CENTER *for* RETIREMENT RESEARCH *at* BOSTON COLLEGE

THE INFLUENCE OF EARLY-LIFE ECONOMIC SHOCKS ON AGING OUTCOMES: EVIDENCE FROM THE U.S. GREAT DEPRESSION

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Abstract

We show that earnings over the life cycle and health and productivity around retirement age vary with exposure to economic conditions in early life. Using state-year-level variation from the most severe and prolonged economic downturn in American history – the Great Depression – combined with restricted microdata from the *Health and Retirement Study,* we find that changes in macroeconomic indicators during the in utero period and early childhood are associated with changes in accumulated earnings, human capital, metabolic syndrome, and physical limitations decades later. After evaluating changes in endogenous fertility responses and mortality rates for Depression-era birth cohorts in the U.S. Census and Vital Statistics Death Records, we conclude that these effects likely represent lower-bound estimates of the true impacts of the economic shock on aging outcomes. Our results could help inform the design of retirement and healthcare systems and pinpoint the long-term costs of business cycles.

The paper found that:

- Fluctuations in wages and unemployment during the Great Depression impacted the long-term health and productivity of children born in the 1930s.
- Exposure to the Great Depression during the in utero period had the strongest effects on aging outcomes.
- The effects of the Great Depression also impacted earnings productivity in midlife.

The policy implications of the findings are:

- Declines in productivity in midlife and at older ages due to prenatal exposure to the Great Depression may have reduced contributions to the Old Age, Survivors, and Disability Insurance (OASDI) system.
- Worse health conditions in advanced ages due to prenatal exposure to the Great Depression may have increased the demands on OASDI programs and the healthcare system.
- U.S. safety net programs, including food stamps, TANF, EITC, and Medicaid, may play a significant role in mitigating the future long-term adverse effects of the COVID-19 recession on the aging outcomes of children born during this time.

Introduction

The Great Depression was the worst economic downturn in the history of the industrialized world. From 1929 to 1933, real output in the United States contracted by more than 25 percent, prices fell by 33 percent, and the unemployment rate increased from 3.2 percent to 25 percent, reaching the highest levels ever documented (Temin 1994). The extreme nature of the economic shock was a unique failure of the industrial economy that had devastating effects on individuals' financial and overall well-being (Temin 1994, Terkel 2012).

While the Depression has received enormous attention from economists, the vast majority of research has focused on examining the various macroeconomic aspects associated with the crisis (e.g., possible aggregate-level causes and consequences, macroeconomic dynamics, or fiscal and monetary policy implications).[1] Surprisingly few studies have directly evaluated the micro-level consequences of the shock on families and children who lived through the Depression. The few studies available have found mixed evidence on short- and long-term health outcomes (Granados, Tapia, and Diez-Roux 2009; Stuckler et al. 2012; Fishback et al. 2007; Cutler, Miller, and Norton 2007). Some have argued that any adverse effects were mitigated by public health investments introduced in the years preceding the Great Depression, such as the provision of clean water (Cutler and Miller 2005; Anderson, Charles, and Rees 2018; Costa 2015), or by post-Depression public investments from New Deal relief programs (Fishback, Haines, and Kantor 2007), or the expansion of social insurance and old age assistance (Balan-Cohen 2008). The evidence on economic outcomes is more consistent, pointing to significant declines in education and income (Thomasson and Fishback 2014, Feigenbaum 2015); however, little research has analyzed life cycle impacts on productivity and economic well-being, particularly at older ages.

In this paper, we provide novel evidence on the long-term impacts of exposure to the Great Depression in early life on accumulated earnings across the life course and on productivity, physical health, and mortality at older ages. Our focus on the first few years of the life course is motivated by a large body of research showing that prenatal and early childhood events can have life-long consequences for educational attainment, health, and wages (Almond 2006; Almond and Currie 2011a, b; Almond et al. 2018; Barker 1992; Fletcher 2019;

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[1] See for example Bernanke (1983, 2000), Fisher (1933), Keynes (1936), Kehoe and Prescott (2007), Friedman and Schwartz (1963).

Smith 2009). Uncovering a link between early life exposures and aging is important from both a theoretical and a policy perspective. From the perspective of the theory of skill formation (e.g., Cunha and Heckman 2007, Lleras-Muney and Moreau 2018), understanding the persistence of shocks at different stages of the life course can provide valuable insights into the shape of the production function, and the interaction between early life shocks and future investments. From a macro policy perspective, our results refine our understanding of the costs of business cycles, which are a key input for the design of stabilization policies (Lucas 2003, Krussell et al. 2009); from a micro policy perspective, they inform the extent to which retirement and healthcare systems have to adjust to the long-term scarring effects of economic shocks (Gruber and Wise 2002, French 2005). These realities are particularly pressing in light of sharp economic declines from the COVID-19 pandemic that threaten the financial security of businesses and families in the U.S. and abroad.

To examine the long-term impact of the Great Depression on the health and socioeconomic well-being of older adults, we used micro data from the *Health and Retirement Study* (HRS), a nationally representative study of individuals over the age of 50 in the U.S. We linked restricted geocoded data on state of birth in the HRS to historical state-level macroeconomic measures on wages, employment, and consumption and employed a difference-in-differences strategy, which allowed us to compare individuals aged 50 plus who were born between 1929 and 1940 in different states across the U.S. and who were differentially exposed to the shock in their first years of life. In addition, to assess the effect of the shock on earnings trajectories, we utilized linked restricted administrative records on annual earnings between ages 35 and 65 from the Social Security Administration's Master Earnings File. To our knowledge this is one of few studies to document the impact of the Great Depression on the lifetime earnings and long-run health and economic outcomes of cohorts born in the 1930s.

The closest study to ours is Cutler et al. (2007), which examined the long-lasting effects of exposure to the Great Depression and Dust Bowl at birth on individual health outcomes in the HRS. The authors found no evidence that the shock affected long-term health outcomes, *plausibly* due to the fact that their empirical strategy relied on exploiting variation in economic conditions at the region and year of birth, which masks substantial heterogeneity in economic activity. By exploiting state-year-level variation, we are able to show that the effects of the

Depression persist over decades and affect a myriad of outcomes beyond an individual's health, even before old-age.

We also build on the work by Thomasson and Fishback (2014), who found that fluctuations in state income for men born in the 1930s reduced prime age earnings and increased disability rates using data from the Census of 1970 and 1980. We complement these findings along several dimensions. First, by using the HRS longitudinal data we can track the *same* individuals over time after age 50, and in the case of earnings, assess when in the life course the effects of the shock began to emerge. Second, the longitudinal structure of the data also allows us to separate treatment effects from other measures of early-life disadvantage by controlling for key family characteristics like maternal education and father's presence in the household at baseline. Third, by exploiting rich measures of physical and economic well-being, we can broaden our understanding of the long-term effects of early-life economic shocks. Fourth, in addition to the HRS, we employ data from the Census and Vital Statistics Death Records to examine the effects of the Great Depression on cohort-specific demographic trends in fertility, the male-to-female population ratio, and mortality.

Our results indicate that cohorts exposed to the Depression in the first years of life experienced substantial declines in accumulated earnings, productivity, and health, and that for the majority of outcomes we observe, the timing of the effects are concentrated during the in utero period. We measure exposure to the shock using average wages at the state and year level (our treatment of interest, discussed in more detail below). We find that half of the overall decline in wages between 1929 and 1933, which is equivalent to a one standard deviation (SD) contraction in state-level wages, leads to a 0.16 SD decline in long-term economic productivity, a 0.25 SD increase in the incidence of metabolic syndrome, and a 0.19 SD increase in physical disability after age 50. We also find significant declines in accumulated earnings that tend to increase with age, suggesting that the effects of in utero shocks may vary over the life course. Considering that real wages in the United States fell by almost 40 points between 1929 and 1933 (see Figure 1), these estimates imply substantial declines in lifetime income and overall well-being.

We then investigate the effects of the Great Depression on mortality using Vital Statistics Death Records. Similar to past studies (Van den Berg, Lindeboom, and Portrait 2006), we find that worse economic conditions in early-life are positively associated with a higher probability of dying at earlier ages and with deaths related to diabetes, heart problems, and cardiovascular disease (Cutler, Huang, and Lleras-Muney 2019). Early-life economic conditions are also negatively associated with the male-to-female population ratio for these cohorts, which is consistent with the idea that males are more vulnerable to environmental factors in early-life than females and were therefore less likely to survive (Naeye et al. 1971; Waldron 1985; Pongou 2013). Based on this evidence of mortality selection, we conclude that our coefficients on earnings, productivity, and health obtained in the HRS likely represent lower-bound estimates of the true impacts of the economic shock on long-term outcomes.

Finally, we examine the extent to which potential sources of selection bias, namely endogenous fertility or other co-occurring shocks throughout the 1930s, could be driving our results. Selective fertility may impact the interpretation of our findings if women (or men) with certain characteristics are more likely than others to change their fertility decisions in the presence of economic downturns (Dehejia and Lleras-Muney 2004). Historically, the U.S. fertility rate had been declining since the early twentieth century, and continued to fall during the Great Depression years, slowly recovering only after 1933 (Jones and Tertilt 2008; Bailey and Hershbein 2015; Fishback 2017; Schaller, Fishback, and Marquardt 2020; Albanesi and Olivetti 2016) (see Appendix Figure 3). Using historical Census data, we show that changes in economic conditions throughout the 1930s were differentially associated with changes in fertility. In particular, less educated women and women living in urban areas were less likely to have a child during the 1930s once the Depression hit. If women with better resources were more likely to have a child during the crisis, and these children were more likely to survive to be sampled at older ages in the HRS, this suggests that our results are potentially underestimated because we are capturing fewer individuals who were born into disadvantaged families. We also show that our results do not seem to be driven by other co-occurring shocks or events during the 1930s, including the Dust Bowl (Arthi 2018; Hornbeck 2012) and the New Deal economic recovery (Fishback 2017). However, we do show that being born in areas that were affected by the Dust Bowl amplified the impact of the economic shock on health, suggesting interacting effects between the Great Depression and the environmental shock. Conversely, although the estimates are largely imprecise, we show suggestive evidence that New Deal spending appeared to mitigate the adverse effects of the Great Depression.

The rest of the paper is organized as follows: Section 2 briefly discusses the previous literature on the effects of economic conditions in childhood on long-term outcomes. Sections 3 and 4 present the data and the empirical strategy followed by the results in Section 6. Sections 7 and 8 examine robustness checks and selection concerns, respectively, and Section 9 concludes.

Related Literature

Theoretical and empirical work on the development of human capital emphasizes the importance of conditions in the first years of life in determining long-term outcomes (Almond and Currie 2011; Almond et al. 2018; Cunha and Heckman 2007; Heckman 2008; Lleras-Muney and Moreau 2018; Prinz et al., 2018). Here, we discuss the extant literature on the effects of business cycles on health and socioeconomic well-being, as well as potential mechanisms through which economic downturns may affect the long-term health and productivity of children born during recessions.

