.org

[15] The Life-M Project links by hand between 28.7−31.1% of a subsample of individuals from birth certificate to deaths in the states of Ohio and North Carolina. For the full sample they link individuals to deaths at a rate of 17.8 − 23.6% (Bailey et al., 2022). Abramitzky et al. (2014) link 16% of native men from the 1900 Census to the 1910 and 1920 Census. Abramitzky et al. (2012) link 29% of men from the 1865 Norwegian Census to either the 1900 Norwegian or US Censuses.

parents' names, we observe women's maiden and married last names so that we can link them at nearly the same rate as men.

Second, the FamilySearch death data includes deaths from 1930 to the present day. This allows us to study and compare both short- and long-run effects on longevity. For comparison, a commonly used source of death and birth dates is the Death Master Files (DMF), which only includes information on birth and death dates for men who died between 1975 and 2005. As a robustness check, we also use the DMF records to compute longevity. Some additional problems appear when matching these records, since these data have only been linked to the 1940 Census (And not to the 1930 Census, which is our base data).[16]

Our dataset has some limitations: The sources of death data might be of uneven quality; all counties are not equally represented due to limitations of the matching process; and not everyone is equally likely to have a profile on the Family Tree. For these reasons and others, there may be some selection problems in our sample; we discuss these issues below.

3.2 County-level data

3.2.1 New Deal Relief Data

We use data on New Deal spending by program at county level published in 1940 by the Statistical Section of the Office of Government. It reports all federal spending on New Deal programs from March 1933 to June 1939.[17] The data include information on loans and grants given to different agencies, such as the Federal Works Agency, the Federal Security Agency, the Department of Agriculture, and the Federal Housing Administration. To our knowledge, this is the only source of New Deal spending by county. Unfortunately, the data are not broken down by year.

Using data at county level is important for two main reasons. First, New Deal programs entailed multiple layers of political administration. Therefore, the final success of each program was determined as much by what happened within states as by what happened across states (Fishback et al., 2003). Second, to evaluate the effects of the relief on longevity, it is important to measure the relief received by individuals, and the most disaggregated data available are at county level.[18]

[16] The linkage was done by the Censoc project. https://censoc.berkeley.edu

[17] These reports were digitized by Fishback et al. (2005). New Deal Studies. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2018-11-18. https://doi.org/10.3886/E101199V1

[18] In the 1940 Census there is an individual measure of relief participation; however, most participants would be missed, since most of New Deal relief programs ended in 1939. Only 1% of the population reports

More than $16 billion were distributed from March 1933 to June 1939 in different non-repayable New Deal funds. Of those, $14.1 billion (87%) were allocated to the relief programs of interest here. On average, each county received, for the whole duration of the New Deal (1933-1939), $261.54 per capita in 1967$, with a standard deviation of 287.48. In 2020$, this would be an average of $4,869.76 per capita.[19] Average relief from 1933 to 1939 represented 31.6% of average annual income in 1939.[20] Mohave Counyt, Arizona, was the county with the highest per capita funds—more than $9,000 per capita—and Armstrong County, South Dakota, with the lowest, receiving less than $0.28 per capita.[21]

3.2.2 Severity of the Economic Crisis (1929-1933)

To assess the severity of the crisis, we create an index using economic variables from different data sources. This allows us to obtain a single estimate of the effects of the Depression on mortality and longevity and to compare counties that differed on relief spending but had the same crisis severity.

The index is the standardized and adjusted sum of the following variables, transformed such that larger values correspond to greater severity of the crisis: 1930 unemployment rates (from the full-count US Census); the change in retail sales from 1929 to 1933 and from 1929-1935 (from Fishback et al. (2005)); the change in farm value (from the Agricultural Census); and the change in income per capita (from 1929 to 1933 from the US Bureau of Economic Analysis). Some of these variables are based on estimates and might not be exact, which might cause some measurement error.[22]

working on relief in the 1940 Census. Modrek et al. (2022) use this data to create a county-level index of New Deal exposure. Individual participation in these programs is available in the National Archives, but the records have not been digitized. To our knowledge, the only individual-level records of participants that have been digitized were digitized by Aizer et al. (2020) for men participating in the CCC in Colorado and New Mexico.

[19] These are the total amounts of relief per capita for the full 1933-1939 period; annually it would be equivalent to $695.68 in 2020$.

[20] The average income in 1939 was $442.14 ($1,062.41 in 1967$). This data come from the 1940 full-count US Census, and it is top coded at $5,001. If we divide the amount of relief by 7 years, it represents 4.5% of the average income.

[21] In our sample, we drop 2 counties with extremely large values of New Deal relief per capita; they represent less than 1% of our original sample.

[22] We investigate whether our results are sensitive to the construction of the index as a robustness check. We also re-estimated our results including all variables instead of the index. See Appendix Table 15.

3.2.3 US Election results 1920-1932

We use information on election results from 1920 to 1932 to understand how political incentives affected the distribution of New Deal funds. The political variables come from data available in the "United States Historical Election Results, 1824–1968" (ICPSR 1), which reports how many votes each party got for different elections. The variables used include voter turnout in presidential and congressional elections, averages and standard deviations the turnout from 1920 to 1932, fractions of votes for Democrats and Republicans, averages and standard deviations of the fractions of votes for Democrats and Republicans, numbers and fractions of loyal and swing voters, numbers of representatives and their tenures, and closeness of the elections.[23] In Section 4, we explain how we use these political variables in our identification strategy.

3.3 Estimation Sample and Summary Statistics

Table 1 shows summary statistics of individuals in the full-count 1930 US Census (column 1) and our FamilySearch linked sample (column 2). Less than 1% of our linked sample is non-white, and only around 3% are foreign born. Since these populations are underrepresented in our data, we restrict our analytic sample to white, US-born individuals.[24] Columns 3 and 4 of Table 1 present the same summary statistics as columns 1 and 2, but for our analytic sample. Statistics in column 4 are weighted at cohort and county level to be representative of the white, US-born 1930 population.

There are 89,677,282 white, native-born individuals the in full-count 1930 US Census. We link 26,508,899 individuals to their death dates—29.6% of the 1930 census sample. This matching rate is comparable to or higher then that achieved in other historical studies.[25]

Table 1 shows that once we restrict our sample and weight it, our analytic sample is broadly representative of the 1930 population we target. Average New Deal relief per capita across the entire sample is $270, slightly more than the county-level average reported in

[23] Voter turnout and votes for Democrats and Republicans are included for all election years from 1920 to 1932.

[24] Other studies that use FamilySearch data also face this issue and take the same approach (Lleras-Muney et al., 2022.

[25] The Life-M Project links by hand between 35.8% and 37.8% of men and 21.5% and 24.4% of women from birth certificate to death for a subsample of individuals in the States of Ohio and North Carolina. For the full sample, they link individuals to death at a rate of $22.9\% - 27.8\%$ for men and $12.7\% - 19.3\%$ for women (Bailey et al., 2022). Abramitzky et al. (2014) link 16% of native men from the 1900 Census to the 1910 and 1920 Censuses. Abramitzky et al. (2012) link 29% of men from the 1865 Norwegian Census to either the 1900 Norwegian or US Census. Craig et al. (2019) match 30% of married women of specific cohorts from marriage certificates in Massachusetts to the 1850, 1880, and 1900 US Censuses.

Section 3.2.1. The average age of individuals in our sample in 1930 is 27. Although women are slightly underrepresented (we link 31.95% of the men and 27.2% of the women), about half of our sample are women, which is significantly higher than other studies that use linked historical records (Craig et al., 2019; Abramitzky et al., 2021). Our linked sample is a bit less urban than the full-count Census, and individuals in our sample are more likely to be married. This likely happens because of the construction of the Family Tree: Married people are more likely to be on the tree because they are more likely to have had descendants who could later add them to their tree.

3.4 Matching and Sample Selection

Not all counties are equally represented in our sample. Match rates at county level are presented in Appendix Figure 2, and range from 5% to 77%. The larger match rates are in Utah and Idaho, where FamilySearch's modern users are overrepresented. The lowest match rates are in New Mexico and southern of Texas. To address this problem, we weight our dataset at cohort and county level, and—as previously discussed and shown in Table 1—using these weights, we obtain a sample that is mostly representative of the white, US-born 1930 US population.

Nevertheless, our final linked sample suffers from sample selection in some dimensions for various reasons. First, we are more likely to observe the ancestors of people who are interested in their genealogy. Second, our linked sample has a smaller fraction of people who were relatively young in 1930 compared with the full-count census. This is shown in Appendix Figure 3 and could be due in part because individuals who are still alive do not have their death on the tree. Finally, FamilySearch's users tend to only enter information regarding their own ancestors. People who died young are less likely to be known by their family members, so they are less likely to appear in our sample. Compared with Vital Statistics deaths for the 1929 cohort, our sample misses a large amount of infant and young deaths (Appendix Figure 4). To account for this selection, we condition our sample to survival to age 20 in the robustness checks.

To account for other types of selection, we identify who has missing longevity information and whether individuals who lack this information differ from the general population. Table 2 presents estimates of the effects of different individual characteristics on an indicator for whether the individual has a death record. Some individuals have higher probabilities to be linked to their deaths than others. Linked individuals have larger families and higher socioeconomic status, and live in areas in which the recession was less severe and that

received less relief. Thus our analytic sample is a positively selected sample of individuals who would be expected to live longer than average. As stated above, to solve some of these issues we weight the population at county-cohort level and control for factors that affect the probability of being linked when conducting our analysis. [26]

4. Empirical Strategy

To obtain the causal effects of New Deal relief and the Great Depression on longevity, we would like to estimate the following accelerated failure time (AFT) model of duration:[27]

$$Log(\text{Age at Death})_{ict} = \beta_0 + \beta_1 Log(\text{Relief Spending})_c + \delta \text{Crisis Severity}_c + \alpha_1 X_i + \alpha_2 X_c + \gamma_t + \gamma_s + u_{ict} \quad (1)$$

where ict stands for an individual i living in county c and born in the year t. X_i are individual covariates from the 1930 census: age, urban, married, schooled, employed, in the labor force, occupation score, family size, and number of children. X_c are county controls selected using LASSO: severity index, % black, % rural farm, farms per capita, % farm area, % farms 50-99, % farms 500-999. γ_t are cohort fixed effects and γ_s are birth state fixed effects.[28]

To estimate and compare the short- and long-run effects of the Great Depression and the New Deal, we estimate a survival model instead in which we will estimate the following regression for each 10-year age cohort separately:

$$\mathbb{1}(\text{Survived to } m)_{ict} = \beta_0 + \beta_1 \text{Relief Spending}_c + \delta \text{Crisis Severity}_c + \alpha_1 X_i + \alpha_2 X_c + \gamma_t + \gamma_s + u_{ict} \quad (2)$$

where m is a year from 1930 to 2020. Since we estimate this for a given cohort (e.g., those born between 1915 and 1925 who were between 6 and 15 years old in 1930); surviving

[26] We investigate whether our results are robust to weighting using the predicted probability of being linked in Appendix Table 16, following work by Bailey et al. (2020).

[27] This is one of two main models used to study durations, and it assumes that covariates have proportional effects on the duration. Alternatively, we could use a proportional hazard model. Since we do not have time-varying covariates, it is not clear whether this alternative presents any advantages, but it would present large computational difficulties since the data would have to be transformed into a panel of individual * year observations.

[28] In Appendix Table 11, we present results for the analysis of longevity using levels instead of logs.

to a given year is equivalent to surviving to a given age.[29] Thus $\mathbb{1}$(Survived to m) =1 if the person died after the year m, and $\mathbb{1}$(Survived to m) =0 if the person died the year m or before. ict denotes individual i living in county c and born in the year t. Covariates are the same as in equation 1. In both specifications, standard errors are clustered at county level.

Even accounting for county severity, some counties received different amounts of relief. To address this, we include the set of county controls described above that are predictors of both relief and longevity. We do not observe who received relief at individual level, only at county level. However, we know that some individuals were more likely to receive relief than others, depending on demographic characteristics. For this reason, we include predetermined individual covariates from the 1930 Census, as defined above.

The coefficient delta estimates the effect of the recession on outcomes in relative terms. Since the index has been normalized, the coefficient measures the impact of an increase of one standard deviation in the index on outcomes. The coefficient β_1 estimates the effect of \$1 more in New Deal relief on outcomes. For a causal interpretation of β_1 and δ, we further require that New Deal relief spending and crisis severity be orthogonal to other determinants of longevity that are not controlled for in the model. We do not have access to an instrument for severity, and thus the analysis of these effects will be descriptive.

However, we attempt to obtain causal estimates of the effects of the New Deal. Naive OLS estimates of the effects of New Deal relief on longevity from equation (1) might be biased for several reasons. First, there might be omitted variables related to crisis severity. Although we control for the severity of the Great Depression, this severity might be poorly measured. For example, there might be relevant variables that we can't observe, such as a change in personal income or individual wages, which we cannot include in our computation of the severity index. Second, different sources of measurement error can be related to both New Deal relief spending and crisis severity, leading to attenuation bias. Available data on New Deal spending provides information on funds from the federal government to counties but, for example, there could be missing transfers if there are independently funded programs at municipal or individual level. Finally, there could also be error from assuming that people suffering the recession and received relief in their county of residence in 1930. We will separate movers from non-movers in our robustness checks.[30]

[29] We grouped the youngest cohorts in intervals of 5 instead of 10 years, because under-5 mortality tends to differ from mortality at older ages.

[30] See Appendix Table 7.

4.1 Identification Strategy using IV-LASSO

To assess the long-term effects of New Deal relief and address the issues described above, we use an instrumental variable approach based on political variables from 1920 to 1932. The ideal instrument predicts where funds are allocated (relevance assumption), but it is otherwise uncorrelated with predictors of longevity, conditional on the severity of the crises (exclusion restriction assumption).

Our instrumental variable (IV) approach is based on the political incentives that influenced the geographic allocation of New Deal relief funds. Political models in the literature agree that the main variables that affected relief were voter turnout, support for Democrats, how tight the elections were, the number of loyal and swing voters, and congressional influence, among others (Anderson and Tollison, 1991; Wright, 1974; Fleck, 1999; Fishback et al., 2005; Fishback et al., 2006). However, it is hard to identify which political variables affected New Deal relief the most and how. Many of these variables could matter, and their interactions could also matter. Twenty-Five potential instruments have previously been used in the literature. If we allow for interactions and second-order terms, the set of potential instruments could include more than $1,000$ variables.

We use a sparse model that identifies and uses optimal and parsimonious controls to select our instruments from this set of potential instruments. We use a least absolute shrinkage and selection operator (LASSO) for instrumental variables to select the best predictors of relief (Belloni et al., 2012; Belloni et al., 2014; Chernozhukov et al., 2015). This machine learning methodology results in the selection of optimal instruments and a sparse set of controls, given the assumption of approximate sparsity. This assumption assumes that the conditional expectation of endogenous variables given the instruments can be well approximated by a parsimonious yet unknown set of variables and imposes a restriction where by only some of the variables have nonzero coefficients.[31]

Thus, we select the instruments and controls by estimating

[31]The potential set of county controls includes total population, population for different age intervals, population density, % black, % foreign born, % schooled in different age intervals, % urban and rural population, % people in urban and rural farms, % people not in farms in rural areas, illiteracy rates, manufacturing establishments per capita (pc.), % wage earners in manufacturing, average manufacturing wages, manufacturing product value, manufacturing added value, manufacturing added value pc., % gainful workers, % out of work, % layoff, whole establishments pc., whole average wages, % stocks, retail stores pc., % retail employment, retail sales pc., retail stocks pc., average retail payroll, value of crops pc., number of farms, farms pc., area, area of farms, % farms' area, average farm size, area for crop, area for pasture, % farms of different sizes, and farmland value pc.

$$\hat{\beta} = argmin \sum_{i=1}^{n} (y_i - \sum_{j=1}^{n} x_{i,j})^2 + \lambda \sum_{j=1}^{p} |b_i| \gamma_j, \tag{3}$$

where λ is the "penalty level" and γ_j are the "penalty loadings." Penalty loadings are estimated from the data to ensure the equivalence of coefficient estimates to a rescaling of $x_i j$ and to address heteroskedasticity, clustering, and nonnormality in model errors. Similarly, standard errors are clustered at county level to address within-county correlation.

The algorithm for the IV-LASSO methodology does the following: First, it estimates a LASSO regression with New Deal relief as a dependent variable which includes all potential instruments (Z) and potential controls (X). From this first regression, we obtain a group of instruments and controls. Second, it estimates a LASSO regression with the outcome variable, longevity, and all control variables (X) (but not the instruments) as regressors. From this second regression, we get a second set of controls. Third, it estimates a LASSO regression in which New Deal relief spending is the dependent variable and all controls (X) are the regressors. Finally, we estimate a 2SLS regression using the selected instruments in step 1 and the selected controls in steps 2 and 3, to get the post-LASSO IV estimator.[32] When using the LASSO algorithm, we partial out cohort fixed effects and state of birth fixed effects—in other words, we always include these controls.[33] The post-LASSO estimator refits the regression via 2SLS to alleviate LASSO's shrinkage bias.[34]

After this process, the LASSO algorithm selects one instrument which we label "voting culture exploitability," and the sparse set of controls defined at the beginning of Section 4. The voting culture exploitability instrument is the interaction of the standard deviation of the 1932 presidential election voter turnout with the standard deviation of the 1928 Congressional election voter turnout.[35] By the nature of the standard deviation of voter turnout, our instrument will take values from 0 to 0.0625 (since each standard deviation takes values from 0 to 0.25). The instrument takes larger values when the county has a medium level of voter turnout and low values in areas with very low and very high turnout.

This instrument reflects voting culture exploitability in different areas—that is, how easy it is to obtain additional votes in a given location based on voting behavior. Places with very low turnout do not have voting culture, so obtaining an extra vote in these locations may be

[32] All county controls defined at the beginning of this section and crisis severity are selected using our IV-LASSO approach.

[33] We partial out fixed effects because they are important in our model from a theoretical point of view. We want to compare individuals born in the same year and same state, since both will affect the age at death.

[34] We use the *ivlasso* package to compute these estimators (Ahrens et al., 2020).

[35] Standard deviation is defined as turnout*(1-turnout).

very expensive: Even if the incumbent spends money in those areas, it will be hard to induce additional people to vote. Places with very high turnout have a robust voting culture, and as a result there are fewer people left to be convinced. Places with medium-level turnout have some voting culture, so it might be possible to induce people to vote. Because there are also more people who could potentially vote, obtaining more votes there is likely cheaper. Thus, it is efficient to allocate funds in places with medium-level turnout.

The key identification assumptions are that the IV is relevant and that the exclusion restriction holds. We will now discuss each assumption. Voting culture exploitability is strongly correlated with New Deal relief spending per capita, as shown in the binned scatter plot in Figure 4. Appendix Table 2 shows that the instrument is strongly predictive of New Deal relief at both county level and individual level. The F-statistic has values of 108, 41.99, and 29.79 in the different specifications—well above the recommended cutoffs.[36] Figure 5 documents that there is substantial cross-county variation in the instrument. The South had the lowest values, since voter turnout was very low in the region. Interestingly, this area also received the lowest relief.