Studies on the Great Depression and Human Capital at Older Ages

Apart from the studies mentioned above, few papers have analyzed the effects of the Great Depression on short-term health outcomes, as measured by mortality rates, and the evidence is mixed. Among the studies using aggregate-level geographic data, some have found that the rise in unemployment during the 1930s was associated with substantial declines in mortality rates (Granados, Tapia, and Diez-Roux 2009), while other studies that used a more rigorous empirical approach that accounted for geographic and temporal fixed effects in aggregate economic conditions found no effect on mortality except for an increase in suicide rates (Stuckler et al. 2012), or a small decline in death rates due to New Deal spending (Fishback et al. 2007).[2] Findings on how the Depression affected adults' economic outcomes are more consistent, suggesting significant declines in income and education, and some increases in disability rates by age 40 (Thomasson and Fishback 2014; Feigenbaum 2015; Elder, Jr. 1974; Moulton 2017); however, little is known about whether these effects persisted decades later.

[2] Studies on the early-life effects of economic crises that occurred in the late 19th and early 20th centuries have found mixed evidence on later-life health outcomes. While Banerjee et al. (2010) showed that individuals born in French regions affected by the phylloxera outbreak (which led to economic hardship) had shorter stature, Lindeboom et al. (2010) showed that changes in national GNP in the year of birth had a small effect on functional limitations at older ages.

Studies on Recent Economic Recessions and Human Capital

The finding that health improves during economic recessions has been documented using aggregate U.S. data (Ruhm 2000, 2003, 2005; Ruhm and Black 2002; Dehejia and Lleras-Muney 2004). These studies claim that health improves during economic downturns as people adopt better health behaviors (e.g., less smoking and drinking and better exercise habits). However, Huff-Stevens et al. (2011) show that cyclical changes in mortality are concentrated among younger and older groups who are not representative of changes in health behaviors among working-age adults. In fact, the authors demonstrate that cyclicality is especially strong for deaths occurring in nursing homes, which is largely explained by fluctuations in the quality of nursing home care. Using individual-level administrative data, others have demonstrated adverse effects of unemployment on health outcomes (Sullivan and von Wachter 2009; Eliason and Storrie 2009a,b; Browning and Heinesen 2012). Research has also shown that exposure to job displacement, income loss, or economic recessions in early-life is linked to lower birth weight (Lindo 2011, Carlson 2015), higher infant mortality (Gutierrez 2014), worse child and adult mental health (Golberstein, Gonzales, and Meara 2016), worse personality traits (Akee et al. 2010), lower test scores (Stevens and Schaller 2011), lower educational attainment and income in young adults (Bratberg, Nilsen, and Vaage 2008; Coelli 2011; Hilger 2016; Løken 2010; Page, Huff-Stevens, and Lindo 2007; Rao 2016; Stuart 2018), higher welfare participation (Oreopolus, Page, and Huff-Stevens 2008), and housing instability (Duque et al. 2018).

Despite this large body of evidence, the effects of the Great Depression are likely unique for at least two reasons. First, the Depression was the largest and most profound economic crisis of the 20th century (comparable only to the current COVID-19 recession) (NBER, at http://www.nber.org/cycles.html). Second, there was little to no safety net for families with children to help buffer the effects of the shock. Bitler, Hoynes, and Kuka (2016), for instance, showed that U.S. safety net programs, including food stamps, TANF, and Medicaid, played a significant role in mitigating the adverse effects of the 2007 recession on child poverty, especially for the most vulnerable children.

Potential Mechanisms: Economic Downturns and Human Capital Accumulation

Several mechanisms help explain the relationship between economic shocks around birth and well-being over the life course. Here we describe channels that have been identified in previous studies, and in Section 7 we provide some suggestive empirical evidence for a few of them in relation to the current study.

Income. Recessions impact the financial stability of households by decreasing income and increasing debt via unemployment and unstable work histories. Research has shown the importance of household income on child development (Duncan and Brooks-Gunn 1997; Almond and Currie 2011; Black and Devereux 2011; Hair et al., 2015; Fletcher and Wolfe 2016). Aizer et al. (2016), for instance, showed that income can have persistent effects, even across generations.[3]

Stress. Maternal stress during pregnancy due to job loss, the fear of job loss, or declines in income can lead to increased levels of corticotropin-releasing hormone (CRH), which increases the likelihood of preterm birth (Duncan, Mansour, and Rees 2015). Maturation of tissue is sped-up, while fetal growth is reduced (Hobel and Culhane, 2003). Prenatal maternal stress can also lead to excess cortisol passing through the placental wall; this may result in reprogramming and subsequent dysregulation of the fetal hypothalamic-pituitary-adrenal (HPA) axis, which controls the body's hormonal reactions to future stress (DiPietro and Voegtline, 2017). As a result, individuals subject to prenatal stress are more likely to develop hypertension later in life (Seckl and Holmes, 2007), and experience cognitive, behavioral, and emotional deficits or even schizophrenia (Aizer, Buka, and Stroud 2016; Persson and Rossin-Slater 2018; Cotter and Pariante 2002; Van den Bergh et al., 2005). Atella et al. (2020), for instance showed that in utero stress significantly reduced individuals' earnings between the ages of 30 and 60 and that these effects worsened with age. Maternal and paternal stress can also harm child developmental after birth (Thompson 2014). For example, in his longitudinal study on the children of the Great Depression, Elder (1974) found that the economic shock placed families and children under profound stress, which reduced fathers' ability to provide for their children, disrupted parental relationships, and altered the nature and quality of parenting, all of which ultimately deteriorated children's future outcomes.[4]

[3] Using data from the U.S. Mothers' Pension program, which substantially improved the income of female recipients, Aizer et al. (2016) found that the program increased longevity and that male children of these mothers accumulated more years of schooling, were less likely to be underweight, and had higher income as adults than children of mothers in the control group.

[4] Several studies focusing on significant economic crises in other countries have found substantial declines in children's health and education (Smith et al. 2002; Strauss et al 2004; Thomas et al. 2004; Thomas and Frankenberg 2007).

Nutrition. For children who are carried to term, changes in nutrition as a result of lower household resources could lead to an increase in the probability of low birth weight, metabolic syndrome in adulthood, disability, and/or declines in economic productivity (Almond and Mazumder 2013; Hoynes et al., 2016; Almond 2016; Bailey et al. 2020). Prenatal exposure to poor nutrition may hamper fetal growth and damage fetal organs. Famine studies have shown that prenatal malnutrition can lead to a wide range of diseases – most of which progress at older ages, including coronary heart disease, type-2 diabetes, hypertension (Roseboom et al., 2011), and higher mortality rates (Lindeboom et al., 2010).[5] Moreover, it can negatively affect the cognitive performance of offspring (De Rooij et al., 2010). Malnutrition in childhood has also been linked to lower than average height-for-age and increased susceptibility to illness (Victora et al., 2010).

Healthcare. Access to affordable healthcare may decline during a recession. As the Great Depression worsened, the federal government cut spending on hospitals and on medical aid to the poor. At the same time, widespread unemployment forced thousands of people into severe poverty and many families could no longer afford to heat their homes. The absence of a broader social safety net at the time meant many people could not afford medical care, especially if they lived in rural areas. Lower income, nutrition, and limited access to health care can also increase exposure to disease, which has been shown to increase the incidence of diabetes among women in the U.S. (Almond, Currie, and Herrmann 2012) and frailty in older age (Alvarado et al. 2008; Gale et al. 2016; Van der Linden 2019).

Mobility. Recessions could also affect outcomes through geographic mobility (Boone and Wilse-Samson 2014; Arthi, Beach, and Hanlon 2019). For example, Feigenbaum (2015) demonstrated that the Great Depression prompted the sons of richer fathers to move to places less affected by the crisis.

Data and Variable Measures

The Health and Retirement Study (HRS)

The HRS is a nationally representative, longitudinal panel study of individuals over the age of 50 and their spouses. Launched in 1992, the study was designed to paint a detailed

[5] See Lumey et al. (2011) for a review of the epidemiological literature on the effects of nutritional deprivation in utero on long-term outcomes.

portrait of the labor force participation and health transitions individuals undergo towards the end of their work lives and into retirement; comprehensive information about participants' socioeconomic background, income, assets, and employment is collected from the time of respondent entry until death. The HRS introduces a new cohort of participants every six years and interviews around 20,000 participants every two years.

We link public use data from 12 waves of the HRS (1992-2014) on respondent health, education, earnings, wealth, labor force participation, and socioeconomic circumstances in childhood with restricted geographic information on respondent state of birth and lifetime earnings.[6] Our sample includes 7,352 individuals (61,850 person-year observations) born between 1929 and 1940.

Micro Data from the U.S. Census and Vital Statistics Death Records

Given its relatively small sample size and the fact that individuals are only observed after age 50, the HRS is not an ideal source to observe life course demographic and mortality patterns. Therefore, in addition to the HRS, we employed six consecutive waves of the decennial U.S. Census between 1940-1990 (Ruggles et al., 2019), and Vital Statistics Death Records in 1980, 1990 and 2000 (years with information on state of birth) obtained from the National Vital Statistics System. We used the Census to construct population level male-to-female sex ratios for affected birth cohorts and, together with Vital Statistics Death Records, age-specific mortality rates. Mortality rates were disaggregated into four leading causes of death: (i) infectious diseases, (ii) cancer, (iii) diseases of the heart, diabetes, and other cardiovascular diseases, and (iv) accidents.

Outcome Variables

Using the HRS, we focus on the health and economic outcomes of respondents and their spouses. To capture the multi-dimensional nature of human capital attainment and reduce the burden of multiple hypothesis testing, we follow Kling, Liebman, and Katz (2007) and Anderson (2008) and estimate standardized indices that aggregate information across three treatments. In

[6] Data on respondent health, education, and economic outcomes came from the RAND HRS Data (Version P, 2018)—an easy to use longitudinal data set based on the HRS data. It was developed at RAND with funding from the National Institute on Aging and the Social Security Administration.

particular, we constructed three indices:

1) *Human capital index*: includes information on whether or not the respondent received their GED/high school degree, whether or not the respondent is working full-time or part-time, log of individual income, and whether or not a household is in the top fifty percent of the sample's wealth distribution (excluding wealth from a secondary residence).[7] We use this index as a proxy for economic productivity prior to retirement age.
2) *Metabolic syndrome index*: includes information on whether an individual has ever been diagnosed with diabetes, heart problems, stroke, or high blood pressure.
3) *Physical limitations index:* indicates whether an individual reports any difficulty with activities of daily living (ADL) (i.e., difficulties bathing, eating, dressing, walking across a room, or getting in or out of bed), or instrumental activities of daily living (IADL) (i.e., difficulties using a telephone, taking medication, handling money, shopping, or preparing meals). ADL and IADL measures have been widely used in the aging and gerontology literature to assess capabilities related to the maintenance of self and lifestyle, which often includes self-care, keeping one's life-space in order, and obtaining basic resources.

Summary indices were constructed by taking the average across standardized z-score measures of each component. The human capital index was constructed for all survey years prior to the Social Security full retirement age for these cohorts, or between the ages of 50 and 65 only. The metabolic syndrome and physical limitations indices were constructed for all available survey years.