We also gather empirical evidence to support the exclusion restriction assumption. For this restriction to hold, we need the instruments to affect longevity only through New Deal relief funds, conditional on the severity of the crisis and on other controls. A possible way to obtain this evidence is to test the correlation between health variables and the instrument before the New Deal. Thus, we examine whether county-level mortality rates from 1920 to 1928 are correlated with our instrument. Appendix Figure 8 shows that voting culture exploitability is not correlated with the mortality rates before the New Deal. This provides evidence that the selected instrument is valid.

5. Short- and Long-term Effects of the Great Depression

In this section, we descriptively analyze the short- and long-run effects on longevity and survival.

We begin by examining the impact on longevity. In Table 3, column 6 presents OLS estimates of the effects of the severity of the crisis on longevity with controls, excluding New Deal relief. Columns 7 to 9 introduce controls for New Deal relief. Individuals residing

[36]The highest F-statistic corresponds to the county-level specification without controls. Others correspond to individual-level specifications without and with controls, respectively. Appendix Figure 7 shows the distribution of the voters' importance instrument. The instrument is concentrated between the values 0.04 and 0.06, with some counties having values between 0 and 0.2. Counties with lower values have very low or very high voter turnout.

in areas with a more severe depression experienced shorter lives. Without accounting for relief generosity, a one-standard-deviation increase in depression severity is linked to a 0.12% decrease in longevity, equivalent to an average decline of about 1 month. Controlling for New Deal relief, the estimate remains the same. However, given the non-random allocation of New Deal funds, these OLS estimates remain biased.

In Table 4 we present post-IV-LASSO estimates, in which we use an instrumental variable for New Deal relief. The coefficient for the severity index almost doubles compared with the OLS coefficient. A one-standard-deviation increase in the severity index decreases longevity by 4 months on average. We are interested in how these effects differ by gender, as most relief recipients were men.[37] The point estimate for men more than doubles, leading to a reduction in longevity of 5 months. For women, the IV coefficients are smaller, corresponding to a reduction in longevity of 2.4 months.[38]

The effects of the Depression could differ by age, since some groups could be more sensitive to the economic shock than others. Appendix Table 4 shows the effects of the Great Depression on longevity by birth cohort, in which a cohort is defined as a 10-birth year group.[39] We find that individuals aged 0-10 have the largest effects and experience decreases in lifespan of 5.6 months for a one standard-deviation-increase in severity of the crisis, followed by individuals aged 10-20, who experienced decreases in longevity of 5.2 months on average.

We want to understand when the longevity declines occur. To do this, we study the effects of severity on survival to each year from 1930 to 2020 separately by birth cohort. Since survival rates depend on the age of the individual, we study the effects on survival separately by cohort.[40] Figure 6 presents OLS and IV estimates for cohorts aged 16 to 25 in 1930, which are the most affected. For this group of cohorts, we can see that negative effects appear right after the start of the Great Depression and become significant after 1939, when the cohort was age 26 to 35. The magnitude of the effects increases steadily with age and peaks around age 60—30 years after the Great Depression ended. One of the reasons for seeing delayed effects could be that there are few deaths before age 60: The survival rate to age 60, conditional on being alive at age 20, is 0.83%. The largest effect is found in 1984, when the cohorts are 74. In that year, a standard-deviation increase in crisis severity decreased survival by 4.5%. Appendix Figure 9 reports IV estimates on survival for the other

[37] See Appendix Table 1.

[38] Severity coefficients for men and women are statistically different in the IV specification.

[39] Estimates are conditional on surviving to age 20. They are not statistically different from the unconditioned estimates.

[40] To further account for trends in longevity, these regressions also control for cohort fixed effects.

groups of cohorts.[41]

We find a similar pattern for all cohorts: larger negative effects in the long run compared to the short run. This delay in effects likely occurs because health responses to economic shocks take time to accumulate and cause individuals to die. Schwandt and Von Wachter (2020) document an increasing pattern of mortality effects of the 1982 recession similar to the pattern found here. These cumulative and delayed effects are also predicted by the model of Lleras-Muney and Moreau (2022), who simulate the impact of temporary shocks to 20-year-olds on cohort mortality profiles.

If we disaggregate the effects by gender, we observe in Appendix Figures 10 and 11 that the magnitude of the effects for men is larger than for women in all cases. The largest effects for men are for the 1915-1924 birth cohorts in 1994, in which a one-standard-deviation increase in the severity of the crisis is related to a decrease in the survival rates of 7%. For women, this occurs in 2001 for the 1915-1924 birth cohort, in which an increase of one-standard-deviation in the severity of the Great Depression is associated with a decrease in survival rates of 3%.[42]

In summary, we find that the Great Depression was bad for the well-being of the population. The effects on health appear to be larger in the long run, and teenagers, children, and men have larger effects. A possible reason young men have the largest effects is that they had the largest unemployment rates during the recession, so they were one of the groups that suffered the most in the 1930s. Also, they were finishing school and entering the labor market during a recession that has had long-term negative consequences for income and longevity (Schwandt and Von Wachter, 2019; Schwandt and Von Wachter, 2020).

6. Short and Long-term Effects of New Deal Relief

In this section, we estimate the casual short- and long-term effects of New Deal relief spending, using the identification strategy explained in Section 4.1.

Table 3 presents OLS estimates of the impact of New Deal relief on longevity. Columns 1-3 provide estimates without considering crisis severity, while columns 7-9 account for it. In the first column, New Deal relief appears associated with negative effects on longevity. The inclusion of county controls in column 2, addressing regional differences, reduces the

[41] For the groups 0-5 and 6-15, we condition the sample on survival to 20 years to address the fact that young deaths are underrepresented in our sample.

[42] We repeat our estimation using mortality rates instead of survival rates, and the results are very similar. However, the effects on mortality are less precise.

coefficient magnitude by almost a third, as expected given the high correlation between New Deal relief and the severity of the Great Depression. In column 8, incorporating crisis severity, the relief coefficient decreases by half compared to column 2, indicating a negative bias in the OLS coefficients when severity is not considered.

To address potential bias in the OLS estimates, we now report results from the IV specifications. Recall the intuition for this identification strategy: We are comparing individuals in counties that obtained more relief because of political motivations with individuals in counties with the same severity of the Great Depression but that received less money for political reasons. Table 4 presents post-IV-LASSO estimates of longevity from equation (5). Odd columns show first-stage estimates. As noted earlier, coefficients on the severity index are positive and statistically significant, which indicates that more New Deal funds went to areas where the crisis was more severe. The voting culture exploitability instrument is positive and statistically significant, so places with larger values of the instrument got more funds.[43]

The coefficient on relief is now positive and statistically significant. Unlike the OLS estimates, these estimates imply that New Deal relief extended longevity. In column 2—the specification without controls—the coefficient for New Deal relief is positive; compared with the same OLS estimate, its magnitude more than doubled. A one-standard-deviation increase in New Deal relief ($140) increased longevity by 15 months on average. When we include all controls in column 9, the coefficient is still positive and significant but slightly decreases in magnitude, which indicates an average extension in longevity of 15 months.[44]

Next, we investigate whether the New Deal compensated for the negative effects of the Great Depression. To do this, we estimate the predicted effects of the New Deal and of Great Depression severity and compute the net effect. Figure 7a presents histograms for the predicted effects of the Great Depression and the New Deal using the post-IV-LASSO specification. The predicted effects of the crisis on longevity are mainly negative and positive for relief. Figure 7b presents the density for computed net effects. On average, the New Deal more than offset the negative effects of the recession. On net, there is an average 3-month extension in longevity.

[43] F-statistics in the range of 54.11 to 18.1 indicate that the instrument is strong. Additionally, they pass the Stock and Yogo test, and the Anderson-Rubin test rejects the null hypothesis that the coefficient of the effect of relief on longevity is zero in all specifications (Lee et al., 2021).

[44] $140 of New Deal relief is equivalent to approximately $2,000 in 2020$ for the full period 1933-1939. We could think about this as $285.7 a year for 7 years in 2020$.

Heterogeneity

Understanding how the effects of New Deal relief on longevity differ across the population is crucial for policy evaluation and future policy design. Individuals who received relief during their working age can be affected differently than children: For instance, women and men worked in different industries and occupations and were affected differently by the Great Depression. They also received relief at different rates.To understand who was most likely to receive New Deal relief, we use the full-count 1940 Census, which included a question that asked whether the individual was working on or assigned to a public emergency project or local work relief. The main limitation of this source of information is that there were many fewer people on relief by 1939 than in previous years.

We find that only 2% of individuals were working on relief, and only 8% of households had a member receiving relief. Appendix Table 1 presents the results from a regression of the indicator for receiving relief in the 1940 Census for both single individuals and households on individual characteristics. People in households who received relief are less likely to be white, married, have children, own a house, or live in urban areas. They are more likely to have larger family sizes and to be native born.

These patterns can be partly explained by age differences. Appendix Figure 5 shows the age distributions of individuals who worked on relief in 1940, compared with those who did not. A large fraction are young individuals between 18 and 22 years old who are less likely to be married or to have children. In fact, most individuals working on relief were young adults, possibly just entering the labor market. Moreover, individuals receiving relief were poorer as, Appendix Figure 6 shows, and had lower family wages. However, these differences do not seem to be statistically significant (Appendix Table 1).

When we analyze the causal effects of New Deal relief on longevity by gender in Table 4, we see that the main effects come from men. Women have a much smaller and less significant positive coefficient. For men (women), a one-standard-deviation increase in New Deal relief ($140) extended longevity by 22 (8) months.[45]

We examine the causal impact of the New Deal on longevity by cohort using post-IV-LASSO estimates (Figure 5). Significant results are observed for individuals born between 1905 and 1915, particularly teenagers in 1930, experiencing a 28-month increase in longevity

[45]In Appendix Table 11, we present these estimates using specifications in levels instead of logarithms. The results are very similar: An increase of one standard deviation in New Deal relief per capita extended, on average, longevity by 13 months when we account for all of the white native population, and by 20 months for men. For women, the effects are not statistically significant. In Appendix Table 12, we present the same results as in Table 4 but condition the sample to individuals surviving to 20 years to account for the fact that our dataset does not accurately report young deaths.

for a one-standard-deviation rise in relief ($140). This aligns with the findings of Aizer et al. (2020) on the CCC. Despite encountering increased noise, our analysis reveals substantial effects for children, with a particular emphasis on those under the age of two.

To study the dynamic effects of New Deal relief, we investigate the effects on survival. Figure 9 and Appendix Figures 15 to 18 show the dynamic effects for different groups of cohorts estimated by both OLS and IV-LASSO. We can see in the figures that OLS estimates for all cohorts are practically zero. However, when we look at IV estimates, New Deal relief has positive effects on survival rates for all cohorts, with larger magnitudes in the long run. The cohorts that benefited the most are individuals aged 16 to 25 and 6 to 15 in 1930. The effects are largest in 1988 and 1984, respectively, when the cohorts are around ages 60 to 80, which is again consistent with the model of cohort mortality of Lleras-Muney and Moreau (2022). For that period, a standard deviation increase in the New Deal relief results in an increase in survival rates of 18.3% and 11%, respectively. For the rest of the cohorts, the effects on survival are smaller.

Appendix Figures 19 and 20 confirm that men are much more affected than women. The figures present IV coefficients on survival by gender.[46] For men, we see the largest effect for cohorts aged 16 to 25 in 1930. Women also get the largest effects in the cohort 16 to 25, although the coefficients are smaller than for men.[47]

In summary, our findings highlight that men and teenagers and children were the primary beneficiaries of New Deal relief. This may be attributed to their heightened vulnerability to the crisis, leading to positive compensation effects. Additionally, the substantial receipt of relief by men and teenagers, compared to women, aligns with our observations in Section 3.[48] These outcomes resonate with existing studies indicating that men exhibit greater sensitivity to adverse shocks (Autor et al., 2019; Van den Berg et al., 2016; Bertrand and Pan, 2013). Furthermore, teenagers may experience amplified effects due to their transition from school to the labor market, enhancing the benefits of relief employment in such circumstances.[49]

We also investigate whether there are other sources of heterogeneity. First, we want to know whether the relief compensated more for the poor. We divide the sample by occupation score in 1930, and our results in Appendix Table 5 show that the lowest quartile was more affected by the recession and more compensated by New Deal relief than the upper quartile.[50]

[46] OLS coefficients on survival by gender are available upon request.

[47] For men the largest coefficient is for survival to 1984, where a standard deviation increase in New Deal relief increases survival rates by 27.6%. For women it is to 1987, which increases survival rates by 10.2%.

[48] See Appendix Figure 5.

[49] See Appendix Figure 12.

[50] The occupation score in 1930 is an approximation for income, since the 1930 US Census did not include income information. We can't reject the null hypothesis that crisis severity coefficients are equal. Coefficients

Since we do find significant smaller effects for women, in Appendix Table 6 we examine whether married women benefit from New Deal relief through their spouses. Interestingly, we find that single women benefited slightly more form the funds. Finally, in Appendix Table 7 we compare IV estimates for men who changed (or not) counties between 1930 to 1940.[51] Since we use their county of residence in 1930 when assigning New Deal relief and Great Depression values, if individuals move this could be a source of measurement error. Men who did not move were more affected by the recession, and slightly more affected by the New Deal. Considering that individuals in places where the recession was more severe moved more, this could explain why movers have smaller point estimates.

7. Mechanisms

In this section we explore potential mechanisms to understand why and how the Great Depression and New Deal relief affected longevity for a subsample of the population, by investigating outcomes in 1940 as a function of relief.

The study highlights lasting impacts of economic downturns and policy responses on individuals, urging targeted relief for maximum effect during crises. Generalizing findings must consider the historical lack of a comprehensive safety net during the Great Depression, while modern policies post-2008 and 2020 may offer more extensive support. It's crucial to note sample bias towards above-average lifespans, potentially leading to underestimations. Future research, leveraging data advancements, can explore medium-term effects and diverse populations with improved record-linking processes and access to additional datasets like the full-count 1950 US Census.

New Deal relief also affected 1940 outcomes, but the effects are less precise. On average, it improved labor market outcomes. However, these improvements are only statistically significant for labor force participation. The New Deal also has positive point estimates for years of education, but they are not significant. It also affected family structure by increasing (decreasing) the probability of being divorced (widowed).

The impact of New Deal relief on 1940 outcomes is evident but less precise. On average, it improved labor market outcomes, showing significance only for labor force participation. Positive education effects were noted, though not statistically significant. The New Deal also influenced family structure, impacting divorce and widowing probabilities.

The Great Depression negatively impacted labor market outcomes and minimally affected

for New Deal relief are statistically different.

[51] About 20% of our linked sample moved from one county to another between 1930 and 1940.

family structure, influencing county migration probability by 11%. Despite men exhibiting the largest effects on longevity, the New Deal did not significantly affect 1940 outcomes for men. Teenagers in 1930 stood out as the only group with positive and statistically significant effects on income and education. Although no effects on employment or labor force participation were found, teenagers displayed substantial positive estimates for employment. Additionally, in areas with more New Deal relief, teenagers exhibited increased marriage rates and longer duration of school attendance.

8. Robustness Checks

This section presents robustness checks we conducted to address issues in our data that could bias our results. We present the main results at county level, in levels, and conditioned on surviving to 20 years.

The New Deal spending data available to us are at county level, so in our robustness checks we present estimates on longevity at county level.[52] OLS estimates for the New Deal and the Great Depression on average longevity in Appendix Table 9 are smaller compared with individual-level estimates (Table 3). Now, however, they are positive for both the New Deal and the Great Depression in the joint and men specifications. It could be that when grouping information at county level the bias acts differently, and now the Great Depression is partially absorbing the positive effects of the New Deal. The county-level IV estimates in Appendix Table 10 are more similar to individual-level estimates. The New Deal has positive effects on the full sample—men and women—and the coefficients for the Great Depression are negative in all specifications. However, we find larger effects in county level specifications. The magnitude of the coefficients almost doubles, and the effects become significant also for women.

When analyzing the effects on longevity, we follow an accelerating failure time model; thus, instead of using as a dependent variable the age of death, we use its logarithm. In Appendix Table 11 we present the main results in levels, and the effects are equivalent to the ones in our preferred specification in logs.

Young deaths are underrepresented in our sample, since individuals who die young are less likely to be linked to their deaths. To address this issue, we estimate the main model restricting our sample to individuals who survived to 20 and report the estimates in Appendix

[52] In county-level specifications, the dependent variable is the average of the logarithm of the individual's age at death at county level. Besides the county controls, we also include individual covariates as county-level averages.

Table 12, which are consistent with our findings in the main specification.

9. Conclusion

Using a large novel dataset that links the population alive in 1930 to their deaths, we provide evidence that the Great Depression was bad for people's health. Although we find negative effects in both the short and long run, the effects are larger in the latter. More importantly, we find that failing to account for the New Deal—the government's response to the economic crisis—results in biased estimates that underestimate the negative effects of the recession. This could partly explain why our results differ from the traditional literature, which finds short-run positive effects of recessions on health (Ruhm, 2000; Ruhm and Black, 2002; Dehejia and Lleras-Muney, 2004; Ruhm, 2005; Miller and Urdinola, 2010; Stevens et al., 2015; Strumpf et al., 2017; Tapia Granados and Ionides, 2017; Tapia Granados and Diez Roux, 2009; Stuckler et al., 2012). Another reason could be that we can follow individuals even if they moved (Arthi et al., 2022).

We also present causal evidence that New Deal relief extended individuals' longevity, and the effects are also larger in the long run. On average, the New Deal extended longevity by 15 months. Our results on the effects of the New Deal are consistent with Fishback et al. (2007), who find reductions in infant mortality, and Aizer et al. (2020), who find positive effects of a specific New Deal program, the CCC, on longevity. New Deal relief more than compensated for the negative consequences of the Great Depression; we find a predicted average net effect of a 3-month increase in longevity.

These findings are driven by men and teenagers and children; we do find smaller effects for women. It is well documented that young men suffered the largest levels of unemployment during the Great Depression and were therefore among the most affected sectors, so this result is encouraging. We find that much of the effect of New Deal spending on longevity for the most affected groups likely came through increases in income and education using outcomes from the 1940 US Census. Interestingly, we find that New Deal spending had no effect on employment or labor force participation.