Lifetime Earnings. To assess the impact of the Great Depression on earnings trajectories across the life course, we used restricted HRS-linked earnings data from the Social Security Administration's Master Earnings File. Lifetime earnings were calculated as the sum of respondents' 2010 CPI-adjusted earnings from Old-Age, Survivors, and Disability Insurance (OASDI) covered employment, non-covered employment, and OASDI-covered self-employment for all records available up to age 35, 40, 45, 50, 55, 60, and 65. We include positive earnings only (i.e., individuals with zero earnings were not included in the analyses). To capture earnings above the Social Security Administration (SSA) taxable maximum that were top-coded prior to 1978 for all earnings, as well as earnings from self-employment that were top-coded between 1978 and 1994, we used an enhanced version of the HRS SSA-linked records that imputed

[7] All income and wealth measures were standardized to 2010 dollars.

earnings subject to top-coding at the OASDI or Medicare taxable maximums (Fang 2018). These files also include imputations for earnings above $250,000 that were masked to protect respondent confidentiality.[8]

Exposure Variables: State-level Measures of Economic Conditions

Macroeconomic data that document the dynamics of the labor force during the 1930s at both the state and year level are rare, and decennial data from the Census are too far apart in time to convey much information about cyclical variations.[9] Even the Censuses of Manufacturers and Agriculture, which provide rich economic measures, were only collected every five years. In this study we used all measures that we are aware of that provide state-year level variation in economic conditions in the 1930s:

1) *Wage Index (1929-1945)*: farm and non-farm wages for each state from the Bureau of Economic Analysis (BEA).[10]
2) *Employment Index (1929-1940)*: employment in manufacturing and nonmanufacturing sectors (Wallis 1989).[11]
3) *Car Sales Index (1926-1940)*: total car sales for each state from the annual statistical issues of the industry trade publication, *Automotive Industries* (Hausman 2016).

For each of these measures, we constructed indices by dividing the variable by its 1929 level and multiplied by 100 so each measure has a value of 100 in 1929. The wage index was also transformed to real wages using the consumer price index (base year=2011). We linked all three "treatment" measures to the HRS at the year of birth and state of birth levels. Our preferred measure is the wage index because it better approximates the economic conditions of families with young children in both urban and rural areas (Garrett and Wheelock 2006), and because it extends beyond 1940. This allowed us to test the impact of wage fluctuations during the in utero period and through age six for all respondents born in the 1930s. Because data on employment and car sales are only available through 1940, we were limited in the number of

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[8] A more detailed report of the imputation methodology is available on the HRS website: https://hrs.isr.umich.edu/sites/default/files/restricted_data_docs/Imputed_Lifetime_Earnings.pdf
[9] For instance, while national unemployment statistics are available throughout the 1930s period, state-level unemployment rates are not. Moreover, many people had lost hope and stopped looking for work.
[10] Link: https://apps.bea.gov/regional/histdata/#collapseSPI.
[11] Wallis constructed these indices using firm-level data from the Bureau of Labor Statistics. Wallis' indices have been used in previous studies that have analyzed the macroeconomic impacts of the Great Depression (Borts 1960; Christiano et al. 2003; Creamer and Merwin 1942; Cutler et al. 2007; Rosenbloom and Sundstrom 1999).

years in early childhood that we could examine their impact. In the Robustness Checks section, we discuss results using these alternative indices.

Figure 2 shows the large variation in the wage index over time and across states. Illinois (which is depicted in green), experienced a 50 percent decline in wages between 1929 and 1933 and only recovered to its initial level after 1940. In contrast, Washington DC (red) faced a 20 percent drop in wages by 1933 and a remarkable recovery that surpassed its 1929 level by 1935. State-level variation in the employment and car sale indices are similar to the fluctuations observed in the 1930s for the wage index (see Appendix Figures 1 and 2).

Calculating Exposure to Early Life Economic Conditions

To identify the relevant life-cycle period of exposure to economic conditions, we build on previous literature in developmental psychology, epidemiology, and more recently in economics on sensitive periods for skill formation (Gluckman and Hanson, 2005; Heckman, 2008; Knudsen et al., 2006; Thompson and Nelson, 2001). Based on this, we estimated effects for two sensitive periods of development: i) the in utero period, which we approximated by using exposure to the wage index in the year prior to birth for respondents' state of birth, and ii) the early childhood period, which we calculated by taking the average of economic conditions in the state of birth for the first six years of life, or from birth through age six.

Descriptive Statistics

Table 1 presents descriptive statistics for our estimation sample. Fifty-three percent of the sample is female, with an average age of 65.6 (mean birth year is 1936), and the vast majority are white (89 percent). More than 50 percent of the sample had a mother with less than a high school degree, and almost one-third of participants reported that they served in the military. In terms of individual outcomes, 81 percent of the sample completed at least a GED/HS degree, and at least 51 percent were working before retirement, or between the ages of 50 and 65. Average household wealth was $541,684 in 2010 U.S. dollars. In terms of health outcomes, 18 percent of the sample was diagnosed with diabetes, 22 percent experienced heart problems, and 54 percent suffered from high blood pressure. One fifth of respondents reported having at least one ADL or IADL.

Empirical Model

To estimate the link between exposure to the Great Depression and individuals' outcomes after age 50, we leverage the temporal and geographic variation in economic conditions at the state-year level throughout the 1930s while accounting for state and regional-level characteristics to help isolate the effect of the economic shock from other potential confounders (Borts 1960; Rosenbloom and Sundstrom 1999). Our difference-in-differences specification is as follows:

$$Y_{isrtc} = \beta_0 + \beta_1 Wages_{sc\_before\ conception} + \beta_2 Wages_{sc\_in\ utero} + \beta_3 Wages_{sc\_early\ childhood}$$
$$+ \boldsymbol{X}_{isrc}'\beta + Z_{s1930} * c + \theta_s + \eta_c + \lambda_t + u(_{s1930\times c}) + \gamma_{r\times c} + \varepsilon_{isrct} \quad (1)$$

where Y_{isrct} is the outcome of individual *i*, born in state *s*, in region *r*, in year *c*, and observed in the HRS at year *t*. *Wages* represents the aggregate wage index at the state and year levels for the period before conception, in utero, and in early childhood; the matrix $\boldsymbol{X}_{isrc}$ contains individual characteristics including sex, age, age squared, veteran status, indicators for maternal education (i.e., less than high school education, high school or more than high school, or unknown), whether the father was present in the home, and whether the household lived in a rural/urban area. $Z_{s1930} * c$ is a vector of state-level characteristics around 1930 interacted with year of birth time trends. We include interactions with the maternal[12] and infant mortality rate in 1928,[13] the population in 1930,[14] and whether the percent of farmland was above the 75th percentile in 1930.[15] The term $u(_{s1930\times c})$ represents a state's share of wage earners in manufacturing in 1930 (or earlier whenever possible)[16] interacted with year of birth fixed effects. We include these controls because, as discussed in Borts (1960), the severity of cyclical fluctuations across states was driven in part by state differences in the proportion of manufacturing and agricultural

[12] Albanesi and Olivetti (2016) show that "starting in the 1930s, there was a dramatic improvement in maternal health. Maternal mortality declined from 673 deaths per 100,000 live births in 1930 to 37.1 deaths per 100,000 live births in 1960, accompanied by a corresponding decline in the burden of pregnancy-related conditions" (p. 651).
[13] Calculated as the number of infant deaths per state per year divided by the number of births by state and year multiplied by 1,000. Information on infant deaths and births by state-year were obtained from the NBER data website: https://www.nber.org/data/im/. Information on maternal mortality by state-year were obtained from Lleras-Muney and Jayachandran (2010).
[14] Information on population by state-year were obtained from Lleras-Muney and Jayachandran (2010).
[15] Obtained from the 1930 Census of Agriculture.
[16] This was calculated as the number of wage earners in manufacturing in 1929 (obtained from the 1929 Census of Manufacturers) divided by the working population ("gainfully occupied persons") aged 10 years and older (obtained from the 1930 Census).

industries. The terms θ_s and η_c are state and year of birth fixed effects, respectively. The geographic fixed effects help absorb time-invariant differences at the state level, while the time fixed effects absorb factors that vary over time but are invariant across states. For example, θ_s helps account for consistent differences in the poverty level or economic specialization across states. λ_t captures HRS survey year fixed effects. In some specifications we also include region of birth times year of birth fixed effects, or the term $\gamma_{r \times c}$, to control for region-specific shocks that happened in each birth year throughout the 1930s (Rosenbloom and Sundstrom 1999).[17] Standard errors are clustered at the state of birth level and at the individual level following Cameron, Gelbach, and Miller (2011) to account for within-state-person serial correlation in the observations. All models were estimated using the pooled data and weighted by HRS sample weights to adjust for sample composition. Our coefficients of interest are β_2 and β_3, which are interpreted as the effect of a one-point increase in the wage index in the prenatal and early childhood periods on individual outcomes after age 50. The coefficient β_1, tests for potential differential trends prior to conception.

Sorting by Observable Characteristics

The main identifying assumption required to consistently estimate the effect of the Great Depression on our outcomes of interest is independence between the error term and the shock after controlling for geographic and temporal fixed effects. While we cannot directly test for all potential omitted variables, we assess the degree to which variation in the annual state-level wage index in the year of birth is correlated with family characteristics. Results in Table 2 show that changes in the wage index are not associated with levels of individual or family characteristics at baseline, including individual's age, sex, race, mother's education, father's presence in the household, or rural status, all which imply little evidence of endogenous sorting. In Section 8 we also analyze the extent to which endogenous fertility could be driving our results.

[17] We include nine regions: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific.

Results

Early-life Exposure to Economic Shocks and Late-life Outcomes

Table 3 presents estimates of exposure to the wage index from age three (or two years before conception) to age six on the human capital index for individuals aged 50 to 65 and on metabolic syndrome and physical limitations for individuals aged 50 plus. Column 1 includes year and state of birth fixed effects and HRS survey year fixed effects, Column 2 adds individual and family controls (measured at baseline) to the regression, Column 3 includes region of birth*year of birth fixed effects, Column 4 adds the state-level controls interacted with linear time trends, and Column 5, our preferred specification, includes the share of manufacturing in 1930*year of birth fixed effects.

Research suggests that early exposure to adverse shocks is worse for human capital than later-life exposures (Heckman 2008; Almond and Currie 2011), however, the literature does not offer sharp definitions for when these early stages end, except for the specific case of the in utero period. As we go from Column 1 to Column 5 in Panel A and we slowly include baseline covariates and state- and regional-level controls, we find that the coefficient on the wage index both in utero and in childhood increases in magnitude and becomes more statistically significant. The magnitude of the coefficient in Column 5 suggests that a one-SD increase in the wage index in utero (equivalent to a 20-unit change or about half of the overall decline in wages during the Great Depression), improves the human capital index by 0.16 SD ($p<0.05$). An equivalent change in wages in early childhood would imply a further change of 0.07 SD. Results on the metabolic syndrome and the physical limitations index shown in Column 5 and Panels B and C, reveal that changes in wages prior to birth are associated with a decline in these outcomes by 0.25 SD ($p<0.001$) and 0.19 SD ($p<0.05$), respectively. Importantly, we see little evidence of differential trends prior to conception in Table 3, which is given by the null effect of the average wage index two to three years prior to birth, providing support for the identification strategy.

In Appendix Table 1 we break down the effects of the wage index on the individual components of the three indices. Panel A shows that changes in the human capital index are explained by increases in education, earnings, and wealth, and while we do not find a significant effect on working status, we do find that the coefficient on wages in childhood is positive and large. In supplemental analyses, we estimate the impact of the wage index in childhood on age at full retirement for the subsample of workers in our analytic sample (Appendix Table 2).