The results in this paper could have important implications when evaluating or designing public policy, since they provide evidence that both recessions and the policies designed to address them can have large effects on individuals' lives in the long run. For example, the US suffered two main recessions in the last two decades, in 2008 and 2020, during the financial crisis the covid pandemic, respectively. Our results could shed light on whom to target during an economic downturn, since we have seen that the most affected also benefit the most from

relief. However, when trying to generalize these findings, we need to consider that in our setting a "social safety net" was nonexistent in the United States. Currently, there are several types of policies that may dampen the negative effects of a recession. In addition, our sample is positively selected toward individuals with above-average lifespans, which could cause our results to underestimate the effects of both the Great Depression and the New Deal. As new data become available and as existing data and record-linking processes are refined, future research that builds on this study will benefit from better linking rates and the ability to examine outcomes other than lifespan. For example, when the full-count 1950 US Census becomes broadly available for research use, future researchers could replicate our methods and explore medium-term effects on income, employment, and so on. In addition, with improvements in matching rates, this analysis might be performed including populations we could not study, such as minorities.

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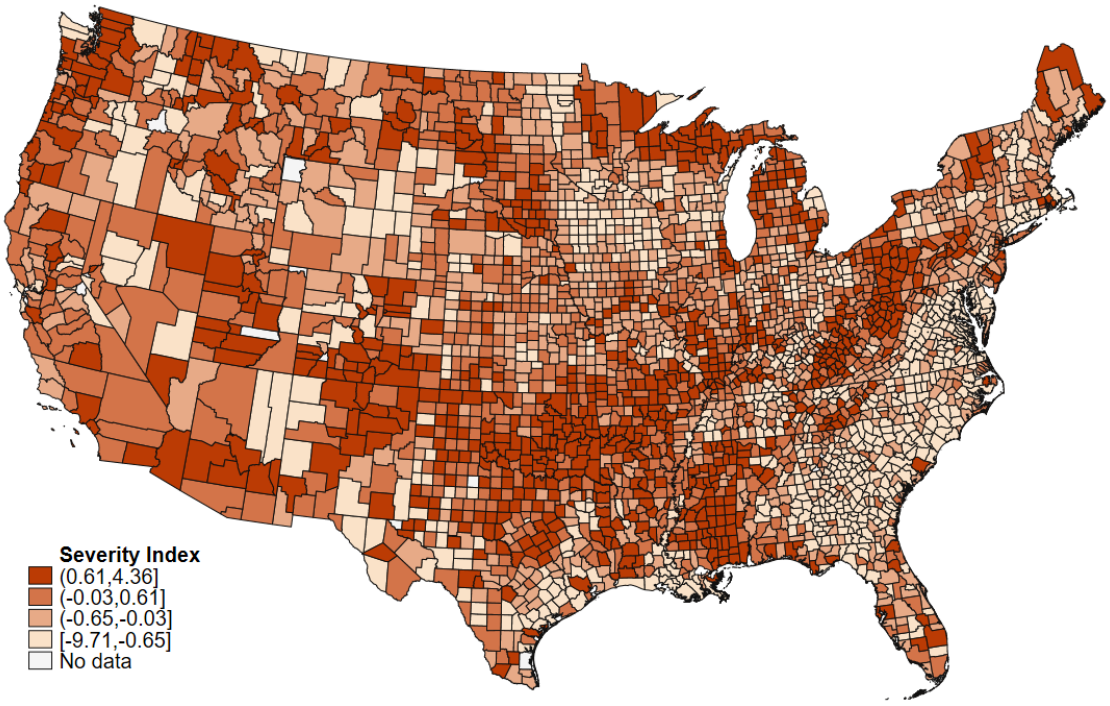
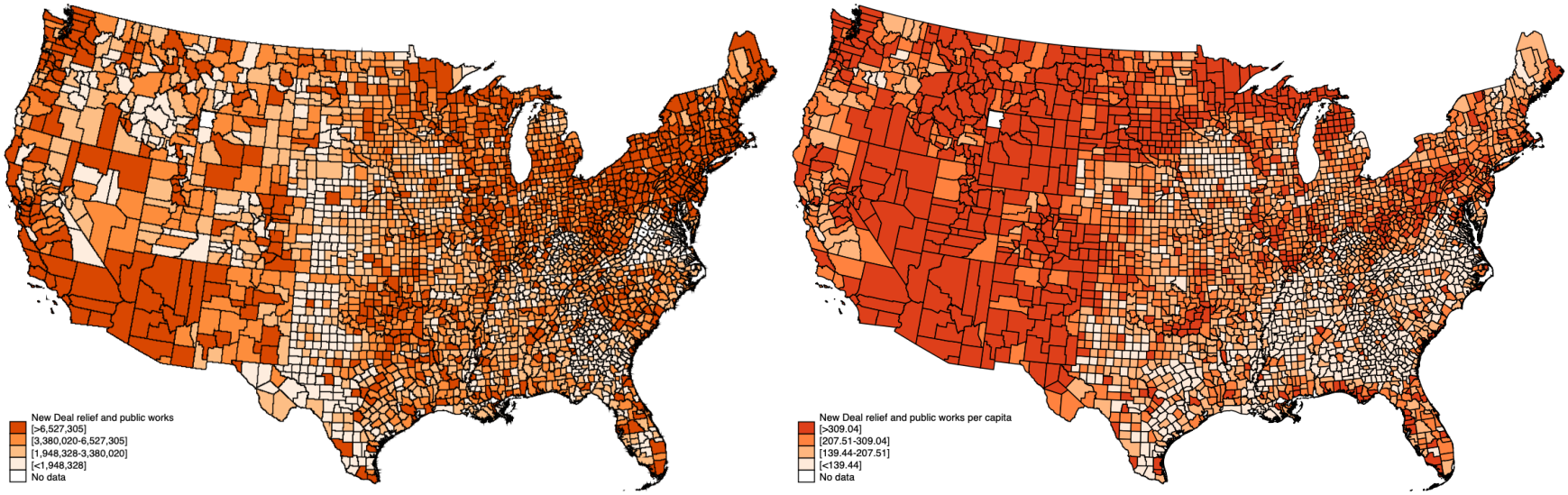
Figures and Tables

Figure 1: Variation of the Severity of the Great Depression by County



Notes: Black lines represent the limits of the counties in 1930. Counties are colored in red scale to depict the severity of the crisis from 1929 to 1933. The data used to construct the index presented in this map include unemployment rates from the 1930 full-count US Census, the change in retail sales from 1929 to 1933 and from 1929-1935 from Fishback et al. (2005), the change in farm value from the Agricultural Census, and the change in income per capita from 1929 to 1933 from the US Bureau of Economic Analysis.

Figure 2: Geographic Distribution of New Deal Relief and Public Works

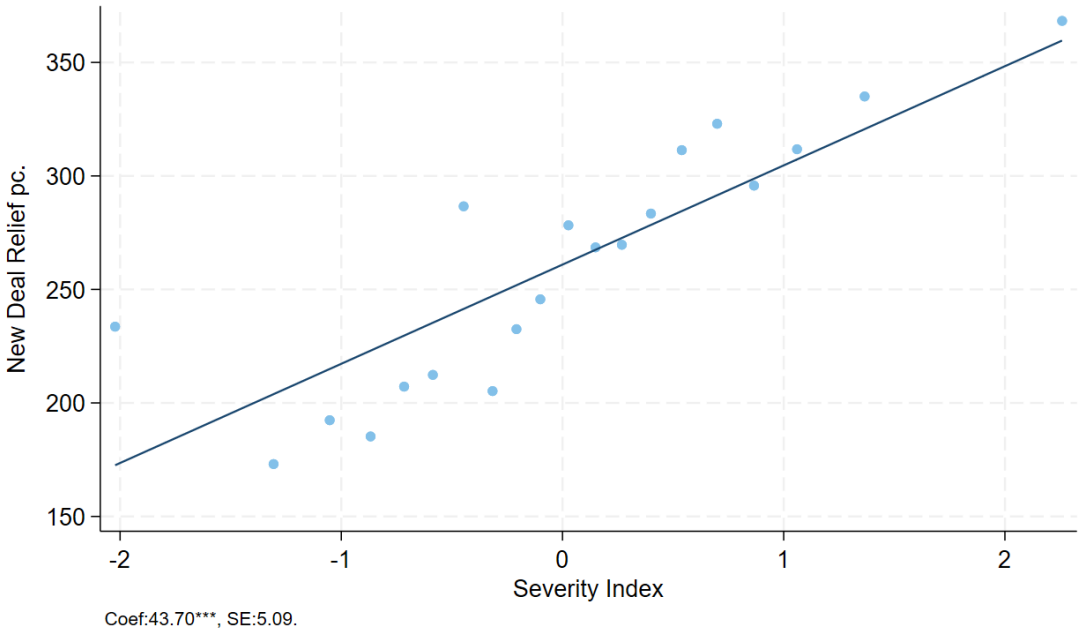


(a) Total Funds

(b) Funds Per Capita

Notes: Black lines represent the limits of the counties in 1930. Counties are colored in orange scale to depict the amount of New Deal relief. New Deal relief data come from the Statistical Section of the Office of Government reports published in 1940, digitized by Fishback et al. (2005).

Figure 3: Relationship between New Deal Relief and the Severity Index



Notes: The figure is a binned scatter plot. New Deal relief data comes from the Statistical Section of the Office of Government reports published in 1940, digitized by Fishback et al. (2005). The severity index is the standardized and adjusted sum of unemployment rates from the 1930 full-count US Census, the change in retail sales from 1929 to 1933 and from 1929-1935 from Fishback et al. (2005), the change in farm value from the Agricultural Census, and the change in income per capita from 1929 to 1933 from the US Bureau of Economic Analysis.

Table 1: Summary Statistics

	All Individuals				White and US Born			
	1930 Census (1)		1930 Census - FS (2)		1930 Census (3)		1930 Census - FS (4)	
	mean	sd	mean	sd	mean	sd	mean	sd
Relief per Capita 1933-1939	280.16	161.57	267.14	164.06	279.58	160.47	265.28	163.32
Severity Index (County level)	0.20	1.18	0.23	0.97	0.22	1.12	0.23	0.96
Year of Birth	1,901.18	19.79	1,901.25	19.30	1,903.04	19.47	1,902.09	18.99
Year of Death			1,975.13	23.02			1,975.94	22.89
Age at death			73.88	15.15			73.86	15.23
Age in 1930	28.82	19.79	28.75	19.30	26.96	19.47	27.91	18.99
Male	0.51	0.50	0.54	0.50	0.50	0.50	0.54	0.50
White	0.90	0.30	0.98	0.13	1	0	1	0
US-Born	0.88	0.32	0.95	0.22	1	0	1	0
Urban	0.56	0.50	0.45	0.50	0.54	0.50	0.44	0.50
Married	0.43	0.49	0.49	0.50	0.39	0.49	0.48	0.50
Schooled	0.23	0.42	0.25	0.43	0.26	0.44	0.26	0.44
Northeast	0.29	0.45	0.20	0.40	0.28	0.45	0.19	0.39
Midwest	0.32	0.47	0.39	0.49	0.35	0.48	0.39	0.49
South	0.30	0.46	0.31	0.46	0.28	0.45	0.31	0.46
West	0.10	0.30	0.11	0.32	0.10	0.30	0.11	0.31
Observations	121,543,425		45,853,147		95,311,287		42,723,117	

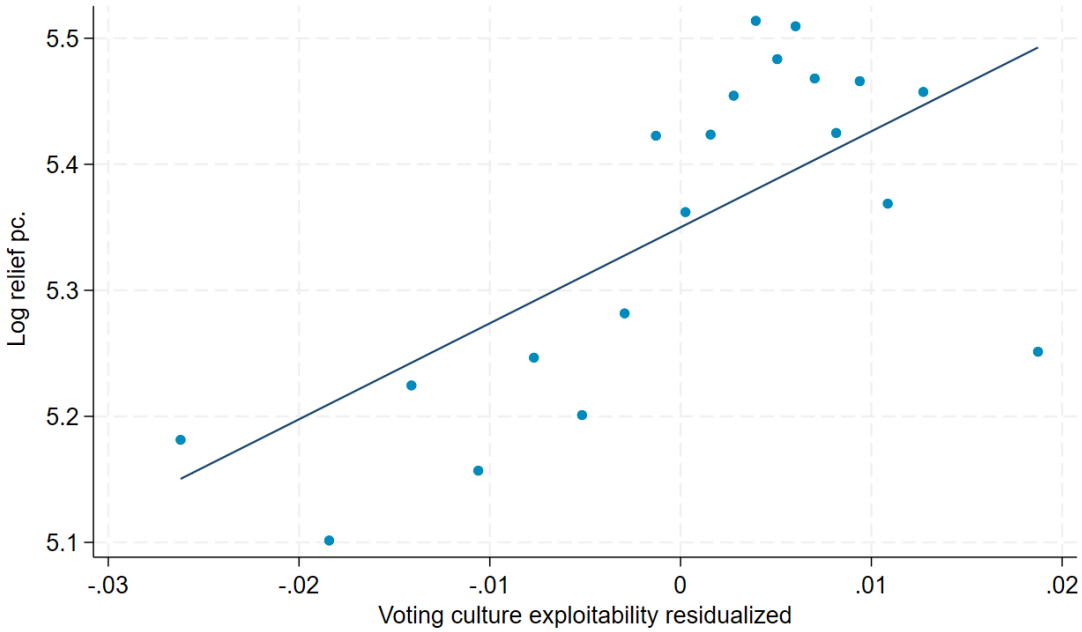
Notes: Column (1) reports summary statistics for the 1930 full-count US Census, while column (2) pertains to individuals linked to FamilySearch deaths. In column (3), you'll find summary statistics for all white and US-born individuals in the 1930 full-count US Census. Finally, column (4) presents data for white and US-born individuals in the 1930 census linked to FamilySearch deaths.

Table 2: Analyzing Whom we Match from the 1930 US Census to the FamilySearch Deaths

Dep. Var.	1(Linked to FS deaths)
Family Size	-0.0001***
	(0.0000)
Number of Children	0.0259***
	(0.0005)
Married	0.2080***
	(0.0033)
Student	0.0653***
	(0.0015)
In the Labor Force	-0.0215***
	(0.0020)
Employed	0.0382***
	(0.0017)
Occupation Score	0.0003***
	(0.0001)
Age	0.0233***
	(0.0008)
Age2	-0.0002***
	(0.0000)
Severity Index	-0.0069
	(0.0111)
Relief pc.	-0.0001***
	(0.0000)
Constant	0.2924***
	(0.0093)
Observations	95,311,287
R-squared	0.0923

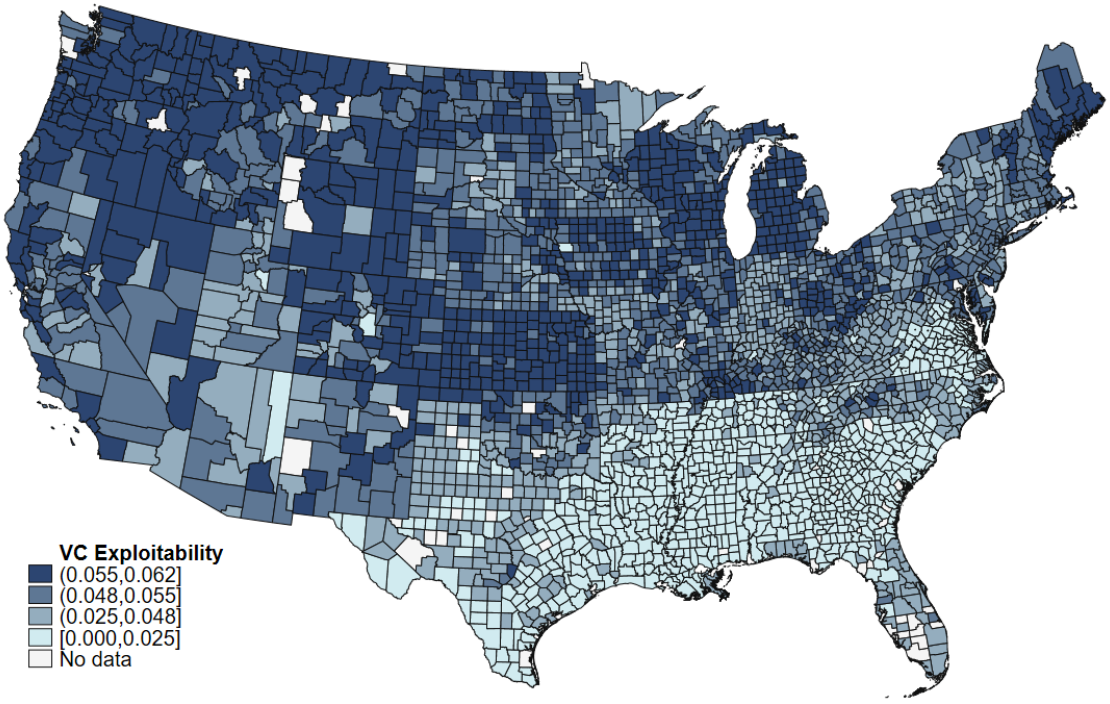
Note: The sample includes all white native individuals in the 1930 US Census. The dependent variable is an indicator whether the individual was linked to their FamilySearch death. The regression includes cohort and state of birth fixed effects. Standard errors are clustered at county level. 10\textbackslash\%*, 5\textbackslash\%**, 1\textbackslash\%***.

Figure 4: Relationship between Voting Culture Exploitability Instrument and New Deal Relief per Capita



Notes: Binned scatter-plot where the x-axis presents the residualized version of the voter's importance instrument and the y-axis presents New Deal relief per capita.

Figure 5: Geographic Distribution of Voting Culture Exploitability Instrument



Notes: Black lines represent the limits of the counties in 1930. Counties are colored in orange scale to depict distribution of the voters' importance instrument.

Table 3: OLS Estimates of the Great Depression and the New Deal on Longevity

Dep. Var. Log(Age at Death)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(Relief per capita $)	-0.0053***	-0.0011*	-0.0008				-0.0039***	-0.0004	-0.0002
	(0.0006)	(0.0006)	(0.0006)				(0.0007)	(0.0006)	(0.0006)
Severity Index				-0.0026***	-0.0014***	-0.0013***	-0.0019***	-0.0014***	-0.0013***
				(0.0006)	(0.0003)	(0.0003)	(0.0006)	(0.0004)	(0.0003)
Constant	4.8190***	4.7950***	4.1618***	4.7989***	4.7921***	4.1578***	4.8158***	4.7940***	4.1588***
	(0.0034)	(0.0041)	(0.0045)	(0.0023)	(0.0023)	(0.0020)	(0.0034)	(0.0041)	(0.0045)
County Controls		x	x		x	x		x	x
Individual Covariates			x			x			x
Observations	42,714,946	42,714,946	42,714,946	42,714,946	42,714,946	42,714,946	42,714,946	42,714,946	42,714,946
R-squared	0.0273	0.0276	0.0456	0.0273	0.0276	0.0456	0.0274	0.0276	0.0456

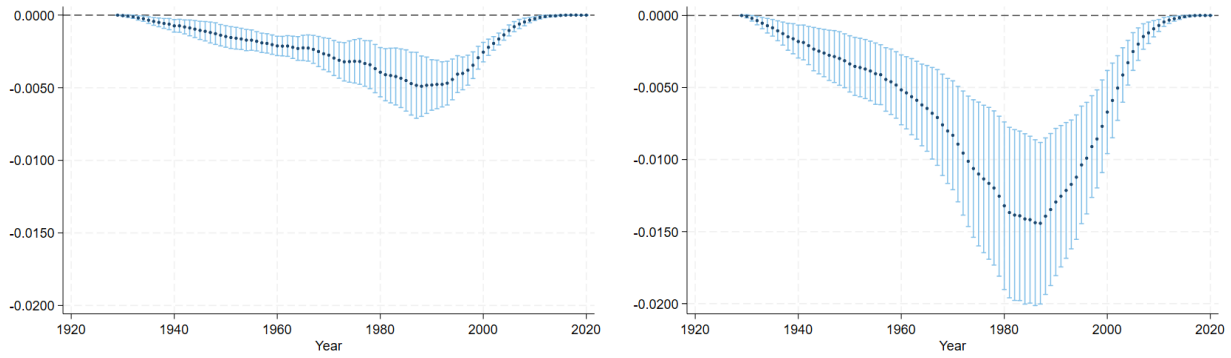
Notes: The sample includes all white native individuals in the 1930 US Census linked to their FamilySearch deaths. Initial specifications (Columns 1-3) lack controls for recession severity, while Columns 4-6 exclude New Deal relief. The final three columns (7-9) incorporate both relief and crisis severity. Standard errors are clustered at the county level, and all specifications include state of birth and cohort fixed effects.10\textbackslash\%*, 5\textbackslash\%**, 1\textbackslash\%***

Table 4: IV Estimates of the New Deal on Longevity

	All						Men		Women	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var:	L(Relief pc)	L(Age at death)	L(Relief pc)	L(Age at death)	L(Relief pc)	L(Age at death)	L(Relief pc)	L(Age at death)	L(Relief pc)	L(Age at death)
Log (Relief pc)		0.0187***		0.0267***		0.0289***		0.0420***		0.0147**
		(0.0049)		(0.0086)		(0.0087)		(0.0112)		(0.0074)
Severity Index	0.1723***	-0.0061***	0.1016***	-0.0040***	0.1016***	-0.0041***	0.0998***	-0.0055***	0.1039***	-0.0026***
	(0.0450)	(0.0019)	(0.0283)	(0.0012)	(0.0283)	(0.0012)	(0.0285)	(0.0016)	(0.0280)	(0.0010)
Voting Culture Instrument	8.4298***		4.1291***		4.1346***		4.1651***		4.0976***	
	(1.1459)		(0.9647)		(0.9648)		(0.9673)		(0.9632)	
Constant	4.0996***	4.7204***	5.0882***	4.6513***	5.5929***	3.9915***	5.5992***	3.8461***	5.5864***	4.0636***
	(0.1212)	(0.0204)	(0.1487)	(0.0451)	(0.0898)	(0.0500)	(0.0901)	(0.0644)	(0.0895)	(0.0425)
County Controls			x	x	x	x	x	x	x	x
Individual Covariates					x	x	x	x	x	x
Observations	42,037,891	42,037,891	42,037,891	42,037,891	42,037,891	42,037,891	22,740,600	22,740,600	19,297,291	19,297,291
R-squared		0.0265		0.0266		0.0445		0.0362		0.0203
F-test	54.11		18.32		18.36		18.54		18.1	

Notes: The sample comprises all white native individuals in the 1930 US Census linked to FamilySearch deaths. All specifications include state of birth and cohort fixed effects. Standard errors cluster at the county level. 10\textbackslash\%*, 5\textbackslash\%**, 1\textbackslash\%***.

Figure 6: The Effects of the Great Depression on Survival for Cohorts Ages 16-25 in 1930

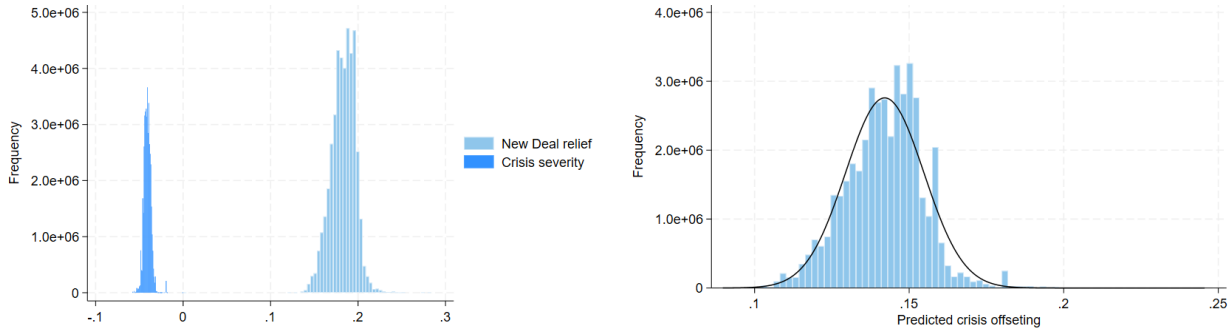


(a) OLS Estimates

(b) IV Estimates

Notes: The figures show the OLS and IV coefficients and 95% confidence intervals, respectively, of the effects of crisis severity on survival from 1933 to 2020 for cohorts aged 16 to 25 in 1930. IV coefficients come from the regression in which we instrument New Deal relief, and the coefficients plotted are for the severity of the crisis without being instrumented. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

Figure 7: IV-Predicted Effects of the Great Depression and New Deal Relief on Longevity

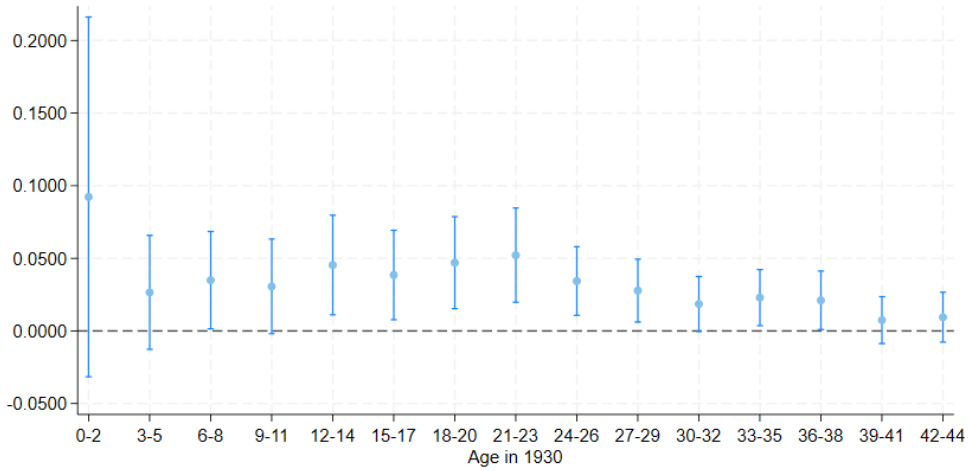


(a) Predicted IV Effects on Longevity

(b) Predicted IV crisis offsetting

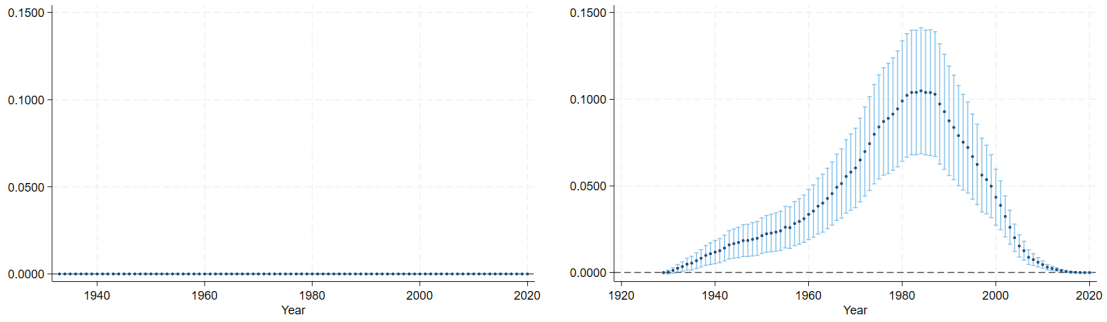
Notes: The figures present the IV predicted effects of the Great Depression and New Deal relief on longevity. The specification to predict effects include county controls selected by LASSO and individual covariates from the 1930 Census, as well as state of birth and cohort fixed effects. The sample includes all white, native individuals in the 1930 Census linked to their FamilySearch deaths.

Figure 8: IV Estimates of the New Deal Relief on Longevity by Cohort



Notes: The figure presents IV estimates and 95% confidence intervals of the post-IV-LASSO regression of the New Deal relief on longevity by cohorts. The regression accounts for the severity of the crisis and includes the county controls selected by LASSO and individual covariates from the 1930 census. All specifications include state of birth and cohort fixed effects. Standard errors are clustered at county level. The sample includes all white, native individuals in the 1930 Census aged 0-44 in 1930 linked to their FamilySearch deaths.

Figure 9: Effects of New Deal Relief on Survival for Cohorts 16-25



(a) OLS Estimates

(b) IV estimates

Notes: The figures present OLS (a), IV coefficients (b) and 95% confidence intervals of the effects of New Deal relief on survival from 1933 to 2020 for cohorts aged 16 to 25 in 1930. Regressions include county controls, individual covariates and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

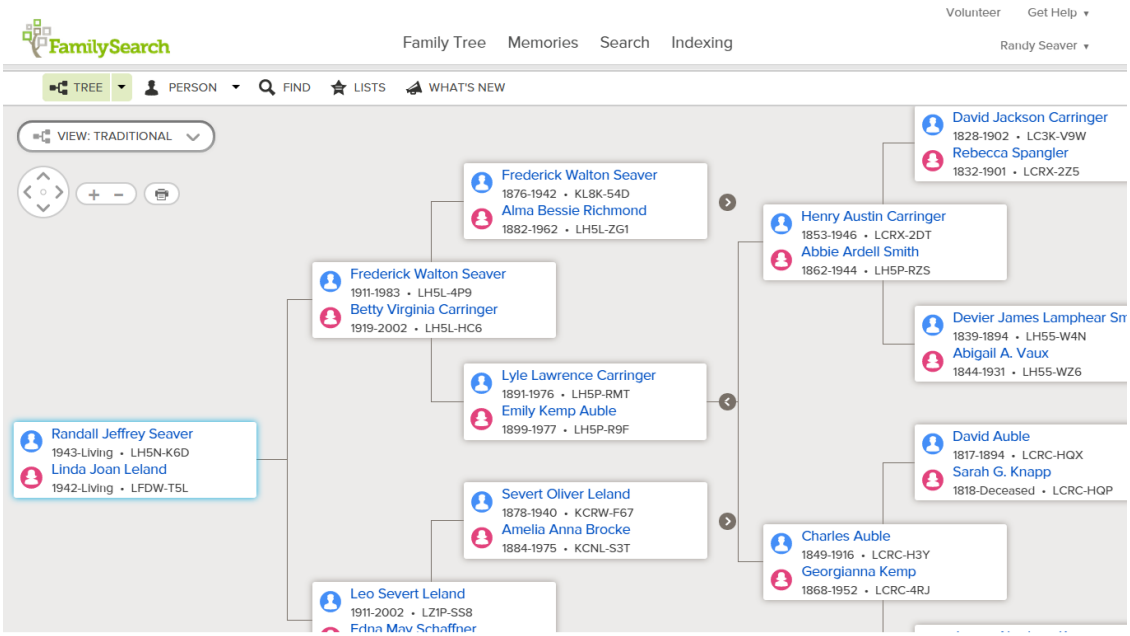
Table 5: IV Estimates of the Effects of the New Deal and the Great Depression on 1940 Outcomes

Dep. Variable	(1) Income	(2) Employed	(3) In Labor Force	(4) Education	(5) Married	(6) Divorced	(7) Widowed	(8) Moved
Relief pc.	0.1492	0.0001	0.0001**	0.002	0.00004	0.00001**	-0.00004***	-0.0002
	(0.2434)	(0.0001)	(0.0001)	(0.002)	(0.00003)	(0.00003)	(0.00002)	(0.0002)
Crisis Severity	-11.1370**	-0.0081***	-0.0045***	-0.166***	0.0005	-0.0012**	0.0007**	0.0223***
	(5.0645)	(0.0015)	(0.0014)	(0.056)	(0.0006)	(0.0005)	(0.0003)	(0.0047)
Constant	130.6288**	-0.0028	-0.008	3.546***	0.0044	-0.0113**	0.0078**	0.3533***
	(56.8772)	(0.0136)	(0.0125)	(0.542)	(0.0064)	(0.0044)	(0.0030)	(0.0429)
Observations	17,893,552	20,952,286	20,952,286	20,536,703	20,952,286	20,952,286	20,952,286	20,952,286
R-squared	0.12	0.12	0.14	0.21	0.54	0.001633	0.101741	0.04
Outcome Mean	497.33	0.5	0.54	9	0.72	0.01	0.04	0.21
Effect severity	-2%	-2%	-0.01%	-1.6%	0.07%	-12%	1.75%	10%
Effect relief	4.2%	2.8%	2.6%	3.5%	0.7%	14%	-14%	13%

Notes: The sample includes all white native individuals in the 1930 Census linked to their FamilySearch deaths and to the 1940 Census. For column 1, the sample is smaller because fewer individuals report information on their income. The table presents second-stage IV estimates for the effects of New Deal relief on different outcomes from the 1940 Census. The variable education is expressed in years. Moved is an indicator whether the individual moved counties from 1930 to 1940. All specifications include county controls selected by LASSO, individual covariates from the 1930 Census, and state of birth and cohort fixed effects. Standard errors are clustered at county level. The effects presented in the last two rows correspond to a standard deviation increase in severity and relief, respectively. 10\%*, 5\%**, 1\%***.

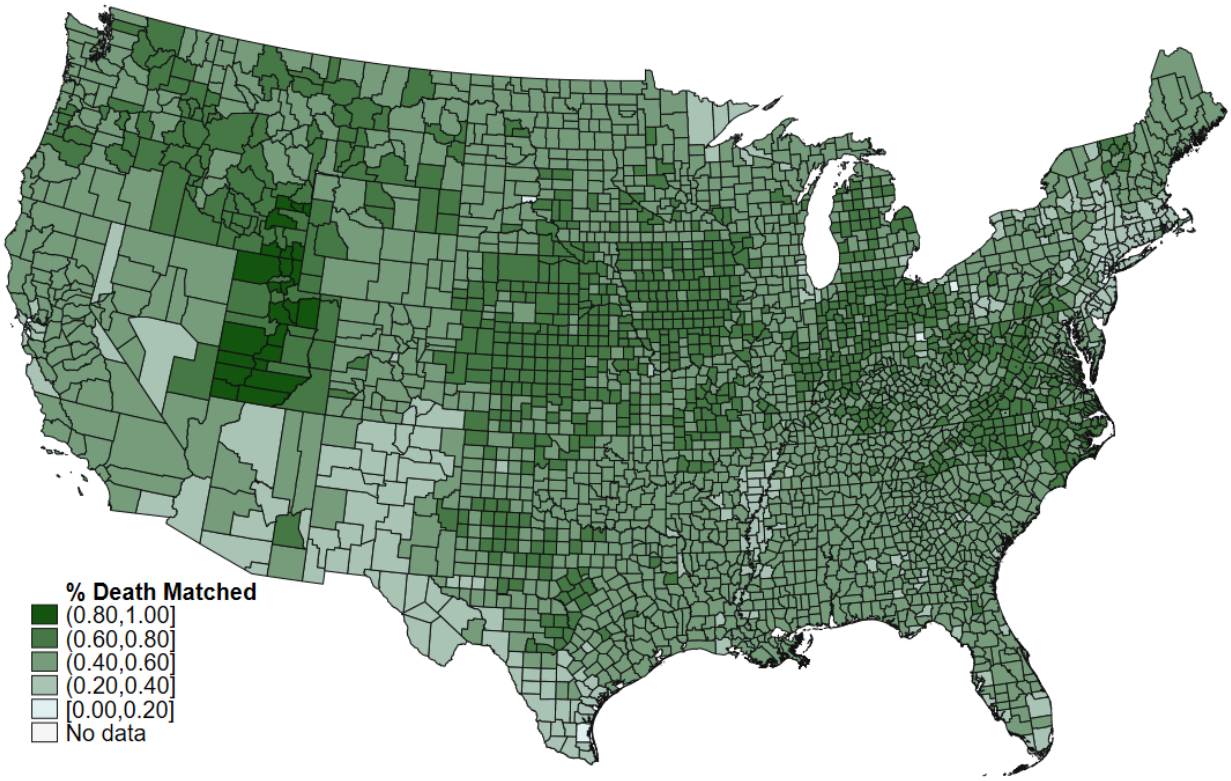
A Appendix Figures and Tables

Figure A.1: FamilySearch Tree from the Point of View of a Regular User



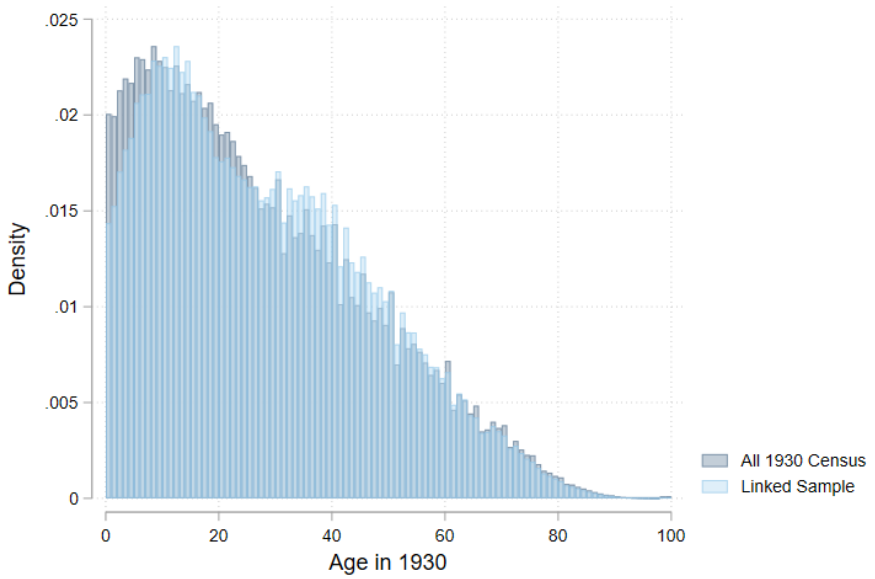
Note: The figure presents an example of a FamilySearch Tree from the point of view of a regular user.