Findings indicate that a one SD increase in the wage index in utero increased the number of years a worker stayed attached to the labor force by 1.22 years, providing further evidence that economic shocks in critical stages of child development can have direct effects on late-life productivity.

Panels B and C show the components of the metabolic syndrome and physical limitations indices, respectively. Since all the components are "bads", a negative coefficient indicates an improvement in long-run health. We find that increases in wages around birth are significantly associated with a lower incidence of diabetes, heart problems, and high blood pressure. Lastly, both ADLs and IADLs (the two components of the physical limitations index) are significantly associated with changes in economic conditions around birth (an effect of 0.56 SD and 0.60 SD, respectively).

In sum, the sizable effects that we find can be explained partly by the fact that 1) the shock of the Great Depression was massive and everyone, no matter what group they belonged to, was to some extent impacted; and 2) families were unable to fully buffer the effects of the Depression due to a lack of a universal social safety net.

Early-life Exposure to Economic Shocks and Accumulated Earnings

We now analyze whether the effects of the Great Depression on human capital and labor market productivity at older ages were also present earlier in the life course. Since the HRS is a representative sample of older adults in the U.S., information on individuals is surveyed after age 50, which limits the degree to which we can examine the impact of the Great Depression on outcomes in mid-life. As a result, we used linked earnings data from SSA tax records to reconstruct the impact of the Great Depression on the age earnings profiles of HRS participants during their prime earning years.

Figure 3 shows the effects of the wage index in utero and in early childhood on accumulated earnings at ages 35, 40, 45, 50, 55, and 60.[18] Overall, we find that 1) the effects of in utero economic shocks are larger than the effects of exposure during early childhood, and 2) the effects of in utero shocks on accumulated earnings tend to increase as individuals age. Appendix Table 3 presents the regression results displayed in Figure 3; we find that a one SD

[18] We note that these effects are estimated on the same sample of individuals and thus are not affected by potential changes in sample composition.

increase in the wage index in utero is associated with a 0.9 percent (statistically insignificant) increase in earnings by age 35, whereas by age 50 this effect had increased to 2 percent (statistically significant) and by age 65 it reached 2.8 percent (also statistically significant).[19]

Early-life Exposure to Economic Shocks and Mortality

While research has shown that economic conditions in early life can affect individual mortality (Van den Berg et al. 2006, Cutler et al. 2019), studies on the effects of the Great Depression on mortality rates have found mixed evidence (Granados et al. 2009, Stuckler et al. 2012, Fishback et al. 2007, Cutler et al. 2007). We re-examine these potential impacts by focusing on changes in the male-to-female sex ratio and age-adjusted mortality rates (as well as the cause of mortality) for those born in the 1930s.

The sex ratio is defined as the number of males divided by the number of females born in a state and year and observed in each of the population Census from 1940 through 1990. Table 4 shows that increases in the wage index around the year of birth are associated with significant increases in the male-to-female sex ratio for the population of children and adults observed across the 1940-1990 Censuses. If the male fetus is more sensitive to environmental stimuli than the female fetus, and males on average have shorter lifespans than females (Waldron 1983), these results could indicate that there were fewer male births as a result of the Great Depression and that those that were born were less likely to survive over time.

To examine mortality rates, we took the sum of deaths for each birth year and birth state in the Vital Statistics - Death Records from the National Center for Health Statistics.[20] To convert these sums into a rate per population, we divided these death counts by the number of individuals born in that state and year using data from the one percent sample from the 1940 Census (Ruggles et al., 2019). This method gives us, for example, the share of native-born individuals who were born in Michigan in 1930 and who died in 2000.

Table 5 shows that a one SD increase in wages during the in utero period leads to a significant 5.4 percent decline in the mortality rate. We find little evidence that postnatal exposure to changes in aggregate wages is associated with changes in mortality, a result that is

[19] Not all respondents in the HRS provided consent for SSA record linkage; therefore, the sample of individuals with information on accumulated earnings at different ages is slightly smaller than the full analytic sample.
[20] We focused on the years for which information on birth state was available.

consistent with previous studies on the effect of economic conditions in early life and death rates in other countries (Van den Berg, Lindeboom, and Portrait 2006). Regarding the cause of death, Table 6 shows that the declines in mortality were more likely to be driven by deaths due to diabetes, heart problems, and cardiovascular disease (a fall of 10.2 percent), all of which have been linked to intrauterine growth disruptions (Barker 1992). These results are further supported by the fact that we do not find a connection between wages and other causes of death that are not associated with fetal conditions, including deaths from infectious disease, cancer, or traffic accidents. Based on this evidence, we conclude that the health effects estimated in the HRS likely represent lower-bound estimates of the true impact.

Additional Results

Other Measures of Economic Fluctuations: Employment and Car Sales Indices

In this section we examine the robustness of our results that use the wage index as our measure of the exposure by comparing them to results that use other measures of economic fluctuations from labor markets and aggregate consumption as the exposure variables. To measure how changes in the labor market or changes in aggregate consumption throughout the 1930s affected long-run health and productivity, we used data collected by Wallis (1989) on changes in employment in both manufacturing and non-manufacturing industries and data on car sales by state and year. Car sales are a good macro indicator for three reasons: 1) state laws mandate the registration of new cars, which means the data are relatively accurate with little measurement error, 2) they capture household consumption, and 3) they are the only macro-level variable that was consistently collected on an annual basis at the state level before 1929, starting in 1926.[21] Appendix Figures 1 and 2 show the movement in the Wallis employment index (1929-1940) and the car sale index (1926-1940) relative to the year 1929.

Results obtained with these exposures are shown in Appendix Table 4 and suggest that changes in both employment and consumption during the in utero and childhood periods are strong predictors of future productivity, metabolic syndrome, and physical limitations. For instance, children exposed to higher state-level employment are more likely to have better human capital outcomes, cardiovascular health, and are less likely to suffer from physical mobility limitations at older ages. The timing of the effects is also consistent with estimates that use the

[21] Both the salary and employment indices series start in 1929.

wage index, confirming that our results are not driven by the use of the wage index but rather reflect a consistent pattern.

The Role of the Dust Bowl Ecological Catastrophe

We now examine whether other co-occurring shocks during the 1930s are potentially driving our results. We first start with the 1930s American Dust Bowl, an environmental catastrophe characterized by droughts, soil erosion, and severe dust storms that eroded sections of the Great Plains (Worster 1979; Hansen and Libecap 2004; Hornbeck 2012). While droughts are relatively common in the Plains and repeat every 22 years on average, the Dust Bowl was particularly extreme due to the overuse and over ploughing of the land that significantly eroded and damaged soil conditions, which left the Plains more vulnerable to the drought cycle. In prior work, Arthi (2018) showed that cohorts exposed to this shock in childhood experienced significant declines in educational attainment and economic well-being decades later.

To assess whether our estimates could be confounded with Dust Bowl exposures, we re-estimate our main specification excluding the sample of individuals born in the Dust Bowl states as well as their neighboring states.[22] Results in Appendix Table 5 show that while estimates become less precise due to a reduction in the sample size, the coefficients on human capital and metabolic syndrome remain relatively similar to those found in the full sample. For the case of physical limitations index, we find little evidence that exposure to higher wages prior to birth influenced the outcome; however, the magnitude of the coefficient in early childhood becomes much larger when we exclude the sample affected by the Dust Bowl.

Consistent with Arthi (2018), our results in Columns 3, 6, and 9 for individuals in Dust Bowl and neighboring states show that the worst effects are found amongst those exposed to both the Dust Bowl and the Great Depression. This suggests that congenital complications from nutritional deprivation, together with low parental incomes in utero and in childhood, may have had an interacting effect that resulted in significant later life disadvantage.[23]

[22] We exclude individuals born in New Mexico, Colorado, Oklahoma, Texas, Kansas, Arkansas, Iowa, Louisiana, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming.
[23] For evidence on the interactions between early-life shocks see Duque, Rosales, and Sanchez (2020).

The New Deal

The Great Depression led to dramatic changes in social spending in the U.S. In 1933, the burden of providing relief to the poor and the unemployed fell mostly on states, local governments, and private charitable organizations. It was not until Roosevelt's New Deal that a welfare state was introduced. The federal government started pouring funds into the provision of emergency work and direct relief programs. Spending was more concentrated in areas with higher unemployment and where the economic downturn from 1929 to 1933 was more pronounced (Fishback 2017). Programs not only had the potential to raise incomes, but also had impacts on migration, mortality rates, employment, crime rates, housing values, home ownership rates, and productivity (Fishback 2017).[24]

We measured New Deal spending using data compiled by Fishback, Kantor, and Wallis (2003). The authors categorized spending into three main types of programs: 1) relief spending, including Federal Emergency Relief Administration grants, Civil Works Administration grants, Works Progress Administration grants, and Public Assistance Grants via the Social Security Act; 2) public works spending via Public Works Administration grants and loans, as well as grants from the Public Roads Administration and the Public Buildings Administration; and 3) housing market assistance with loans or the insurance of mortgages. This spending included loans from the reconstruction Finance Corporation, from the Homeowners Loan Corporation, and grants and loans from the U.S. Housing Administration. We combine all spending into one measure and divide it by the state population in that particular year.

Appendix Table 6 reports the effects of New Deal Spending and its interaction with the economic shock. Although estimates are generally imprecise and not statistically significant, they imply that higher spending is associated with better long-run outcomes and if anything, the interaction between spending and the wage index reinforces this relationship. While suggestive, this evidence indicates that New Deal spending may have ameliorated some of the negative impacts of the Great Depression.

[24] The effects and extent to which the different programs met their goals varied. For instance, public works and relief spending increased incomes and consumption, attracted internal migration, reduced crime rates, and lowered several types of mortality but had little positive impact on private employment (Fishback, Horrace, and Kantor 2005; Fishback 2017). The inflexibility of those wages prevented companies from hiring additional workers and contributed to an environment of policy uncertainty, resulting in firms cutting or postponing their investment projects.

World War II

Lastly, we examined whether our estimates are driven by the impact of World War II (WWII). The war not only represented a large-scale induction of men into the armed forces (many of which had young children) but also drew many women into the labor force (Goldin 1991, Goldin and Olivetti 2013). To examine the impact of WWII on our results, we used data on average mobilization rates compiled by Acemoglu, Autor, and Lyle (2004) and interacted mobilization rates with our treatment of interest (the wage index). Results in Appendix Table 7 reveal estimates that are very similar to those presented in Column 5 in Table 3 (our main results), which suggests that our estimates are not substantively affected by WWII.[25]

Potential Mechanisms

Household Resources: Mother's Education and Childhood Nutrition

Research has shown that family resources can buffer the effects of adverse shocks on children's outcomes. In Appendix Table 8 we stratify estimates by mother's education (i.e., whether the respondent's mother had less than a high school degree or information on mother's education was missing versus higher levels of education). We find that on average the effect of the wage index tends to be greater for respondents with less educated mothers; however, the coefficients are not statistically different across samples.

As another potential resource, we examine access to food and nutrition. To explore this channel, we used estimates of the wage index on self-reported height in the HRS, since height has been linked to childhood nutrition, as well as adult cognitive ability and labor market outcomes (Case and Paxson 2008). Appendix Table 9 shows that an increase in the wage index is negatively (but not significantly) associated with height.

Migration

Overall migration rates during the Depression era were low compared to the previous decade of the Great Migration (Boustan, Fishback, and Kantor 2010, Gutmann et al. 2016); however, the option to move served as informal insurance (Boone and Wilse-Samson 2014).

[25] For ease of clarity and interpretation, we used a slightly different specification in these models that aggregate the in utero and early childhood exposures into just one "early-life" exposure.

In the HRS, 22 percent of our analytic sample reported moving between birth and their primary schooling years. We examined whether families of certain characteristics were more likely to move to a different state as a response to the shock. Appendix Table 10 suggests that this is not the case. While an increase in wages in a child's first years of life is associated with a higher probability of migration, there is little evidence to suggest that there was differential migration across different types of families—i.e., by child's sex, race, mother's education, or father's presence—as evidenced by the fact that none of the interaction terms with these respondent characteristics are statistically significant and the magnitudes of the coefficients are small. Thus, we conclude that at least for families with young children, there seems to be little evidence of selective migration as a mechanism to buffer the economic shock.

Fertility during the Great Depression

In this section, we analyzed the extent to which changes in economic conditions throughout the 1930s were associated with changes in women's fertility decisions, which could potentially bias our estimates of the shock on the outcome (Almond 2006; Bozzoli et al. 2009).

Economic theory predicts that business cycles can affect fertility through changes in income, the opportunity cost of time, or information (Currie and Schwandt 2014; Sobotka, Skirbekk, and Philipov 2011). The evidence on the relationship between the Great Depression and fertility shows that, in the context of an overall decline in total fertility that began since the 1920s (see Appendix Figure 3), fertility rates fell even more from 1929 to 1933 and then slowly recovered during the New Deal (Fishback et al. 2007).[26]

Relevant to our study is whether these patterns differed across groups of women. For example, if the Great Depression differentially affected women's fertility decisions across observable characteristics such that highly educated women were more likely to have fewer children than their counterparts, this may result in a biased estimate of the shock on future outcomes since the children of disadvantaged mothers were more likely to grow up to be disadvantaged themselves (Almond and Currie, 2011; Almond, Currie, and Duque 2018), even in the absence of the Great Depression.

[26] The U.S. fertility rate had been falling below trend since the early 1920s (Jones and Tertilt 2008; Bailey and Hershbein 2015; Albanesi and Olivetti 2016).

Using data from the 1940 Census, we examined the association between changes in the wage index and a mother's total fertility after a (focal) child (i.e., the number of children she has after her first child born in the 1930s) and the association between the shock and the timing of fertility (i.e., the time between two subsequent births). Results in Appendix Table 11 show evidence of differential fertility responses across mothers' characteristics. While Column 1 suggests that an increase in average wages in early childhood was positively associated with women having an additional child, Column 2 shows that those more likely to do so were married women, women with low levels of education, women in their 30s, and women living in rural areas. Column 4 further shows that younger women were more likely to delay timing between births as wages increased.

In sum, our results suggest that as the Great Depression hit and wages declined, women were less likely to have a child and this was more likely to be the case for married and less educated women. Considering that 96 percent of women who had a child in the 1930s were married, our results imply that children born throughout the decade were more likely to be born to highly educated mothers. As a result, changes in fertility due to the Great Depression are more likely to bias our estimates downward.

Discussion

The Great Depression was an extraordinary event in the economic history of the United States (see Figure 1). From 1929 to 1933, real output contracted by more than 25 percent and the unemployment rate increased from 3.2 percent to 25 percent, reaching the highest levels ever documented. However, despite its magnitude, previous literature has found little evidence that the Great Depression affected old-age disability and chronic-disease rates (Cutler, Miller, and Norton 2007). Even studies focusing on more recent recessions have found positive effects of economic downturns on health outcomes, attributing these effects to improvements in health behaviors, selection into pregnancy, and counter-cyclical fluctuations in the quality of care, particularly in nursing homes (Ruhm 2000; Fishback, Haines, and Kantor 2007; Dehejia and Lleras-Muney 2004; Stevens et al. 2011). One potential explanation for the absence of a Great Depression effect that has been suggested in previous studies is that the public health investments that had become available in the preceding years such as the provision of clean water or pasteurization of milk (Cutler and Miller 2005; Anderson, Charles, and Rees 2018;

Fishback et al. 2011), protected people against disease, while incomes were adequate to secure sufficient nutritional intake and shelter (Costa 2015). Recession effects may also have been different prior to the sanitary revolution. In addition, some scholars argue that the effects of the Great Depression could have been mitigated by relief programs (Fishback, Haines, and Kantor 2007) and by Old Age Assistance (Balan-Cohen 2008).

Results from this study indicate that the economic shock from the Great Depression had adverse and long-term impacts on the physical health and life course economic productivity of individuals born during the 1930s, and that these changes likely represent lower-bound estimates of the true effects due to mortality (and fertility) selection. Our estimates imply that a one standard deviation (SD) decrease in employment reduced productivity before age 65 by 0.16 SD and increased the incidence of metabolic syndrome and physical disability by 0.25 SD, and 0.19 SD, respectively. These significant effects may in part reflect both the severity of the contraction and the lack of a universal social safety net at the time to protect families with young children.

Our study has some important limitations. First, because we examined detailed health and economic outcomes, much of our analyses are limited to available sample sizes in the HRS, which may reduce our power to detect effects. Second, because the HRS begins following individuals after age 50, with the exception of earnings, we are unable to examine the onset and magnitude of the effects of the Great Depression on the outcomes we observe at earlier ages. However, despite these limitations, our study contributes to the small literature on the effects of the Depression on individual outcomes by providing new estimates that are informative for assessing the costs of business cycles. Our focus on older adult health and economic outcomes is also relevant given that many developed countries around the world are experiencing population aging. A better understanding of the complex interplay between social environments and initial endowments in shaping human capital and health at later stages in the life course is informative for policies aimed at raising long-term productivity and reducing healthcare costs at older ages (Gruber and Wise 2002; Costa 1998).

Finally, our results may be relevant for evaluating the effects of economic recessions in developing countries, many of which have recently experienced “great depressions” (e.g., Argentina in 2002, Zimbabwe in 2003, or Greece in 2011), and for the recent economic downturn in the U.S. due to the COVID-19 pandemic, which has led to the worst recession since the Great Depression. Our assessment of the long-term consequences of the Great Depression suggests that these recent economic shocks may have substantial costs on the health and productivity of children who were born into or living through these crises. However, these costs could potentially be mitigated by U.S. safety net programs, including food stamps, TANF, EITC, and Medicaid.

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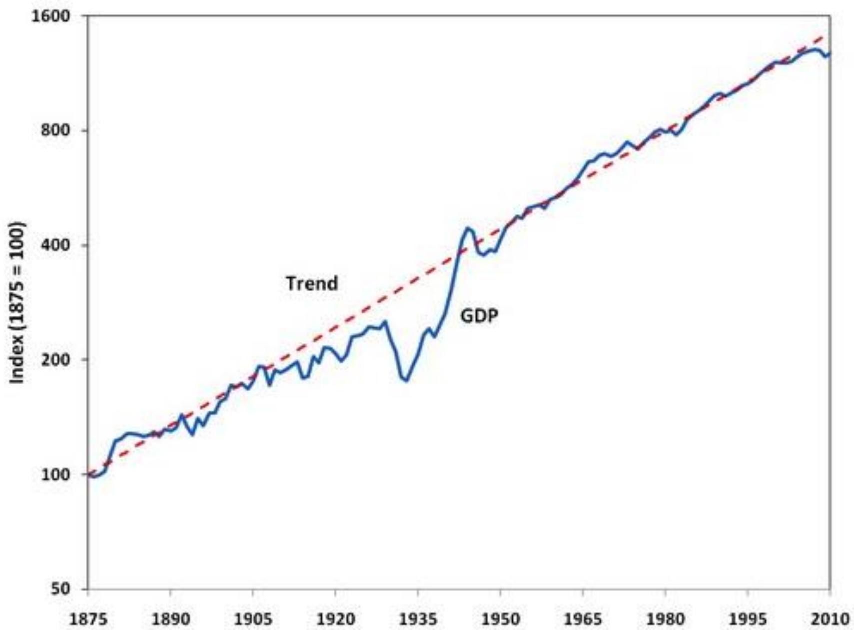
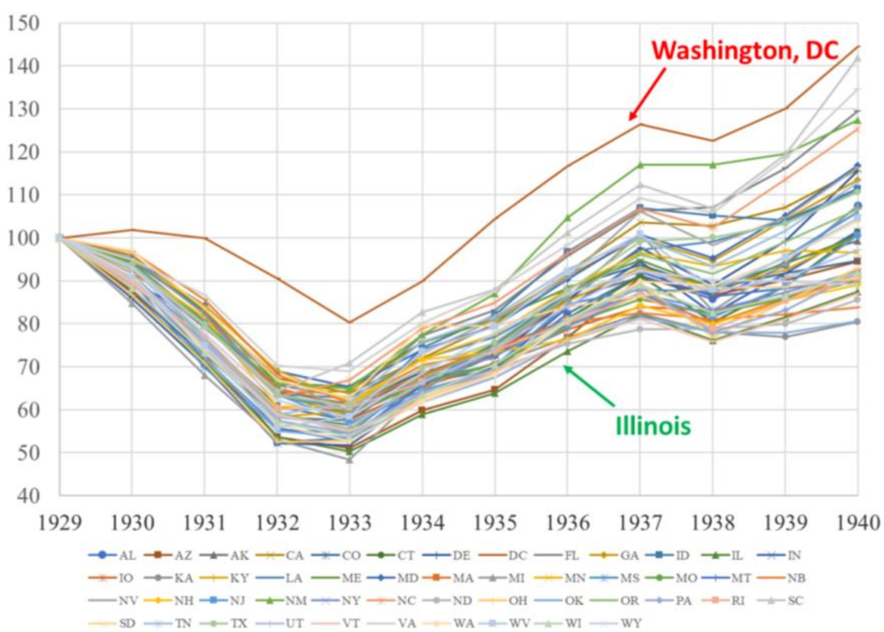
Figure 1. *Real GDP per Working-age Person in the U.S., 1875-2010*