Figure A.2: Match Rates from the White Native Population in the 1930 Census to their FamilySearch Deaths



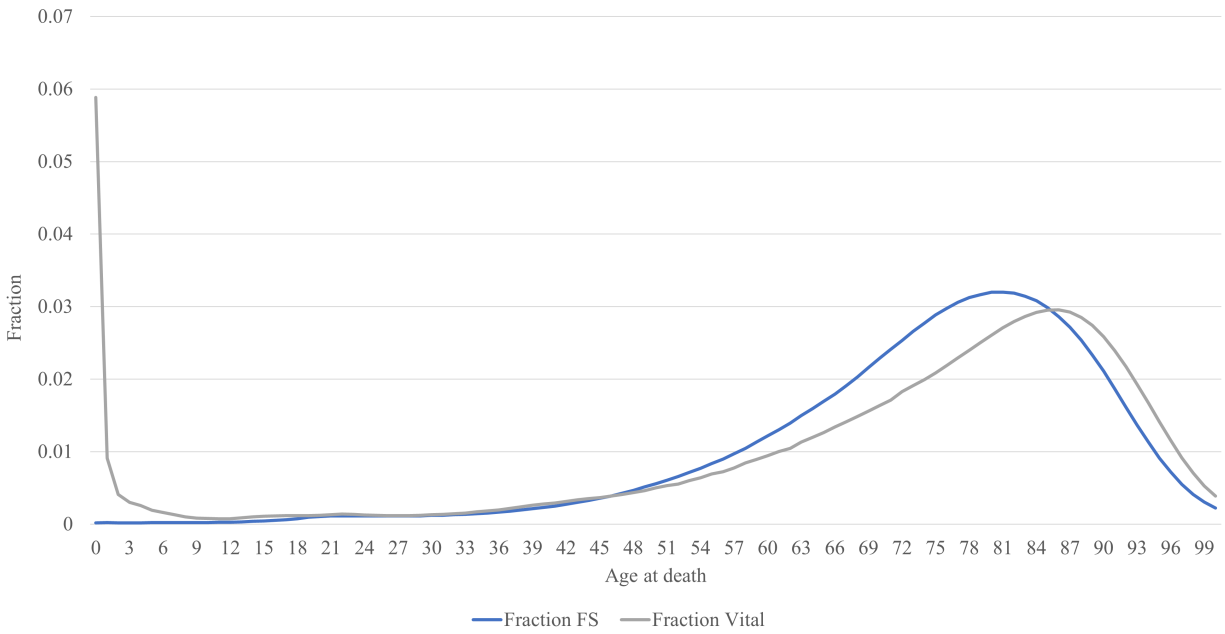
Notes: White lines represent the limits of the counties and states in 1930. Counties are colored in green scale to depict the level of match rates for the linkage from the white native population in the 1930 Census to their FamilySearch deaths.

Figure A.3: Age Distribution in the 1930 Census Sample and the FamilySearch Linked Sample



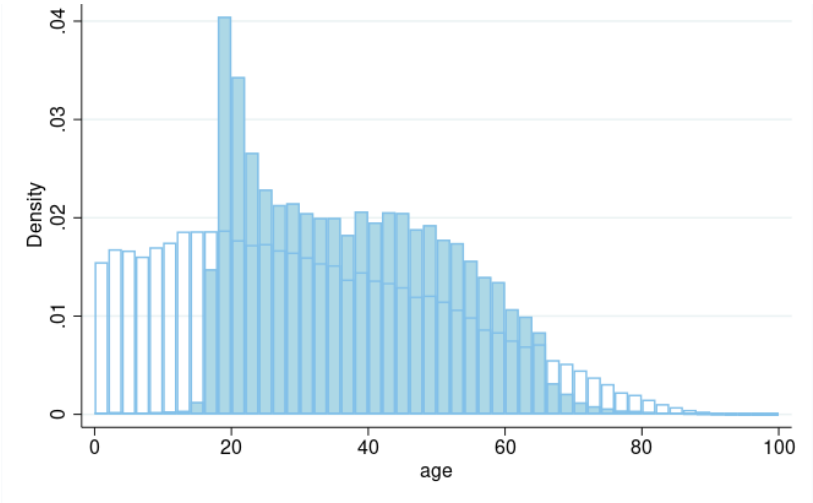
Notes: The histogram presents the distribution of age in 1930 of the two samples of interest: the white native US population in the 1930 Census in grey and our linked sample to FamilySearch deaths in blue.

Figure A.4: Distribution of the Age of Death for the 1930 Cohort Using Our Linked Sample and the Vital Statistics Data



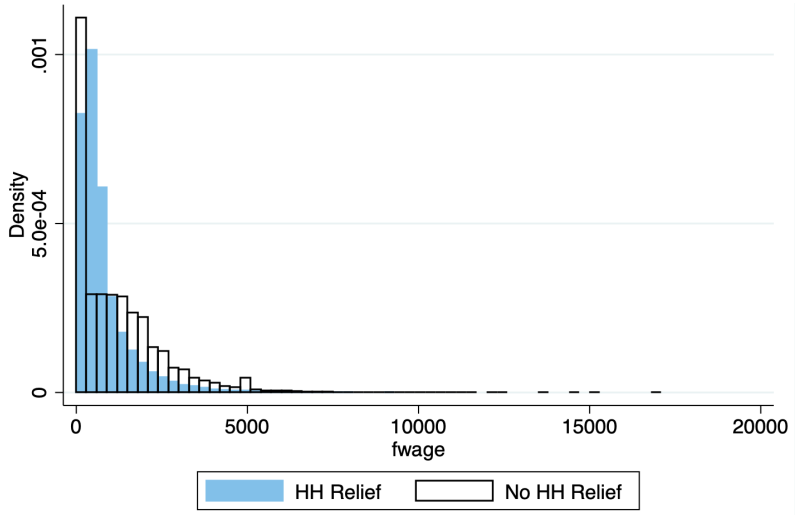
Note: The graph presents the distribution of the age at death for individuals born in 1930. The blue line represents the fraction of deaths at each age in our 1930 Census sample linked to FamilySearch deaths. The grey line represents the fraction of deaths from Social Security Life Tables.Since some individuals born in 1930 are missing form our sample, in blue we report the fraction of deaths for the 1929 cohort.

Figure A.5: Age Distribution of the Relief Recipients in the 1940 Census



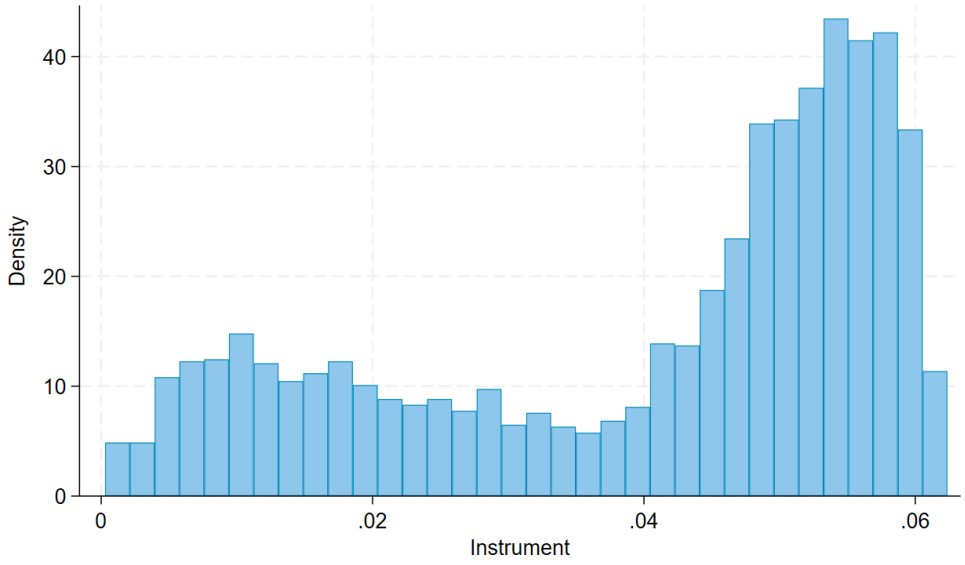
Note: In blue, we present the age distribution in 1940 of relief receivers and in white for non-receivers. The sample includes the population in the 1940 US full-count Census.

Figure A.6: Family Wage Distribution of the relief Recipients in the 1940 Census



Note: In blue, we present the family wage distribution in 1940 of households that had at least one relief recipient in 1940 and in white for households that had no relief recipients. The sample includes 1% of the population in the 1940 US Census from IPUMS.

Figure A.7: Distribution of the Voting Culture Exploitability Instrument



Notes: The histogram presents the distribution of the voting culture exploitability instrument.

Table A.1: Households Receiving and Non-Receiving Relief in 1940

	HH no relief (1)	HH Relief (2)	Difference (3)
Male	0.500	0.521	0.0211***
White	0.902	0.872	-0.0304***
Black	0.094	0.122	0.028***
Spouse	0.436	0.357	-0.0786***
Children	0.340	0.332	-0.0073***
Farm HH	0.235	0.193	-0.0414***
Urban pop.	3376.255	2849.551	-526.704
Owner	0.450	0.335	-0.1141***
Family Wage	1262.914	1163.712	-99.2026
Family Size	4.277	5.298	1.0211***
Income	456.039	270.420	-185.6187
Same Country	0.868	0.905	0.0364***
Urban pop.	1.557	1.538	-0.0187***
Foreign Born	0.092	0.065	-0.0266***
New England	0.064	0.068	0.0038***
Middle Atlantic	0.212	0.177	-0.0344***
East North Central	0.201	0.222	0.0211***
West North Central	0.102	0.111	0.0094***
South Atlantic	0.136	0.131	-0.0043***
East South Central	0.081	0.087	0.0055***
West South Central	0.099	0.102	0.0033***
Mountain	0.031	0.043	0.0127***
Pacific	0.075	0.058	-0.0171***
Observations	121,670,326	10,233,584	131,903,910

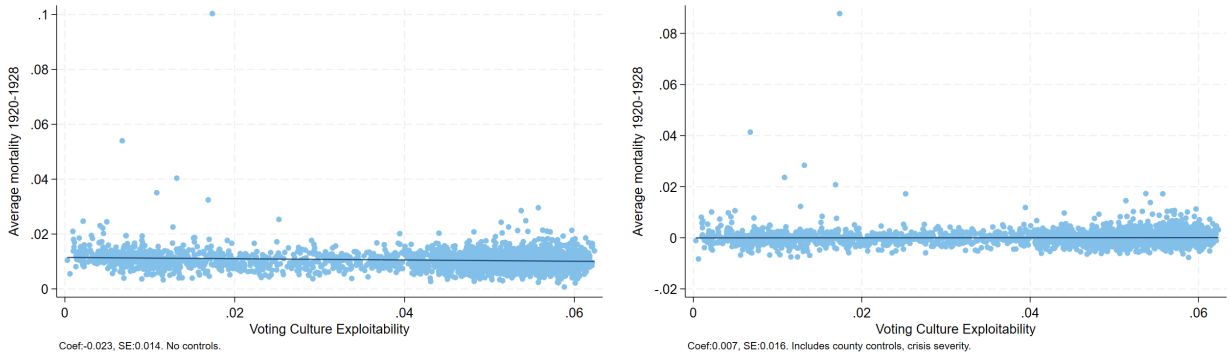
Notes: The table compares the means of individuals' characteristics in households receiving and non-receiving relief in the US full-count Census. The sample in column (1) includes all individuals in the US full-count 1940 Census in households with no individuals receiving relief. The sample in column (2) includes all individuals in the US full-count 1940 Census in households with someone receiving relief. Column (3) reports the differences in means. We classify individuals as receiving relief if they answer yes to the 1940 Census question asking "Was the person at work on, or assigned to, public Emergency Work (WPA, NYA,CCC, etc.) during the week of March 24-30?" 10\%*, 5\%**, 1\%***.

Table A.2: County-level First Stage: Voting Culture Exploitability Instrument and New Deal Relief

Dep. Var: Log(Relief pc)	(1)	(2)	(3)
Voting Culture Instrument	9.236***	6.043***	5.050***
	(0.889)	(0.933)	(0.925)
Severity Index	0.164***	0.114***	0.121***
	(0.008)	(0.008)	(0.008)
Constant	5.118***	5.614***	5.795***
	(0.261)	(0.291)	(0.320)
County Controls		x	x
Average of individual covariates			x
Observations	2,983	2,961	2,961
R-squared	0.455	0.551	0.568
F-Test	108	41.99	29.79

Note: The sample includes all counties for which we have all variables of interest. The dependent variable is an indicator whether the individual was linked to their FamilySearch death. The regression includes cohort and state of birth fixed effects. Standard errors are clustered at county level. All specifications include state fixed effects. Robust standard errors in parentheses. 10\%*, 5\%**, 1\%***

Figure A.8: Relationship of Average Mortality Rates 1920-1928 and Voting Culture Instrument



(a) Without Controls **(b)** With Controls

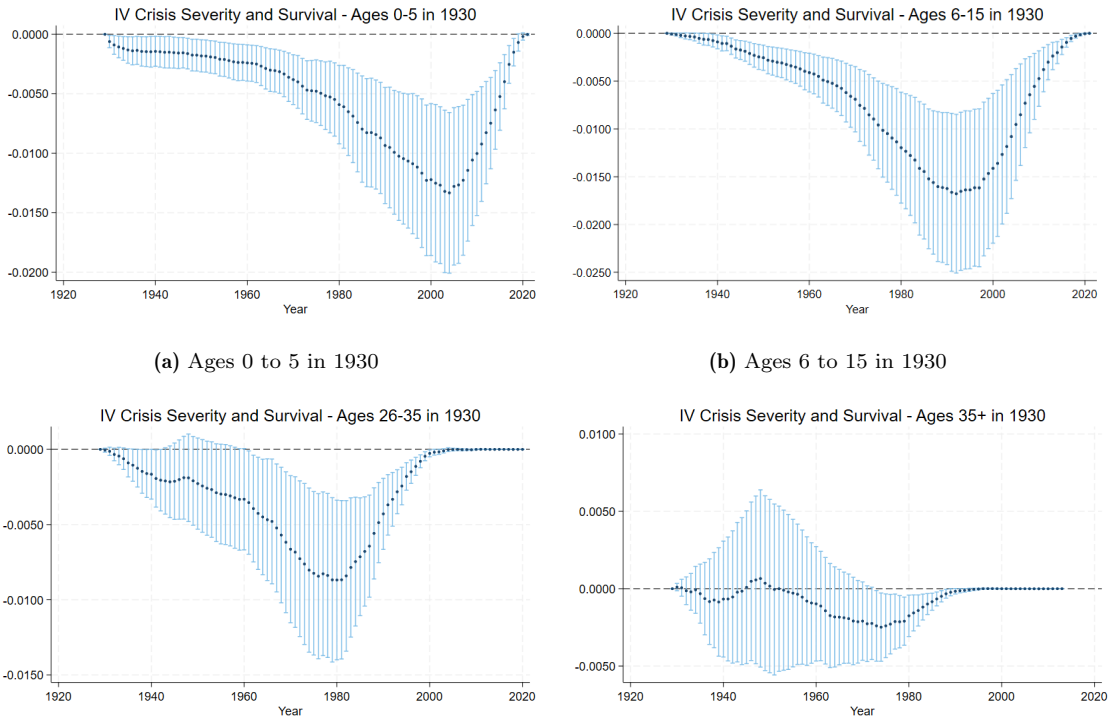
Notes: The graphs plot the county-level relationship between the voting culture exploitability instrument and average mortality from 1920 to 1928. Figure A shows the relationship without controls and Figure B shows the residualized version that account for the severity of the crisis and county-level controls selected by LASSO. We report the coefficient and standard errors for the estimates of the effects of the instrument on average mortality rates.

Table A.3: OLS estimates of the Great Depression and the New Deal on Longevity by Gender

	Men			Women		
Dep. Var. Log (Age at death)	(1)	(2)	(3)	(4)	(5)	(6)
Log (Relief per capita $)	-0.0049***	-0.0017***	-0.0018***	-0.0027***	-0.0008	-0.0008*
	(0.0007)	(0.0006)	(0.0006)	(0.0006)	(0.0005)	(0.0005)
Severity Index	-0.0030***	-0.0016***	-0.0014***	-0.0028***	-0.0018***	-0.0017***
	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0003)	(0.0003)
Constant	4.9672***	4.9343***	4.1177***	4.8262***	4.2661***	4.2483
	(0.0247)	(0.0269)	(0.0100)	(0.0029)	(1.3061)	-1.6152
County Controls		x	x		x	x
Individual Covariates			x			x
Observations	14,409,631	14,366,330	14,366,330	12,098,702	12,062,887	12,062,887
R-squared	0.0474	0.0482	0.0490	0.0159	0.0162	0.0162

Notes: The sample in the first three columns (1-3) include all white, native, men in the 1930 US Census linked to their FamilySearch deaths. The sample in the last three columns (4-6) include all white, native, women in the 1930 US Census linked to their FamilySearch deaths. All specifications include state of birth and cohort fixed effects. Standard errors are clustered at the county level. 10\%*, 5\%**, 1\%***

Figure A.9: IV Estimates of the Effects of the Great Depression on Survival



(a) Ages 0 to 5 in 1930

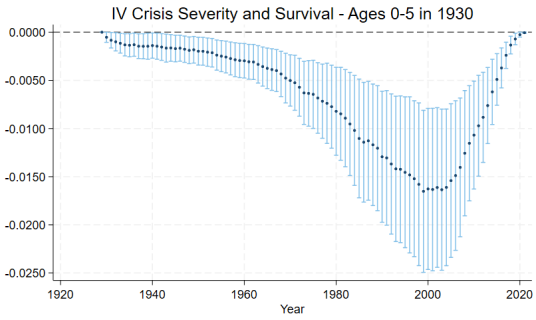
(b) Ages 6 to 15 in 1930

(c) Ages 26 to 35 in 1930

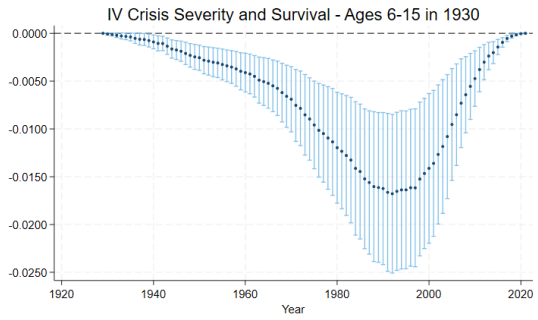
(d) Ages over 35 in 1930

Notes: The figures present IV coefficients and 95% confidence intervals, of the effects of crisis severity on survival from 1933 to 2020 for different groups of birth cohorts. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

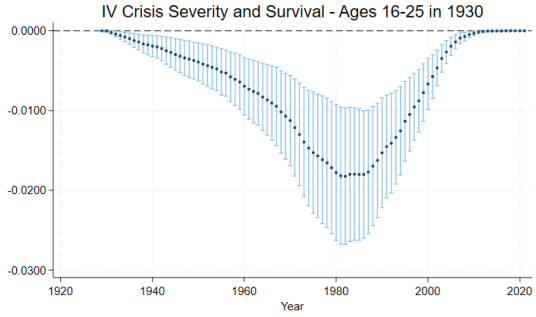
Figure A.10: IV Estimates of the Effects of the Great Depression on Survival for Men