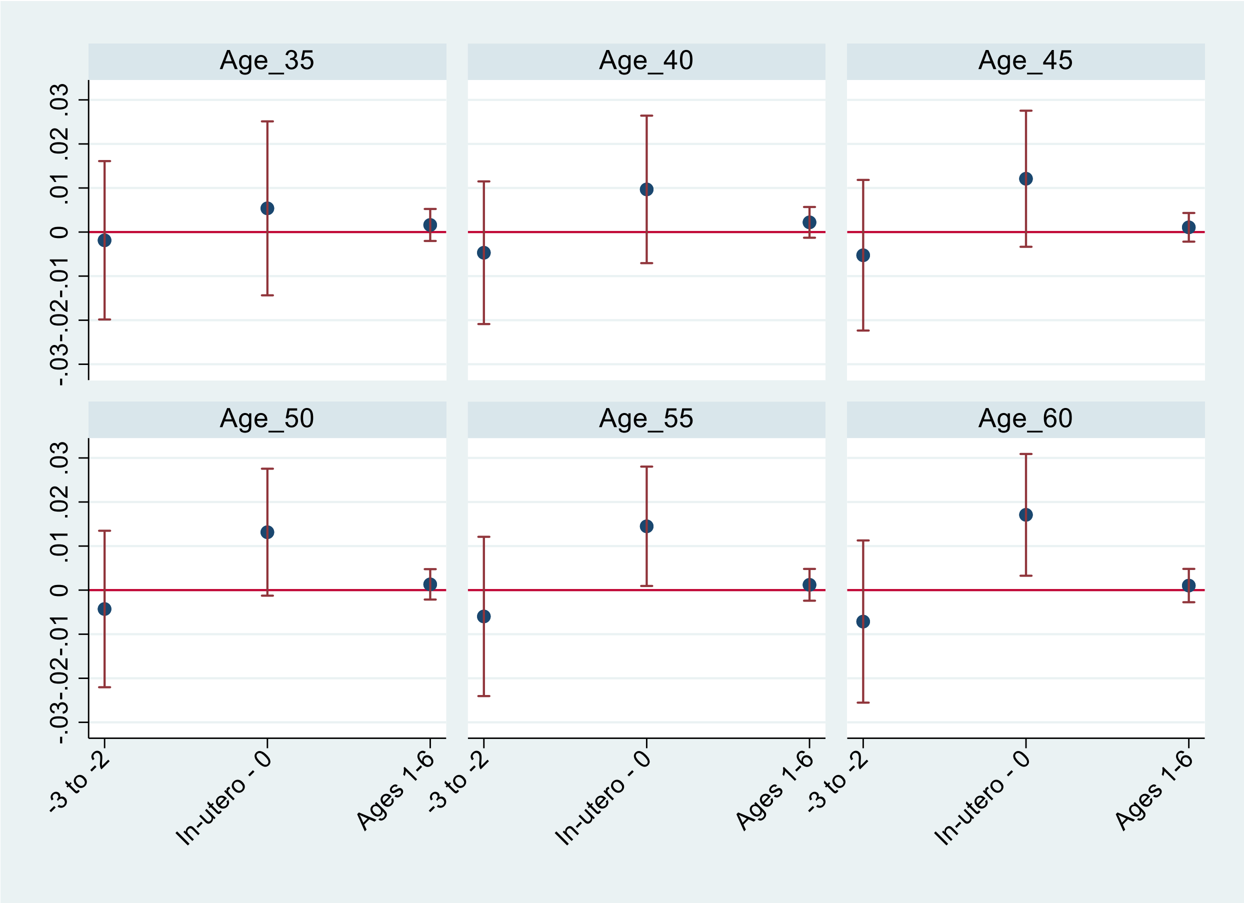
Sources: Kehoe and Prescott (2007) and Professor Timothy Kehoe's website:
http://users.econ.umn.edu/~tkehoe/

Figure 2. *Wage Index, 1929-1940*



Source: Bureau of Economic Analysis.

Figure 3. *The Effect of the Wage index on Log (accumulated earnings) by Age*



Notes: Each figure is obtained from a separate regression of the outcome variable on the wage index at different ages. Models include birth year, birth state, and HRS year fixed-effects, individual covariates, birth region FE*YOB FE, state controls*linear trends, and share of manufacturing in 1930*YOB FE. The state-level controls interacted by linear time-trends include: 1928 infant mortality rate, 1929 maternal mortality rate, and whether state has share of farmland above the 75th percentile. We also include a dummy variable equal to one if a respondent's SSA earnings records were imputed due to top coding or masked numbers. Sample includes all individuals born between 1929 and 1940 between the ages of 50 and 65 in the HRS who consented to SSA earnings records linkage. Estimates are weighted using the HRS sample weights and robust standard errors are jointly clustered at the state of birth and individual level.

Table 1. *Descriptive Statistics*

	Mean or frequency	Std. Deviation
Treatment variables		
Wage index	101.6	[19.29]
Wage index in utero	97.15	[16.45]
Wage index ages 1-6	132.58	[43.00]
Outcomes		
Human capital index (SD)	0.39	[0.99]
GED or HS degree plus	0.80	
Household wealth (2010 dollars)	487,361	[1,561,448]
Working status	0.50	
Individual earnings (2010 dollars)	26,019	[53,150]
Log (individual earnings)	5.90	[5.13]
Metabolic syndrome index (SD)	-0.04	[0.94]
Diabetes	0.18	
Heart disease	0.22	
Stroke	0.06	
High blood pressure	0.54	
Physical limitations index (SD)	-0.18	[0.67]
Activities of daily living (ADLs)	0.22	[0.71]
Instrumental activities of daily living (IADLs)	0.18	[0.65]
Individual characteristics		
Year of birth	1936	
HRS interview year	2002	
Age (in years)	65.60	[7.23]
Female	0.53	
White	0.89	
Black	0.10	
Other	0.02	
Mother's education= No degree	0.52	
Mother's education= HS plus	0.40	
Mother's education= missing info	0.07	
Father was absent	0.08	
Father’s location is missing	0.04	
Veteran status	0.28	
Rural household	0.45	
Rural household missing info	0.06	
N (person observations)	7,352	
N (person-year observations)	61,850	

Notes: The sample includes all individuals born in the U.S. in the 1930s and observed in the HRS. Descriptive statistics for the human capital index and its related components are calculated for the sample aged 50-65, while all other outcomes and variables are measured for individuals aged 50 plus. Household wealth is measured in $100,000s. Earnings and wealth are given in 2010 dollars. All statistics are weighted using HRS sample weights.

Table 2. *Association between the Wage Index and Individual and Household Characteristics*

	Age (years)	Female	White	Non-white	Veteran	Mother has no education
	(1)	(2)	(3)	(4)	(5)	(6)
Wage index ages -3 to -2	0.00164	**0.00272***	0.00017	-0.00017	-0.00259	0.00220
	[0.00148]	**[0.00144]**	[0.00071]	[0.00071]	[0.00175]	[0.00160]
Wage index in utero - age 6	-0.00022	-0.00042	0.00011	-0.00011	0.00013	0.00022
	[0.00040]	[0.00041]	[0.00039]	[0.00039]	[0.00056]	[0.00049]

	Mother has HS	Mother's education missing	Father was absent	Father's location missing	Rural HH	Rural status missing
…continued	(7)	(8)	(9)	(10)	(11)	(12)
Wage index ages -3 to -2	-0.00220	**0.00140***	0.00092	-0.00013	-0.00002	-0.00103
	[0.00160]	**[0.00077]**	[0.00075]	[0.00035]	[0.00216]	[0.00095]
Wage index in utero - age 6	-0.00022	-0.00038	**-0.00049****	0.00012	-0.00047	0.00001
	[0.00049]	[0.00027]	**[0.00021]**	[0.00013]	[0.00065]	[0.00024]
N	61,850	61,850	61,850	61,850	61,850	56,725
Birth Year FE	X	X	X	X	X	X
SOB FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X

Notes: The sample includes all individuals born in the U.S. in the 1930s and observed in the HRS after age 50. Errors are clustered at the respondent-state level. ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Table 3. *The Effect of the Wage Index on Human Capital, Metabolic Syndrome, and Physical Limitations*

	(1)	(2)	(3)	(4)	(5)
Panel A - Outcome: Human Capital Index; N=33,621					
Wage index ages -3 to -2	0.00250	0.00020	0.00195	-0.00130	0.00039
	[0.00342]	[0.00292]	[0.00454]	[0.00507]	[0.00566]
Wage index in utero	0.00340	**0.00634****	**0.00703****	**0.00606***	**0.00753****
	[0.00301]	**[0.00285]**	**[0.00321]**	**[0.00323]**	**[0.00378]**
Wage index ages 0-6	0.00184	**0.00213***	**0.00397****	**0.00333****	**0.00340****
	[0.00129]	**[0.00120]**	**[0.00155]**	**[0.00153]**	**[0.00156]**
Mean (SD)			0.11 (0.93)		
Effect of a 1SD increase in wages in utero		0.14	0.15	0.13	0.16
Panel B - Outcome: Metabolic Syndrome Index; N=61,850					
Wage index ages -3 to -2	-0.00286	-0.00159	-0.00168	-0.00271	-0.00056
	[0.00258]	[0.00262]	[0.00297]	[0.00321]	[0.00352]
Wage index in utero	-0.00198	-0.00249	**-0.00969*****	**-0.01015*****	**-0.01248*****
	[0.00278]	[0.00279]	**[0.00370]**	**[0.00364]**	**[0.00442]**
Wage index ages 0-6	0.00087	0.00084	0.00112	0.00071	0.00040
	[0.00088]	[0.00087]	[0.00111]	[0.00110]	[0.00118]
Mean (SD)			-0.03 (0.98)		
Effect of a 1SD increase in wages in utero			-0.20	-0.21	-0.25
Panel C - Outcome: Physical Limitations Index; N=48,602					
Wage index ages -3 to -2	-0.00121	-0.00048	0.00172	0.00075	0.00045
	[0.00218]	[0.00229]	[0.00270]	[0.00267]	[0.00289]
Wage index in utero	-0.00057	-0.00132	**-0.00523****	**-0.00563****	**-0.00626****
	[0.00182]	[0.00191]	**[0.00247]**	**[0.00248]**	**[0.00306]**
Wage index ages 0-6	-0.00081	-0.00093	-0.00062	-0.00089	-0.00088
	[0.00069]	[0.00073]	[0.00074]	[0.00083]	[0.00082]
Mean (SD)			-0.18 (0.67)		
Effect of a 1SD increase in wages in utero			-0.16	-0.17	-0.19
YOB FE	X	X	X	X	X
SOB FE	X	X	X	X	X
HRS Survey Year FE	X	X	X	X	X
Individual Covariates		X	X	X	X
Birth Region FE*YOB FE			X	X	X
Additional state controls*linear trends				X	X
Share of Manufacturing*YOB FE					X

Notes: Each column is obtained from a separate regression of the outcome variable on the wage index at different ages using data from the HRS. For instance, results in Column 1 only include year of birth, state of birth, and HRS survey year FE; column 2 adds individual and family covariates, etc. The additional state-level controls interacted by linear time-trends include: the 1928 infant mortality rate, the 1929 maternal mortality rate, the population in 1930, and whether a state's share of farmland was in the 75th percentile. The sample includes cohorts born between 1929 and 1940, ages 50 plus. Models also include dummies to control for extreme fluctuations in the treatment variable. The human capital index only focuses on respondents aged 50-65. Estimates are weighted using the HRS sample weights and robust standard errors are jointly clustered at the state of birth and individual level. ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Table 4. *Association between the Wage Index and the Sex Ratio (Males/Females) using U.S. Census Data*

	Sex Ratio (Males/Females)					
Census Year:	1940	1950	1960	1970	1980	1990
	(1)	(2)	(3)	(4)	(5)	(6)
Wage index ages -3 to -2	-0.000015	-0.000001	-0.00005	-0.00003	0.00002	0.00001
	[0.00006]	[0.00004]	[0.00003]	[0.00007]	[0.00003]	[0.00001]
Wage index in utero	**0.00245****	**0.00230*****	**0.00411****	**0.00390***	0.00036	**0.0020****
	[0.00117]	**[0.00074]**	**[0.00183]**	**[0.00223]**	[0.00204]	**[0.0010]**
Wage index ages 0-6	-0.000024	-0.00009	-0.00001	-0.00015	0.000049	0.00004
	[0.00009]	[0.00009]	[0.00004]	[0.00012]	[0.000037]	[0.00003]
N	550	550	550	550	550	550
Mean	1.09	1.01	0.96	0.97	0.96	0.92
YOB FE	X	X	X	X	X	X
SOB FE	X	X	X	X	X	X
Birth Region FE*YOB FE	X	X	X	X	X	X
State-controls in 1930 * birth year	X	X	X	X	X	X
State-specific linear time trends	x	x	x	x	x	x

Notes: the sample uses data from the decennial population Censuses of 1940, 1950, 1960, 1970, 1980, and 1990. The sex ratio is defined as the number of males per number of females in each birth-year-state associated with the cohort of interest (those born in the 1930s). Models include fixed effects at the year of birth, state of birth, and year of birth*region of birth levels, state-specific linear time trends, and state-level controls as described in Equation 1. Errors are clustered at the state of birth level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. *The Association between the Wage Index and Log Age-adjusted Death Rate using Vital Statistics - Mortality Records*

	Log age-adjusted mortality rate
Wage index ages -3 to -2	0.000004
	[0.00004]
Wage index in utero	**-0.00267*** **
	[0.000115]
Wage index ages 0-6	-0.00005
	[0.00003]
Mean (deaths per 100,000)	1,491
Effect of a 1 SD increase in salaries in utero	-5.4%
YOB FE	X
SOB FE	X
Wave FE	X

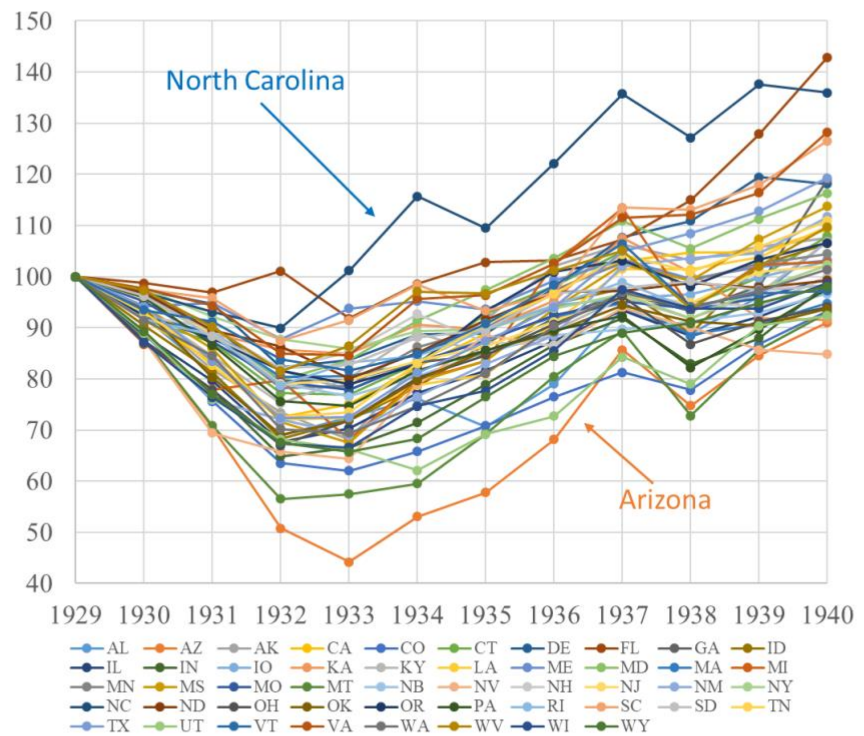
Notes: The sample uses data from Vital Statistics - Death Records 1980, 1990, and 2000. To construct the age-adjusted rate, we use population counts from the Census 1980 and 1990 and from the 2000 American Community Survey. The unit of observation is state-year-wave. Models include state and year of birth FE, and wave FE. Errors are clustered at the state of birth level. The data are collapsed to the birth state-birth-year level and models are weighted using the number of individuals in each birth-state birth-year cell. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. *The Association between the Wage Index and Causes of Mortality using Vital Statistics - Mortality Records*

	Log age-adjusted mortality rate			
	Infectious disease	Cancer	Diabetes/ Heart disease/ Cardiovascular	Accidents
	(1)	(2)	(3)	(4)
Wage index ages -3 to -2	-0.00002	-0.00001	0.000023	0.00017
	[0.00013]	[0.00007]	[0.00007]	[0.00013]
Wage index in utero	0.00278	-0.00132	**-0.00464*** **	0.00058
	[0.00249]	[0.00189]	**[0.00158]**	[0.00301]
Wage index ages 0-6	-0.00016	-0.00008	-0.00004	**0.00029** **
	[0.000146]	[0.00007]	[0.00007]	**[0.00013]**
Mean (deaths per 100,000)	74	643	647	66
Effect of a 1 SD increase in salaries in utero			-10.2%	
YOB FE	X	X	X	X
SOB FE	X	X	X	X
Individual controls	X	X	X	X

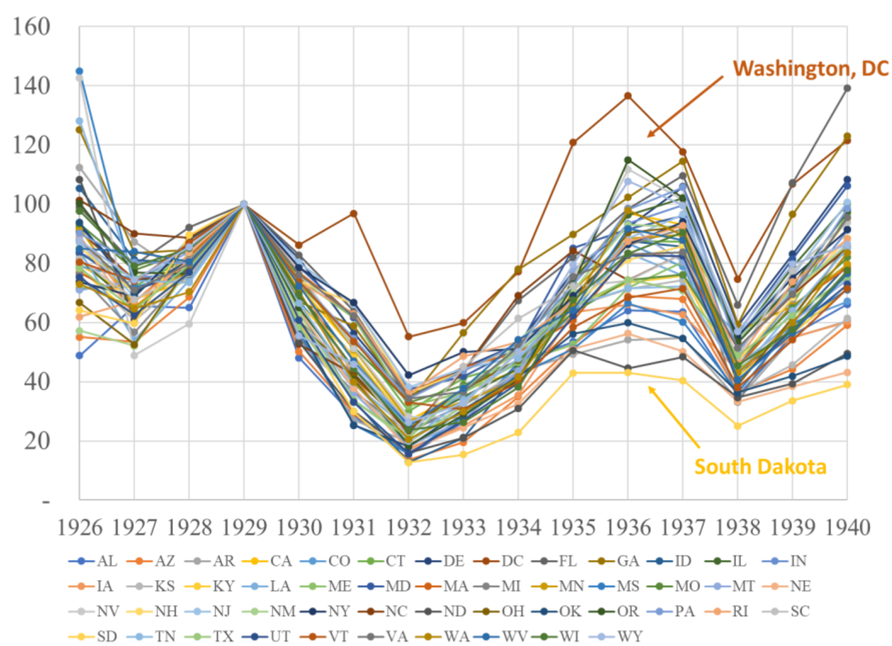
Note: The sample uses data from Vital Statistics - Death Records for 1980, 1990, and 2000. To construct the age-adjusted rate, we used population counts from the Census 1980 and 1990 and from the 2000 American Community Survey. The unit of observation is state-year-wave. The age range is: [39,74]. Models include state and year of birth FE, and wave FE. Errors are clustered at the state of birth level. The data are collapsed to the birth state-birth-year level and models are weighted using the number of individuals in each birth-state birth-year cell. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Figure 1. *Employment Index (Wallis), 1929-1940*



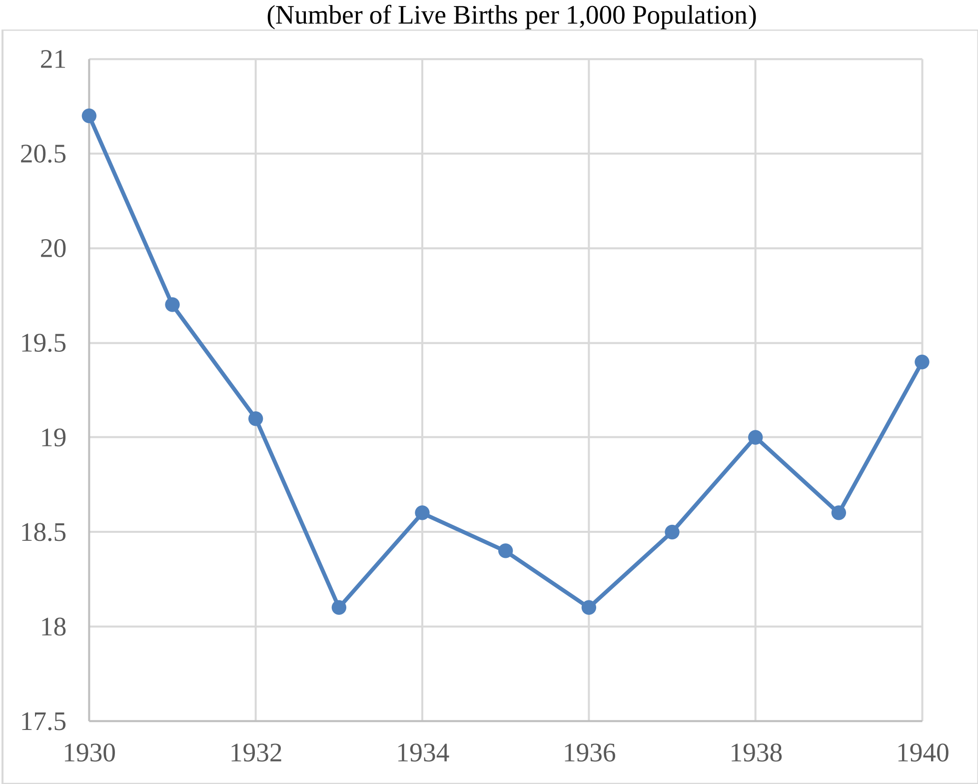
Source: Wallis (1989).

Appendix Figure 2. *Car Sales Index, 1926-1940s*



Source: Annual statistical issues of the industry trade publication, *Automotive Industries*.