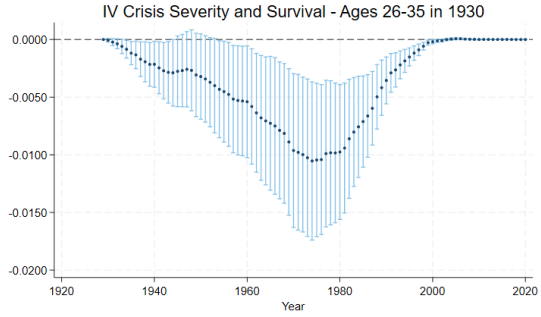
(a) Ages 0 to 5 in 1930



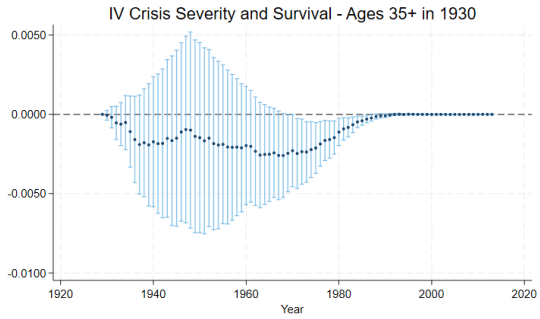
(b) Ages 6 to 15 in 1930



(c) Ages 16 to 25 in 1930



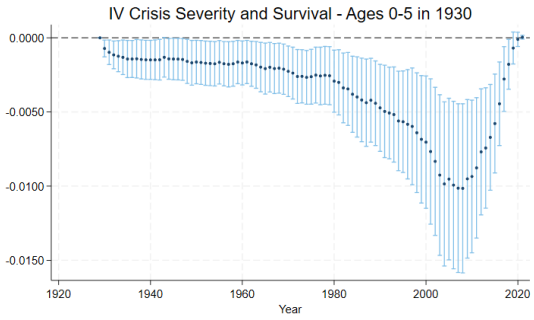
(d) Ages 26 to 35 in 1930



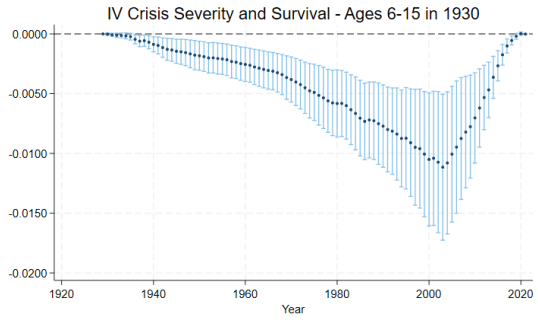
(e) Ages over 35 in 1930

Notes: The figures present IV coefficients and 95% confidence intervals of the effects of the severity of the Great Depression on survival from 1933 to 2020 for men of different ages in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

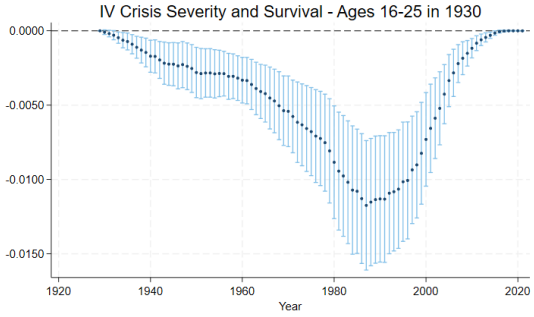
Figure A.11: IV Estimates of the Effects of the Great Depression on Survival for Women



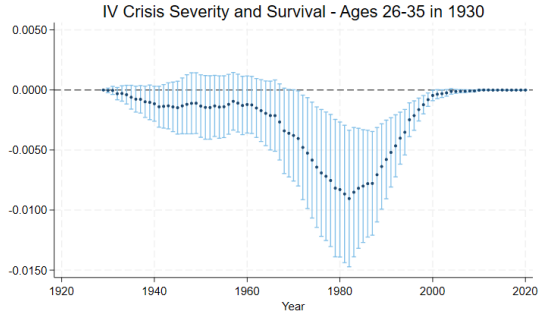
(a) Ages 0 to 5 in 1930



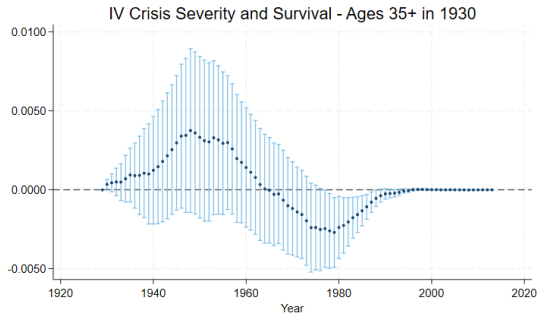
(b) Ages 6 to 15 in 1930



(c) Ages 16 to 25 in 1930



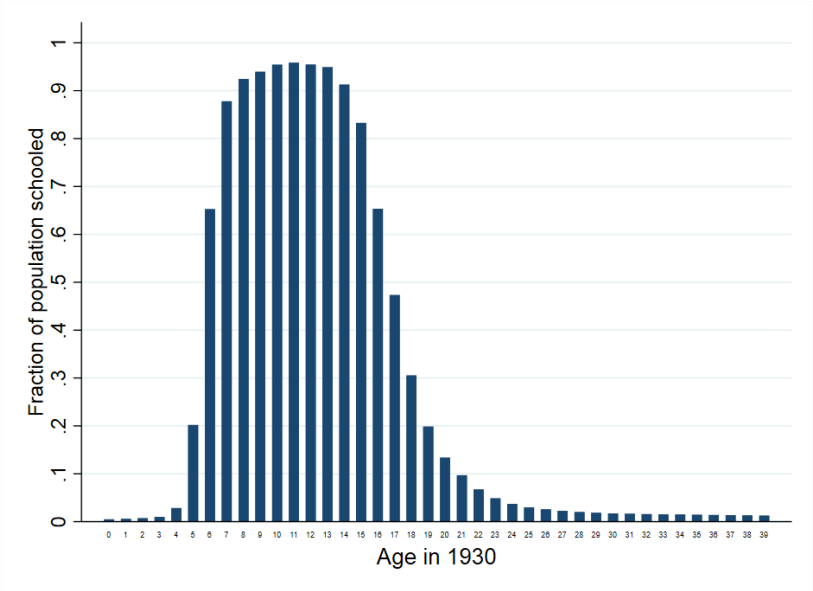
(d) Ages 26 to 35 in 1930



(e) Ages over 35 in 1930

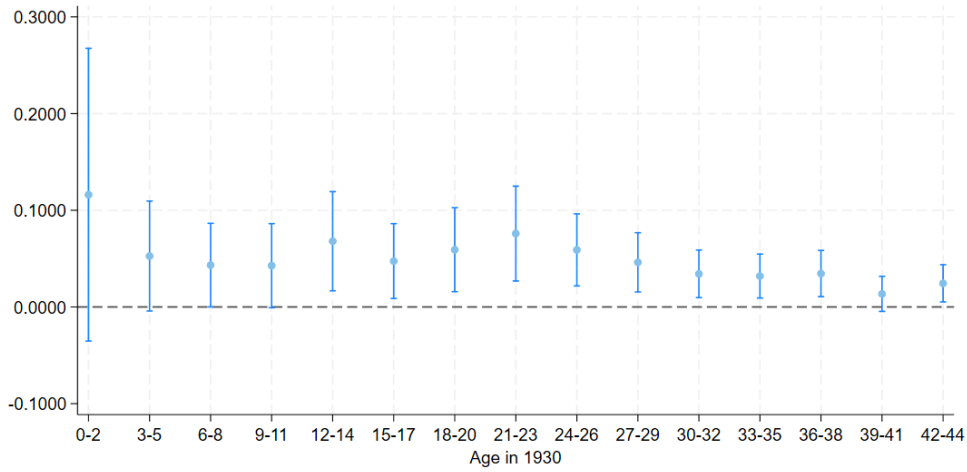
Notes: The figures present IV coefficients and 95% confident intervals, of the effects of the severity of the Great Depression on survival from 1933 to 2020 for women of different ages in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

Figure A.12: Fraction of Individuals in School in the 1930 Census by Age



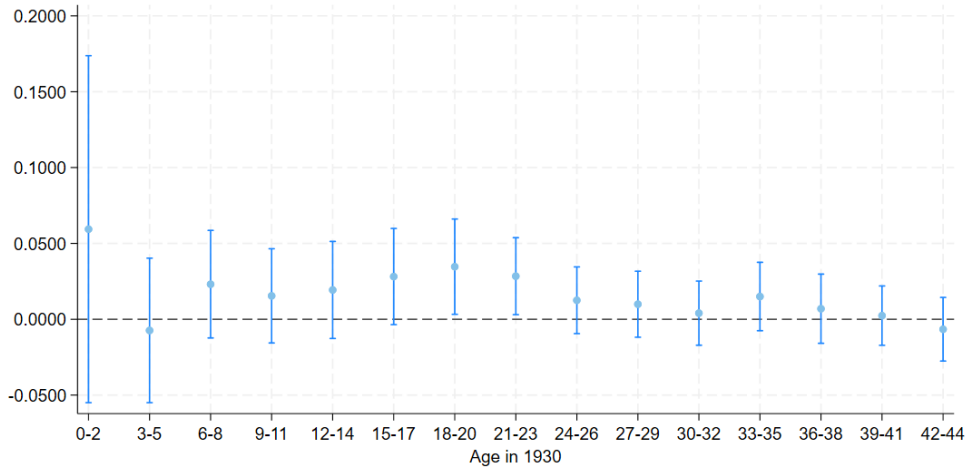
Notes: The sample includes all individuals in the 1930 full-count US Census.

Figure A.13: IV Estimates of the New Deal Relief on Longevity by Cohort for Men



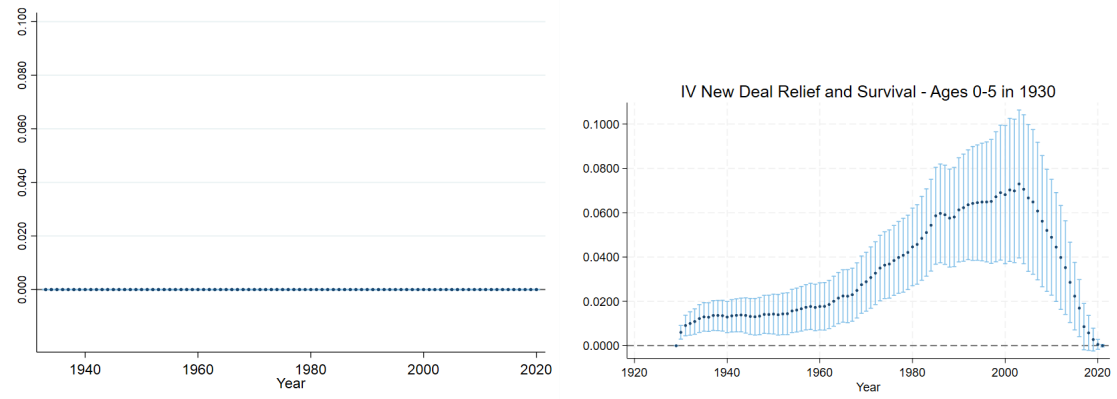
Notes: The figure presents IV estimates and 95% confidence intervals of the post-IV-LASSO regression of the effect of New Deal relief on longevity by cohort. The regression accounts for the severity of the crisis and includes the county controls selected by LASSO and individual covariates from the 1930 Census. All specifications include state of birth and cohort fixed effects. Standard errors are clustered at county level. The sample includes all white native men in the 1930 Census aged 0-44 in 1930 linked to their FamilySearch deaths.

Figure A.14: IV Estimates of the New Deal Relief on Longevity by Cohort for Women



Notes: The figure presents IV estimates and 95% confidence intervals of the post-IV-LASSO regression of the effects of New Deal Relief on Longevity by cohort. The regression accounts for the severity of the crisis and includes the county controls selected by LASSO and individual covariates from the 1930 Census. All specifications include state of birth and cohort fixed effects. Standard errors are clustered at county level. The sample includes all white native women in the 1930 Census aged 0-44 in 1930 linked to their FamilySearch deaths.

Figure A.15: The Effects of New Deal Relief on Survival for Cohort 0-5

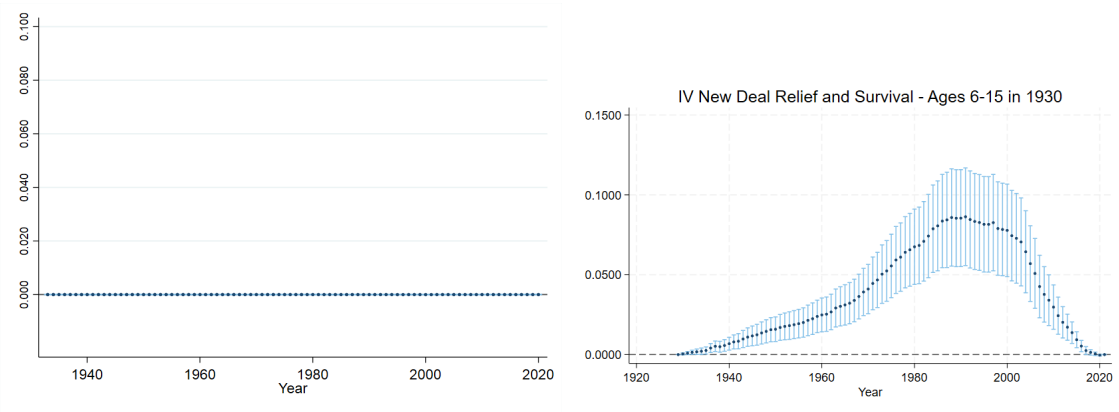


(a) OLS Estimates

(b) IV estimates

Notes: The figures present the OLS (a), IV coefficients (b), and 95% confidence intervals of the effects of New Deal relief on survival from 1933 to 2020 for the cohort aged 0 to 5 in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

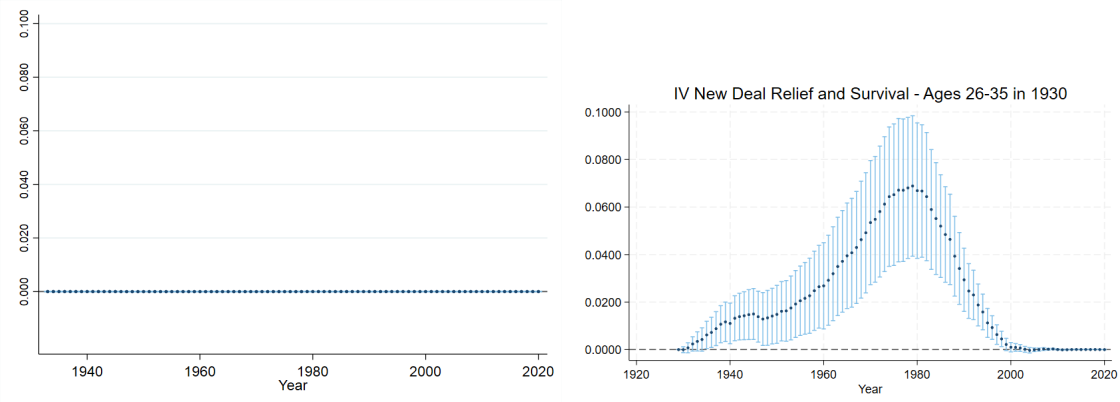
Figure A.16: The Effects of New Deal Relief on Survival for Cohorts 6-15



(a) OLS Estimates **(b)** IV estimates

Notes: The figures present the OLS (a), IV coefficients (b), and 95% confidence intervals of the effects of New Deal relief on survival from 1933 to 2020 for cohort aged 6 to 15 in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

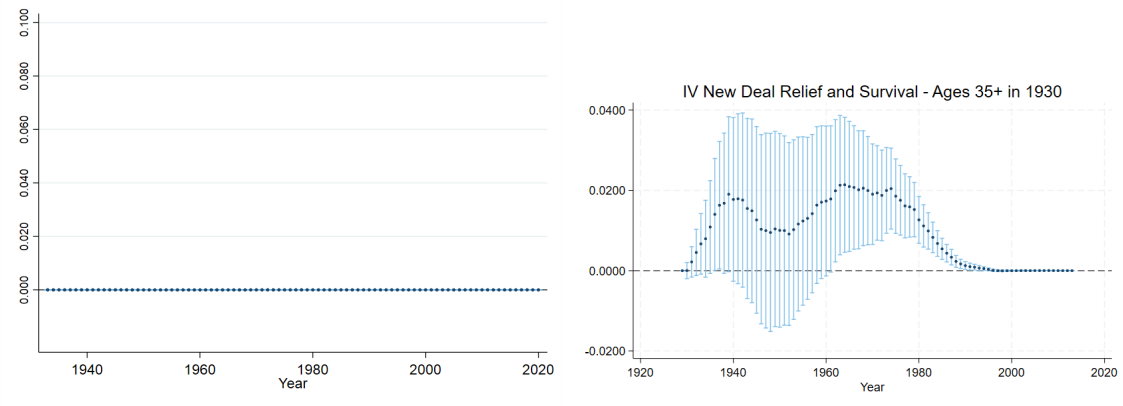
Figure A.17: The Effects of New Deal Relief on Survival for Cohort 26-35



(a) OLS Estimates **(b)** IV estimates

Notes: The figures present the OLS (a), IV coefficients (b), and 95% confidence intervals of the effects of New Deal relief on survival from 1933 to 2020 for cohort aged 26 to 35 in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

Figure A.18: The Effects of New Deal Relief on Survival for Cohort +35



(a) OLS Estimates **(b)** IV estimates

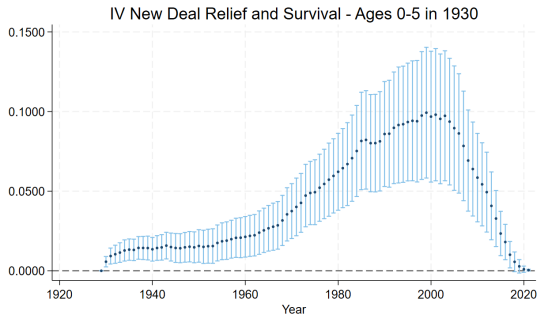
Notes: The figures present the OLS (a), IV coefficients (b, and 95% confidence intervals, of the effects of New Deal relief on survival from 1933 to 2020 for cohort aged over 35 in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

Table A.4: IV Estimates of the Effects of the Great Depression and the New Deal on Longevity by Cohort

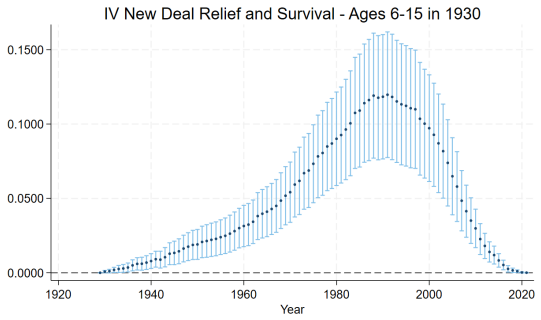
Dep. Var: Log(Age at death)	(1) 0-10	(2) 10-20	(3) 20-30	(4) 30-40	(5) 40+
Log (Relief pc)	0.0448**	0.0379***	0.0408***	0.0198**	0.0059
	(0.0226)	(0.0143)	(0.0124)	(0.0088)	(0.0064)
Severity Index	-0.0066**	-0.0058***	-0.0057***	-0.0023	0.0002
	(0.0027)	(0.0017)	(0.0016)	(0.0015)	(0.0011)
Constant	3.8943***	4.0580***	4.0592***	4.1534***	3.9801***
	(0.1293)	(0.0820)	(0.0718)	(0.0506)	(0.0376)
Observations	8,078,387	8,981,949	6,963,619	6,558,480	11,455,456
R-squared	0.0201	0.0308	0.0315	0.0340	0.0829
Average Longevity	71.24	74.1	73.8	73.63	75.99
Magnitud effect severity	-5.6	-5.2	-5	-2	-0.2
Magnitud effect relief	23.8	20.9	22.4	10.9	3.3

Notes: The sample includes all white native individuals in the 1930 Census linked to their FamilySearch deaths who survived to age 20. All specifications include county controls selected by LASSO, individual covariates from the 1930 Census, and state of birth and cohort fixed effects. Standard errors are clustered at county level. Magnitudes correspond to changes in longevity in months for a standard-deviation increase in severity and relief, respectively. 10\textbackslash\%*, 5\textbackslash\%**, 1\textbackslash\%***.

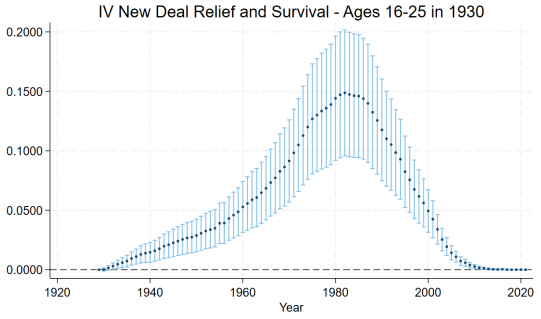
Figure A.19: IV Estimates of the Effects of New Deal Relief on Survival for Men



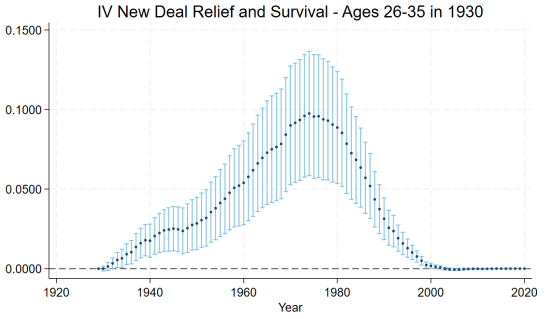
(a) Ages 0 to 5 in 1930



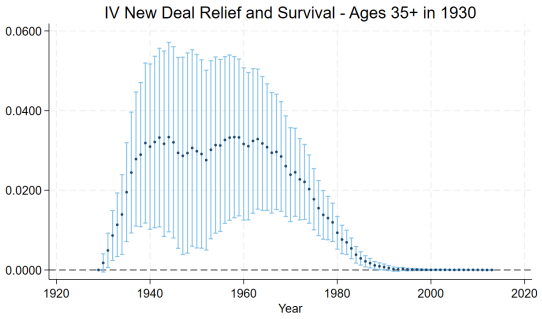
(b) Ages 6 to 15 in 1930



(c) Ages 16 to 25 in 1930



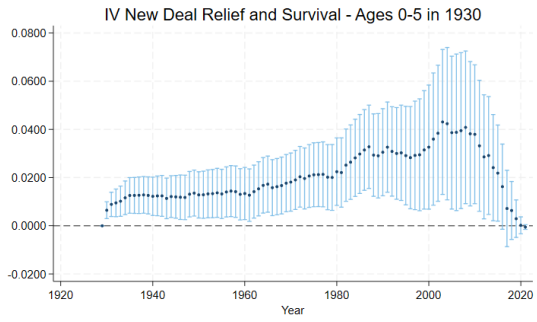
(d) Ages 26 to 35 in 1930



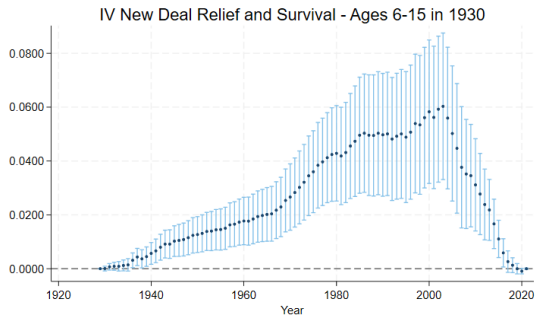
(e) Ages over 35 in 1930

Notes: The figures present IV coefficients and 95% confidence intervals of the effects of New Deal relief on survival from 1933 to 2020 for men of different ages in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute the confidence intervals are clustered at county level.

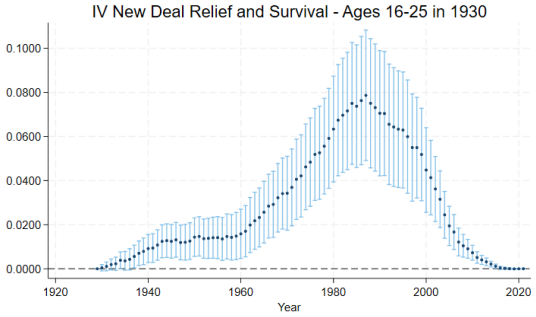
Figure A.20: IV Estimates of the Effects of New Deal Relief on Survival for Women



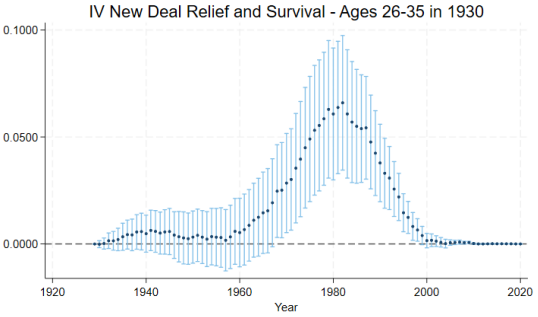
(a) Ages 0 to 5 in 1930



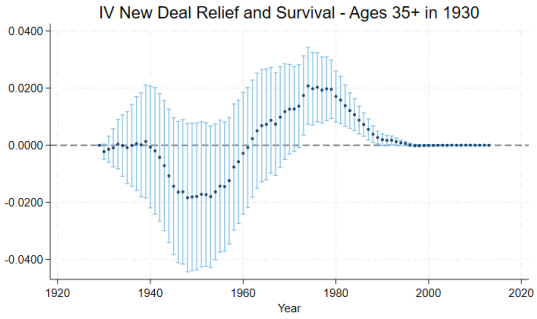
(b) Ages 6 to 15 in 1930



(c) Ages 16 to 25 in 1930



(d) Ages 26 to 35 in 1930



(e) Ages over 35 in 1930

Notes: The figures present IV coefficients and 95% confidence intervals of the effects of New Deal relief on survival from 1933 to 2020 for women of different ages in 1930. Regressions include county controls, individual covariates, and state of birth and cohort fixed effects. Standard errors used to compute confidence intervals are clustered at county level.

Table A.5: IV Estimates of the Effects of the Great Depression and the New Deal on Longevity by 1930 Occupation Score

Dep. Var. Log(Age at death)	(1) Lower quartile	(2) Upper quartile
Log(Relief pc.)	0.0231***	0.0140*
	(0.0073)	(0.0078)
Severity Index	-0.0029***	-0.0026**
	(0.0010)	(0.0010)
Constant	3.9560***	4.1068***
	(0.0483)	(0.0708)
Observations	3,761,723	2,863,020
R-squared	0.05	0.05
Mean Longevity	74.14	
72.3		
Effect severity (months)	-2.5	
-2.2		
Effect relief (months)	13.3	5.5

Notes: The sample includes all white native individuals in the 1930 Census linked to their FamilySearch deaths which are in the first or last quartile for occupation score in 1930. We restrict our classification to individuals with a positive occupation score. All specifications include county controls selected by LASSO, individual covariates from the 1930 Census, and state of birth and cohort fixed effects. Standard errors are clustered at county level. 10%*, 5%**, 1%***.

Table A.6: IV Estimates of the Effects of the Great Depression and the New Deal on Longevity by Gender and 1930 Marital Status

	Men		Women	
IV Estimates	(1)	(2)	(3)	(4)
Dep. Var: Log(Age at death)	Married	Single	Married	Single
Log(Relief pc)	0.024264***	0.058848***	0.004626	0.019597*
	(0.007355)	(0.020695)	(0.006918)	(0.011275)
Severity Index	-0.002449*	-0.007711***	-0.000764	-0.003607***
	(0.001341)	(0.002510)	(0.001050)	(0.001298)
Constant	4.758946***	3.744087***	5.803384***	4.029120***
	(0.492254)	(0.124867)	(0.476105)	(0.067855)
Observations	10,544,933	12,195,667	9,587,756	9,709,535
R-squared	0.058158	0.017894	0.009728	0.024387

Notes: The sample includes all white native men in the 1930 Census linked to their FamilySearch deaths. All specifications include county controls selected by LASSO, individual covariates from the 1930 Census, and state of birth and cohort fixed effects. Standard errors are clustered at county level. 10\%*, 5\%**, 1\%***.

Table A.7: IV Estimates of the Effects of the Great Depression and the New Deal on Longevity by Men Movers between 1930 and 1940

Dep. Var: Log(Age at death)	(1) Movers	(2) Non Movers
Log(Relief pc)	0.025743***	0.035143***
	(0.006594)	(0.010757)
Severity Index	-0.002878***	-0.005415***
	(0.000794)	(0.001463)
Constant	4.013205***	3.972294***
	(0.039534)	(0.064265)
Observations	3,793,399	13,646,355
R-squared	0.033002	0.051030

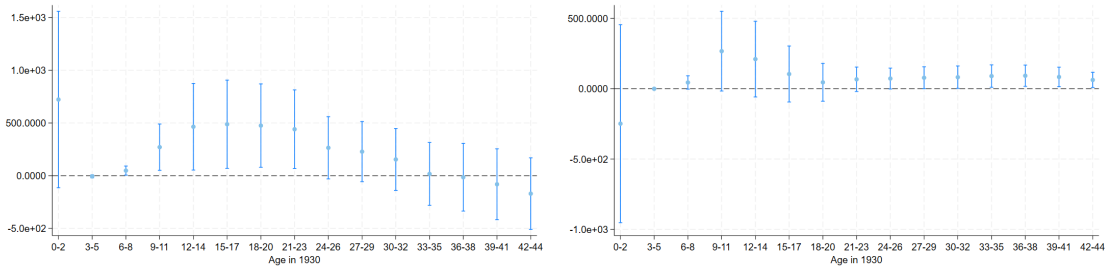
Notes: The sample includes all white native men in the 1930 Census linked to their FamilySearch deaths. All specifications include county controls selected by LASSO, individual covariates from the 1930 Census, and state of birth and cohort fixed effects. Standard errors are clustered at county level. 10\%*, 5\%**, 1\%***.

Table A.8: IV Estimates of the Effects of New Deal Relief on 1940 Outcomes for Men

Dep. Variable	(1) Income	(2) Employed	(3) In labor force	(4) Education	(5) Married	(6) Divorced	(7) Widowed	(8) Moved counties
Relief per capita	0.010125	-0.000107*	-0.000083*	0.002148	-0.000010	0.000067***	-0.000006	-0.000180
	(0.385166)	(0.000063)	(0.000050)	(0.001531)	(0.000028)	(0.000025)	(0.000010)	(0.000244)
Severity Index	-13.818007*	-0.005589***	0.000305	-0.051245	0.000964*	-0.001246**	-0.000024	0.022392***
	(7.511056)	(0.001497)	(0.001149)	(0.031384)	(0.000579)	(0.000499)	(0.000218)	(0.004771)
Constant	223.393604**	0.020525	0.012479	4.045916***	0.021537***	-0.011931***	-0.002047	0.360853***
	(86.853466)	(0.013525)	(0.010645)	(0.326174)	(0.005854)	(0.004373)	(0.002070)	(0.045534)
Observations	10,289,961	11,695,703	11,695,703	11,455,826	11,695,703	11,695,703	11,695,703	11,695,703
R-squared	0.229248	0.388440	0.492030	0.216850	0.563451	0.000066	0.101677	0.037490
Outcome Mean	497.33	0.5	0.54	9	0.72	0.01	0.04	0.21
Effect severity	-2.8%	-1.12%	0.01%	-0.5%	0.13%	-12.46%	-0.06%	10.7%
Effect relief	0.28%%	-3%	2.15%	3.3%	-0.2%	94%	-2.1%	-12%

Notes: The sample includes all white native men in the 1930 Census linked to their FamilySearch deaths and to the 1940 Census. For column 1, the sample is smaller because fewer individuals report information on their income. The table presents second-stage IV estimates for the effects of New Deal relief on different outcomes from the 1940 Census. The variable Education is expressed in years. All specifications include county controls selected by LASSO, individual covariates from the 1930 Census, and state of birth and cohort fixed effects. Standard errors are clustered at county level. The effects are expressed for a one-standard-deviation increase in severity and relief. 10\%*, 5\%**, 1\%***.

Figure A.21: The IV Estimates of New Deal Relief on 1940 Income Wage by Gender



(a) Men **(b)** Women

Notes: The figures present IV estimates and 95% confidence intervals of the post-IV-LASSO regression of New Deal relief on 1940 income wage by cohorts for men and women. All specifications account for the severity of the crisis and include the county controls selected by LASSO and individual covariates from the 1930 Census. All specifications include state of birth and cohort fixed effects. Standard errors are clustered at county level. The sample in Figure a (b) includes all white native men (women) in the 1930 Census aged 0-44 in 1930 linked to their FamilySearch deaths and to the 1940 Census.

Table A.9: OLS estimates of the Effects of the New Deal and the Great Depression on Longevity at County Level

	Everyone	Men	Women
Dep. Var: Log(Age at death)	(1)	(2)	(3)
Log(Relief pc)	0.001260**	0.001973	0.002458**
	(0.000495)	(0.001455)	(0.001100)
Severity Index	0.000345	0.000129	-0.000144
	(0.000245)	(0.000756)	(0.000578)
Constant	4.333828***	4.199061***	4.332166***
	(0.010025)	(0.015269)	(0.013244)
Observations	2,975	2,975	2,975
R-squared	0.533626	0.513859	0.315212

Notes: The sample includes data on all white native individuals in the 1930 US Census linked to their FamilySearch deaths summarized at county level. Columns (2) and (3) include data for men and women, respectively. In all specifications, the dependent variable is the logarithm of the average age at death at county level. All specifications include county controls and individual covariates. Individual covariates are the averages at county level. Robust standard errors reported in parentheses. 10\%*, 5\%**, 1\%***.

Table A.10: IV Estimates for the Effects of New Deal Relief on Longevity at County Level

	Everyone		Men		Women	
	(1)	(2)	(3)	(4)	(5)	(6)
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
Dep. var	log(Relief pc)	log(age at death)	log(Relief pc)	log(age at death)	log(Relief pc)	log(age at death)
Log(Relief pc.)		0.029485***		0.053086***		0.014490***
		(0.004903)		(0.010325)		(0.003431)
Severity Index	0.143651***	-0.004234***	0.150203***	-0.007767***	0.138566***	-0.002281***
	(0.011688)	(0.000777)	(0.011758)	(0.001602)	(0.011726)	(0.000536)
sd_p32sd_cong28	6.164662***		4.983253***		6.984999***	
	(0.840376)		(0.922581)		(0.807156)	
Constant	4.860752***	4.207854***	5.876344***	3.888071***	5.982542***	4.230662***
	(0.829600)	(0.031752)	(0.143130)	(0.064482)	(0.143834)	(0.023161)
Observations	2,976	2,976	2,976	2,976	2,975	2,975
R-squared		-0.155691		-0.917385		0.147320

Notes: The sample includes data on all white native individuals in the 1930 US Census linked to their FamilySearch deaths summarized at county level. Columns (2) and (3) include data for men and women, respectively. In all specifications, the dependent variable is the logarithm of the average age at death at county level. All specifications include county controls and individual covariates. Individual covariates are the averages at county level. Robust standard errors reported in parentheses. 10\%*, 5%**, 1\%***.

Table A.11: IV Estimates for the Effects of New Deal Relief on Longevity Using Levels

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var:	Relief pc.	Age at death	Relief pc.	Age at death	Relief pc.	Age at death
Relief per Capita		0.0086**		0.0128**		0.0041
		(0.0041)		(0.0058)		(0.0027)
Severity Index	21.5473***	-0.2597**	20.8218***	-0.3527**	22.4303***	-0.1614**
	(7.5048)	(0.1117)	(7.5246)	(0.1520)	(7.4784)	(0.0758)
Instrument	826.2297**		829.5779**		822.2019**	
	(353.8956)		(357.3918)		(350.6472)	
Constant	322.1291***	66.5195***	324.8441***	60.3494***	319.4350***	67.1974***
	(24.0075)	(1.4442)	(24.0721)	(2.0675)	(23.9897)	(0.9544)
Observations	42,045,971	42,045,971	22,745,039	22,745,039	19,300,932	19,300,932
R-squared		0.0502		0.0256		0.0190

Notes: The sample includes data on all white native individuals in the 1930 US Census linked to their FamilySearch deaths summarized at county level. Columns (2) and (3) include data for men and women, respectively. In all specifications, the dependent variable is the logarithm of the average age at death at county level. All specifications include county controls and individual covariates. Individual covariates are the averages at county level. Robust standard errors reported in parentheses. 10\%*, 5\%**, 1\%***.

Table A.12: IV Estimates for the Effects of New Deal Relief on Longevity for Individuals Who Survived to Age 20

	Everyone		Men		Women	
	(1)	(2)	(3)	(4)	(5)	(6)
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
Dep. Var	Relief pc.	Longevity	Relief pc.	Longevity	Relief pc.	Longevity
Relief pc.		0.0078**		0.0121**		0.0033
		(0.0038)		(0.0055)		(0.0024)
Severity Index	21.5214***	-0.2427**	20.7873***	-0.3372**	22.4138***	-0.1424**
	(7.5070)	(0.1028)	(7.5265)	(0.1434)	(7.4807)	(0.0668)
Voting culture Inst	827.2838**		830.8784**		822.9661**	
	(353.3083)		(356.8772)		(349.9799)	
Constant	322.3941***	70.1893***	325.1236***	63.9095***	319.6948***	71.0713***
	(23.9986)	(1.3341)	(24.0658)	(1.9588)	(23.9808)	(0.8509)
Observations	41,758,801	41,758,801	22,570,714	22,570,714	19,188,087	19,188,087
R-squared		0.0486		0.0215		0.0147

Notes: The sample includes all white native individuals in the 1930 US Census linked to their FamilySearch deaths who survived to age 20. All specifications include state of birth and cohort fixed effects. Standard errors are clustered at county level. 10%*, 5%**, 1%***.

B Data Appendix

Our analysis relies on linking data from several sources. We begin with the set of white, US-born people recorded in the 1930 full-count US Census (for reasons that are explained below). We link those individuals to 1) themselves in the 1940 full-count US census; and 2) their death year as recorded on FamilySearch. This appendix will describe our methods for obtaining and linking that data in order to create the datasets we used for our analysis. It will also describe match rate outcomes at several levels (including geographic breakdowns at the state and county levels) and discuss potential issues in our matching processes.

I. Linking individuals from the 1930 Census to the 1940 Census

IPUMS USA provides the high quality pre-cleaned full-count US Census datasets from which we obtain the majority of our useful variables, like a person's birth year and place of residence. Their full-count census datasets identify individuals within that census by a uniquely assigned HISTID. These HISTIDs are not consistent between census years; i.e. a person's HISTID in the 1930 census is not the same as their HISTID in the 1940 census.

We link people in our dataset from 1930 to 1940 using the Census Tree method (Price et al., 2021; Buckles et al., 2023) developed in part at the BYU Record Linking Lab (hereafter RLL). The newly-public project provides HISTID-based links across pairs of censuses and is one of the most representative sets of census links currently available, especially for linking women. The public availability of these links coupled with their position at the frontier of record linking make them a perfect fit for our research.

As described more fully in its documentation, the Census Tree uses genealogical data as training data to extrapolate extra inter-census links via supervised machine learning. As such, some links in the dataset are likely to be more reliable than others. If the Census Tree used a certain hand-matched link as training data and also suggested via machine learning that the same match is valid, we would trust such a link more than a link found (for example) only by imputing two other existing Census Tree links. One additional quirk of the Census Tree links is their inclusion of links found only in other well-known linking projects such as IPUMS' Multigenerational Longitudinal Panel (Helgertz et al., 2022). Happily, the datasets include a total of seven indicators for the sources of a given match, such as "XGB" (the ML algorithm used to construct the dataset) and "MLP" (IPUMS' Multigenerational Longitudinal Panel).

In an attempt to remove the most suspicious links from our cross-census analysis, we filter some of the 1930-1940 Census Tree links. If a link in those datasets is found by only

one of the seven methods, we exclude it from our analysis. In addition, if a link is found only by the two external sources included in the Census Tree (the MLP and the Census Linking Project), we exclude the link. We argue that these two filters grant us a reasonably robust set of links that makes the best use of the special properties inherent to the construction of the Census Tree, and they result in us matching 59.168% of our 1930 sample into 1940.

II. Linking individuals from the 1930 Census to their death information

We used the 1930 IPUMS census dataset as our base dataset for all linking. As described above, their datasets index individuals by HISTID. Because census records provide no information about a person's death, we need to link the individuals in that dataset to a different dataset that does provide death information. We use data from the public wiki-style Family Tree from FamilySearch.org as our source for that death information.

Like IPUMS, FamilySearch, one of the world's largest genealogical organizations, also maintains indexed versions of the full-count US Census datasets. In place of HISTIDs, they identify individuals by a uniquely assigned Archival Resource Key (hereafter ARK). Like HISTIDs, these ARKs are not consistent between census years. In addition, FamilySearch's Family Tree is built on ARKs, not HISTIDs, so we have to link our HISTID-based data to its corresponding ARK-based FamilySearch data in order to access the incredible death data contained on the tree. Examples of a matched HISTID and an ARK from 1940 are presented below:

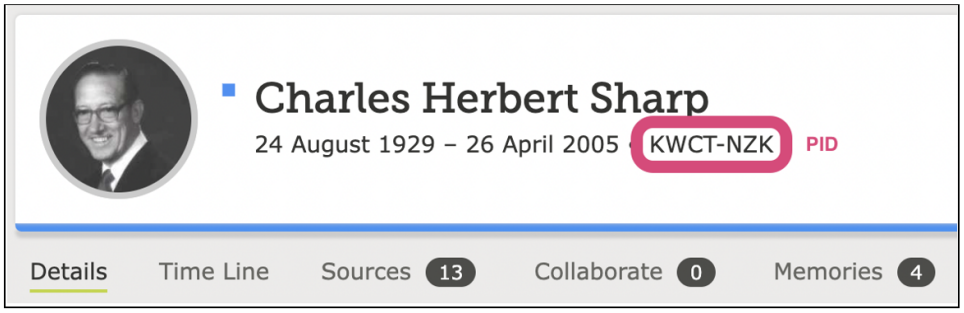
histid1940
00000256-F115-4E18-A124-D78C70F2C985

ark1940
VTWB-WZP

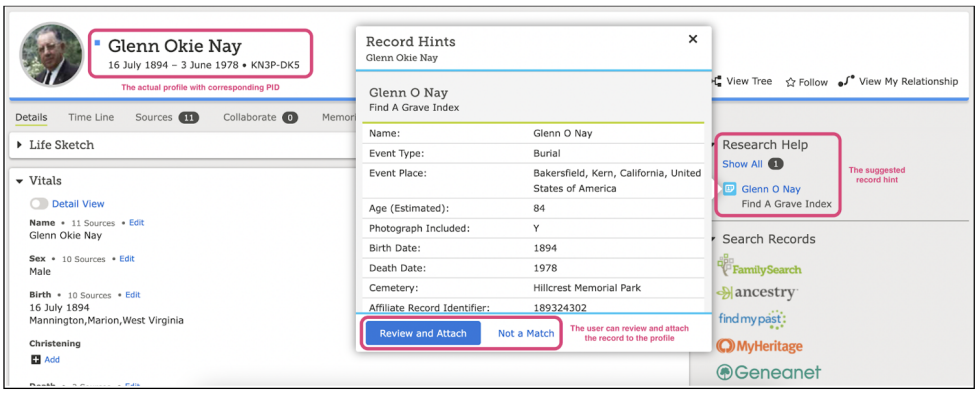
This process of linking from HISTID to ARK is not as easy in reality as it feels like it would be. Though the two datasets should ostensibly be identical indexes of identical images, this is far from the case. For example, FamilySearch is missing the entire 1930 census for Pickaway County, Ohio, making it impossible to link the $\tilde{2}$7,000 HISTIDs belonging to the people in that county to their ARK correspondents, as those ARKs are not presently available to anyone. As such, it is also impossible to link those people to their death data as recorded on the Family Tree. Though this issue is isolated (Pickaway, OH is the only county with this issue), it is illustrative of the difficulty of linking historical records even among copies of themselves. To further complicate matters, linking from HISTID to ARK is not even the final linking step necessary to obtain death data from the Family Tree.

As described above, FamilySearch indexes their census records at the individual level by

ARK. Those indexed records are made available to the public on FamilySearch.org, where users are encouraged to contribute to a shared Family Tree. The tree itself is not composed of ARKs, but of individual profiles assigned uniquely to a deceased individual. Those profiles are created by the deceased's descendants, and each profile is uniquely assigned a PersonID, or PID. An example profile is presented below, with its PID highlighted:



Users search FamilySearch's indexed records (identified by ARKs) and attach information from matching records to a given profile's PID. FamilySearch's record matching algorithms also frequently suggest potential record matches on a given person's profile, allowing users to find and verify potential record matches with minimal effort. An example of one such record "hint" is presented below:



Importantly, the records (ARKs) that a user might attach to a given profile (PID) can include both death records and census records, giving us an extremely reliable set of links from people's entries in census records to their death information.

We therefore have a path to link people in our 1930 IPUMS dataset to reliable death information. Doing so involves three distinct linking steps:

1. Use a HISTID-ARK crosswalk developed by the RLL to link the 1930 IPUMS data to the 1930 FamilySearch data (HISTID1930 → ARK1930).

2. Use a list of census ARKs that are either already attached to or likely to match with existing PIDs on the Family Tree to link the 1930 FamilySearch data to those people's profiles on the Family Tree (ARK1930 → PID).

3. Pull the death year information recorded on the public profiles of each of the matched PIDs from said PIDs and incorporate it into our dataset (PID → Death Year).

Those three steps result in a linking process that uses RLL crosswalks and a list of attached or likely-match ARK-PID sets from FamilySearch to go from HISTID1930 → ARK1930 → PID → Death Year, thereby linking many of the individuals in our 1930 IPUMS dataset to their respective death years.

Again, this process is not perfect; FamilySearch's user base has not historically been representative of the United States as a whole, so the set of people whose death information can be linked is likely to suffer from selection. Specifically, FamilySearch's primary user base is composed of members of The Church of Jesus Christ of Latter-day Saints, who are more likely to be of white European descent than the average person in the United States. Though projects like the African-American Families Project from the RLL are improving the representativeness of the Family Tree as a whole, our dataset still reflects some selection in favor of the ancestors of FamilySearch's users.

III. Overall match rates

No individual step in any of our matching processes ever matches 100% of the individuals it was meant to match, but this is not unexpected. The match rates from each step of the HISTID1930 → Death Year matching process and its overall match rate are presented below:

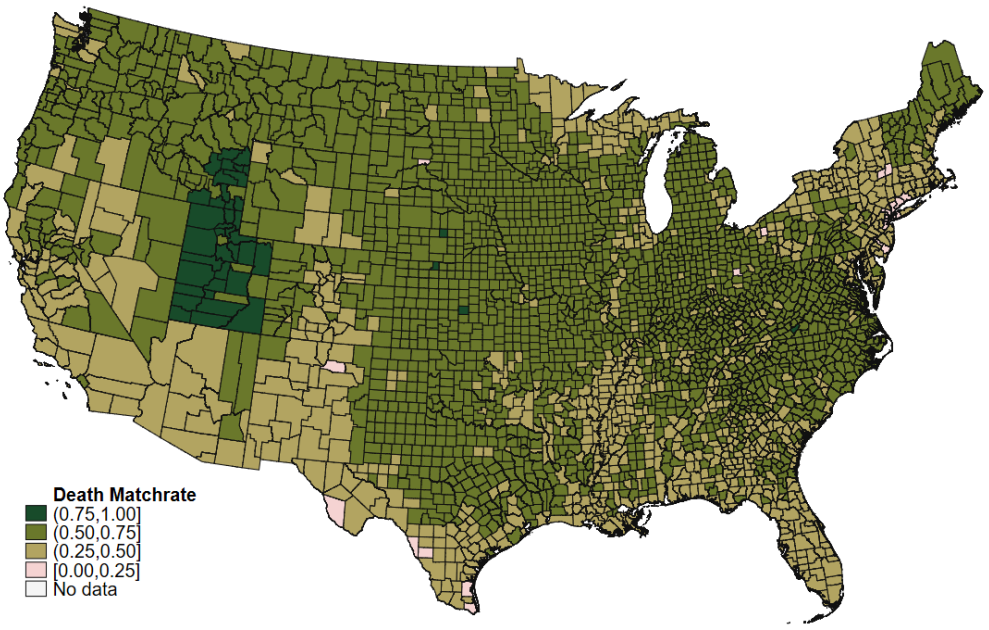
Step of HISTID1930 → Death Year Process	*Matching Success Rate*
HISTID1930 → ARK1930	99.536%
ARK1930 → PID	63.075%
PID → Death Year	71.385%
HISTID1930 → Death Year	**44.817%**

Each of the step match rates presented above is dependent on the step that precedes it; a person whose HISTID1930 does not match an ARK1930 cannot match to either an ARK1940 or a PID. This makes the key HISTID1930 → Death Year match rate equal to the product of the match rates of its steps. Luckily, the match rate for people who matched from HISTID1930 to both HISTID1940 and a death year is not a product of the two end match rates:

The fact that our HISTID1930 → HISTID1940 & Death Year match rate is higher than the product of the two individual match rates suggests that the probability that a person matches to a HISTID1940 is not independent from the probability that a person matches to a death year.

IV. Match rate breakdowns by county

In our dataset, match rates of every kind vary by state and county. Some of this variation could introduce interesting challenges to the interpretation of our results. We present choropleth maps of match rates by county that show possible issues in regional selection. We first examine variation in match rates at the county level. Below are three choropleth maps showing match rates from HISTID1930 to death years, HISTID1930 to HISTID1940, and HISTID1930 to both death years and HISTID1940, respectively. First, the map of HISTID1930 to death year:

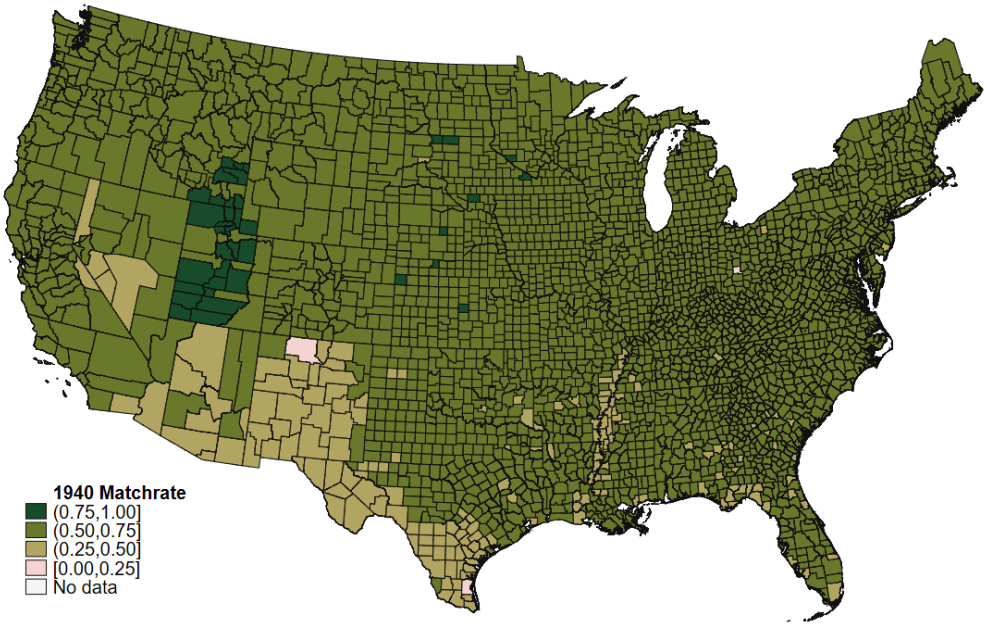


Several trends stand out. First, counties in Utah and Idaho drastically outperform counties in other states. Because we can only link a person in the census to their death year if that year is recorded on FamilySearch, this huge green region reflects an overrepresentation of FamilySearch users' ancestors having lived and died in those counties compared to other counties in the country. Next, we have a 0% at the back end of our color key and a very light county in central Ohio. That is Pickaway County, OH, where the Record Linking Lab's 1930 crosswalk from HISTID to ARK has almost zero coverage. It is a clear outlier as the only county in our dataset whose 1930 HISTID-ARK match rate is below 40%, and it drastically

underperforms the overall 1930 HISTID-ARK match rate of 99.5%.

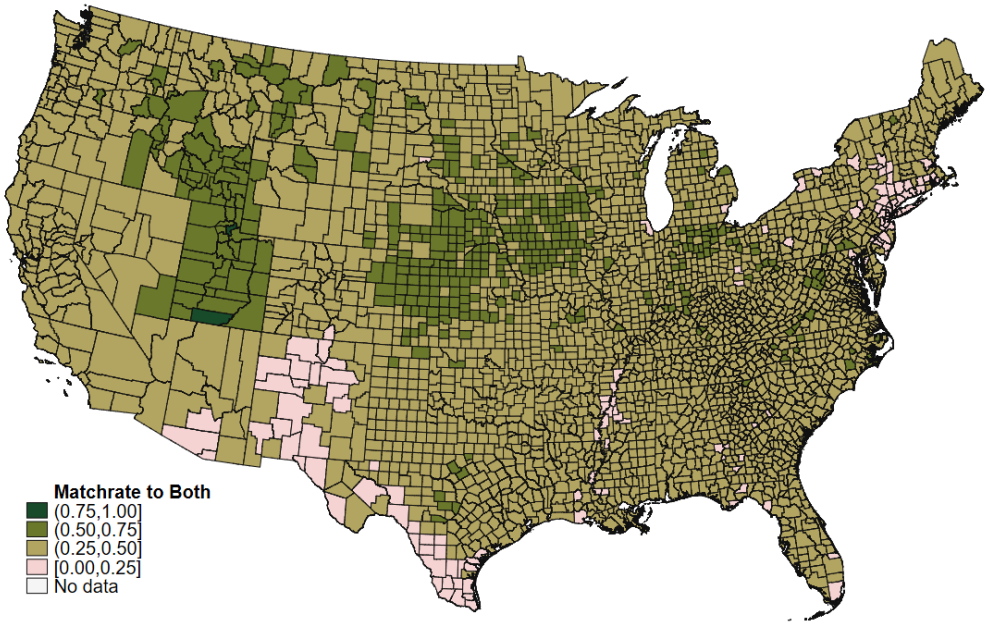
Importantly, the distribution of red counties does not signal any obviously problematic areas outside of a few counties in the region around New York City, and some counties near the U.S.-Mexico border. For the first area of issue, we reason that the very, very large population of the New York City area in 1930 made keeping, organizing, and indexing records difficult, which would make their descendants less likely to have recorded their deaths on FamilySearch. Happily, that large population provides many people to our sample even with relatively low match rates. For the other areas of issue, we reason that the relatively sparse population of U.S.-born white people in New Mexico and southern Texas makes those areas less likely to have a large number of FamilySearch users tracing their ancestors to those areas. This would lower the chance of a person in those areas having their death recorded on FamilySearch.

We next consider the map of match rates from 1930 HISTIDs to 1940 HISTIDs:



This map presents fewer immediate problems for our sample, though it is not free from areas of concern. The lower Mississippi River basin and southwestern U.S. seem to be regions in which linking white, U.S.-born people across censuses is particularly difficult. The reasons for this may be due to increased movement, especially in the southwest, but are largely left to future research. In addition, as FamilySearch users continue to link records by hand, these gaps will eventually close.

To conclude, we consider the map of match rates for people who matched from their 1930 HISTID to both their 1940 HISTID and their death year:



This map reflects all of the concerns discussed in our examination of the first two county-level maps. Outside of those areas, this relatively lighter-shaded map is probably more reflective of the difficulty of matching historical records than any kind of selection in match rates. As matching techniques and data cleaning improve in the future, we acknowledge that our results could become outdated and look forward to revisiting and possibly revising our analysis.