Appendix Figure 3. *Crude Birth Rate in the U.S., 1930-1940*



Source: Vital Statistics Rates in the United States 1900-1940.[27]

[27] Link: https://data.nber.org/vital-stats-books/vsrates1900_40.CV.pdf

Appendix Table 1. *The Effect of the Wage Index on the Components of the Human Capital, Metabolic Syndrome, and Physical Limitation Indices*

	(1)	(2)	(3)	(4)
Panel A - Outcome: Human Capital Index; N=33,621				
	High school plus	Employed	log(earnings)	Wealth>median
Wage index ages -3 to -2	-0.002	**0.00442***	-0.00812	-0.00111
	[0.00274]	**[0.00255]**	[0.03301]	[0.00296]
Wage index in utero	-0.00021	0.00033	**0.04980****	**0.00448***
	[0.00191]	[0.00184]	**[0.02072]**	**[0.00245]**
Wage index ages 0-6	**0.00125***	0.00107	**0.01692*****	0.0001
	[0.00065]	[0.00067]	**[0.00641]**	[0.00086]
Mean (SD)	0.77 (0.42)	0.50 (0.50)	5.87 (5.11)	0.44 (0.50)
Effect of a 1 SD decline in wages in utero			0.09	20%
Panel B - Outcome: Metabolic Syndrome Index; N=61,850				
	Diabetes	Heart disease	Stroke	High blood pressure
Wage index ages -3 to -2	-0.00089	**-0.00342***	**0.00225***	-0.00043
	[0.00198]	**[0.00190]**	**[0.00124]**	[0.00251]
Wage index in utero	**-0.00315***	-0.0004	**-0.00327*****	**-0.00420***
	[0.00191]	[0.00216]	**[0.00126]**	**[0.00238]**
Wage index ages 0-6	0.00049	0.0001	**-0.00054****	0.00078
	[0.00071]	[0.00046]	**[0.00026]**	[0.00053]
Mean (SD)	0.19 (0.39)	0.22 (0.42)	0.06 (0.24)	0.55 (0.50)
Effect of a 1 SD decline in wages in utero	-0.36		-0.11	-0.16
Panel C - Outcome: Physical Limitations Index; N=48,602				
	ADL	IADL		
Wage index ages -3 to -2	-0.00149	0.00236		
	[0.00288]	[0.00288]		
Wage index in utero	**-0.00618****	**-0.00542***		
	[0.00304]	**[0.00309]**		
Wage index ages 0-6	-0.00033	**-0.00131***		
	[0.00094]	**[0.00079]**		
Mean (SD)	0.25 (0.77)	0.20 (0.68)		
Effect of a 1 SD decline in wages in utero	-0.56	-0.60		

Notes: Each column is obtained from a separate regression of the outcome variable on the wage index at different ages. The sample comes from the HRS and includes cohorts born between 1929 and 1940, ages 50 plus. The human capital index only focuses on those ages 50-65. Estimates are weighted using the HRS weights and robust standard errors are jointly clustered at the state of birth and individual level. $***p < 0.01$, $**p < 0.05$, $*p < 0.10$.

Appendix Table 2. *The Effect of the Wage Index on Age at Full Retirement*

	Full sample
	(1)
Wage index ages -3 to -2	0.04283
	[0.04503]
Wage index in utero	**0.06137****
	[0.02635]
Wage index ages 0-6	**0.01692***
	[0.00913]
N	23,275
Mean (SD)	62.96 (5.75)
Effect of a 1 SD decline in wages in utero	1.22 years

Notes: Each column is obtained from a separate regression of the outcome variable on the wage index at different ages. Each model includes all control variables and fixed effects as in Column 5 in Table 3. ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Appendix Table 3. *The Effect of the Wage Index on Log (accumulated earnings) by Age*

	Age 35	Age 40	Age 45	Age 50	Age 55	Age 60	Age 65
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wage index ages -3 to -2	-0.00187	-0.00469	-0.00526	-0.00428	-0.00597	-0.00713	-0.00778
	[0.00917]	[0.00826]	[0.00872]	[0.00906]	[0.00922]	[0.00939]	[0.00938]
Wage index in utero	0.00538	0.00968	0.01210	**0.01315***	**0.01449****	**0.01709****	**0.01827****
	[0.01007]	[0.00854]	[0.00788]	**[0.00735]**	**[0.00691]**	**[0.00705]**	**[0.00716]**
Wage index ages 0-6	0.00161	0.00220	0.00108	0.00131	0.00121	0.00104	0.00087
	[0.00185]	[0.00178]	[0.00166]	[0.00176]	[0.00184]	[0.00193]	[0.00192]
N	47,989	47,989	47,989	47,989	47,989	47,989	47,989
Mean (SD)	11.69 (1.67)	12.30 (1.50)	12.74 (1.38)	13.05 (1.32)	13.28 (1.30)	13.40 (1.30)	13.48 (1.30)
Effect of a 1SD increase in wages in utero				2.0%	2.2%	2.6%	2.8%
YOB FE	X	X	X	X	X	X	X
SOB FE	X	X	X	X	X	X	X
HRS Survey Year FE	X	X	X	X	X	X	X
Individual Covariates	X	X	X	X	X	X	X
Birth Region FE*YOB FE	X	X	X	X	X	X	X
Add'l state controls*linear trends	X	X	X	X	X	X	X
Share of Manufacturing*YOB FE	X	X	X	X	X	X	X

Note: Each column is obtained from a separate regression of the outcome variable on the wage index at different ages. Each model includes all control variables and fixed effects as in Column 5 in Table 3. We include respondents with positive earnings only. We also include a dummy variable equal to one if a respondent's SSA earnings records were imputed due to top coding or masked numbers. Sample includes all individuals born between 1929 and 1940 in the HRS who consented to SSA earnings records linkage. Estimates are weighted using the HRS sample weights and robust standard errors are jointly clustered at the state of birth and individual level. ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Appendix Table 4. *The Effect of the Employment Index and the Car Sales Index on Human Capital, Metabolic Syndrome, and Physical Limitations*

	Wages	Employment	Car Sales
	(1)	(2)	(3)
Panel A - Outcome: Human Capital Index; N=33,621			
Index ages -3 to -2	0.00039	-0.00543	-0.0010
	[0.00566]	[0.00438]	[0.003049]
Index - in utero	**0.00753****	**0.01224*****	-0.001135
	[0.00378]	**[0.00342]**	[0.00300]
Index - post birth	**0.00340****	**0.01440****	**0.003922****
	[0.00156]	**[0.00727]**	**[0.0016571]**
Mean (SD)		0.11 (0.93)	
Effect of a 1SD decline in wages in utero	0.16	0.19	
Panel B - Outcome: Metabolic Syndrome Index; N=61,850			
Index ages -3 to -2	-0.00056	-0.00021	-0.000375
	[0.00352]	[0.00503]	[0.001995]
Index - in utero	**-0.01248*****	**-0.00948***	**-0.005788*****
	[0.00442]	**[0.00510]**	**[0.001747]**
Index - post birth	0.00040	0.00062	**-0.0069*****
	[0.00118]	[0.00623]	**[0.00239]**
Mean (SD)		-0.03 (0.98)	
Effect of a 1SD decline in wages in utero	-0.25	-0.14	-0.14
Panel C - Outcome: Physical Limitations Index; N=48,602			
Index ages -3 to -2	0.00045	0.00033	0.000577
	[0.00289]	[0.00360]	[0.001479]
Index - in utero	**-0.00626****	**-0.00749*****	**-0.003141****
	[0.00306]	**[0.00254]**	**[0.001394]**
Index - post birth	-0.00088	**-0.00719****	**-0.00549*****
	[0.00082]	**[0.00356]**	**[0.002044]**
Mean (SD)		-0.18 (0.67)	
Effect of a 1SD decline in wages in utero	-0.19	-0.16	-0.11
YOB FE	X	X	X
SOB FE	X	X	X
HRS Survey Year FE	X	X	X
Individual Covariates	X	X	X
Birth Region FE*YOB FE	X	X	X
Add'l state controls*linear trends	X	X	X
Share of Manufacturing*YOB FE	X	X	X

Notes: Please see notes in Table 3. Index - Post birth is defined between ages 0-6 for wages, and between ages 0 and 2 for employment and car sales due to data availability. ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Appendix Table 5. *The Effect of the Wage Index on Human Capital, Metabolic Syndrome, and Physical Limitation in Dust Bowl and Neighboring States*

	Human Capital Index			Metabolic Syndrome			Physical Limitations Index		
	Full sample	Excluding DB and neighboring states	Only DB and neighboring states	Full sample	Excluding DB and neighboring states	Only DB and neighboring states	Full sample	Excluding DB and neighboring states	Only DB and neighboring states
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wage index ages -3 to -2	0.00039	0.00134	0.00409	-0.00056	-0.00214	0.00504	0.00045	-0.00037	**0.00821****
	[0.00566]	[0.00631]	[0.01361]	[0.00352]	[0.00330]	[0.01122]	[0.00289]	[0.00398]	**[0.00373]**
Wage index in utero	**0.00753****	0.00518	0.00809	**-0.01248*****	-0.00574	**-0.02714****	**-0.00626****	0.00009	**-0.01972*****
	[0.00378]	[0.00417]	[0.01075]	**[0.00442]**	[0.00366]	**[0.01344]**	**[0.00306]**	[0.00331]	**[0.00508]**
Wage index ages 0-6	**0.00340****	**0.00321***	**0.01146****	0.0004	0.00011	-0.0062	-0.00088	-0.00107	**-0.00708*****
	[0.00156]	**[0.00165]**	**[0.00547]**	[0.00118]	[0.00107]	[0.00866]	[0.00082]	[0.00081]	**[0.00266]**
N	33,621	25,772	7,849	61,850	47,064	14,786	48,602	36,879	11,723
YOB FE	X	X	X	X	X	X	X	X	X
SOB FE	X	X	X	X	X	X	X	X	X
HRS Survey Year FE	X	X	X	X	X	X	X	X	X
Individual Covariates	X	X	X	X	X	X	X	X	X
Birth Region FE*YOB FE	X	X	X	X	X	X	X	X	X
Add'l state controls*linear trends	X	X	X	X	X	X	X	X	X
Share of Manufacturing*YOB FE	X	X	X	X	X	X	X	X	X

Notes: Please see notes in Table 3. The Dust Bowl and neighboring states include New Mexico, Colorado, Oklahoma, Kansas, and Texas and the neighboring states include Arkansas, Iowa, Louisiana, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, and Wyoming. ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Appendix Table 6. *The Effect of the Employment Index and Log (New Deal Spending p.c.) on Human Capital, Metabolic Syndrome, and Physical Limitations*

	Human Capital Index			Metabolic Syndrome			Physical Limitations Index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wage index ages -3 to -2	0.00039	-0.00034	0.00541	-0.00056	-0.00248	-0.00321	0.00045	0.00008	-0.00011
	[0.00566]	[0.00568]	[0.00497]	[0.00352]	[0.00346]	[0.00376]	[0.00289]	[0.00302]	[0.00329]
Wage index in utero	**0.00753****	**0.00719***	0.00701	**-0.01248*****	**-0.01227*****	-0.0101	**-0.00626****	**-0.00620****	-0.00531
	[0.00378]	**[0.00372]**	[0.00422]	**[0.00442]**	**[0.00443]**	[0.00638]	**[0.00306]**	**[0.00305]**	[0.00372]
Wage index ages 0-6	**0.00340****	**0.00320****	**0.00316***	0.0004	0.00018	0.00005	-0.00088	-0.00086	-0.00091
	[0.00156]	**[0.00159]**	**[0.00177]**	[0.00118]	[0.00122]	[0.00122]	[0.00082]	[0.00085]	[0.00086]
Log (ND spending p.c.)		0.03779	0.0279		**-0.09569*****	**-0.08073*****		-0.02653	-0.02078
		[0.03383]	[0.03543]		**[0.02263]**	**[0.03105]**		[0.01666]	[0.01897]
Wage index IU-EC * Log (ND spending p.c.)			**0.00015***			-0.00015			-0.00006
			[0.00008]			[0.00021]			[0.00011]
N	33,621	33,503	33,503	61,850	61,552	61,552	48,602	48,376	48,376

Note: Please see notes in Table 3. The data on New Deal (ND) spending comes from Fishback, Kantor, and Wallis (2003). Wage index IU – EC refers to the wages from in utero up to the relevant age when the shock affects the outcome according to results shown in Tables 3 and 4. For instance, Wage index IU – EC in columns 1-3 covers the period from in utero up to age 6 while in columns 4-6 and 7-9, Wage index IU – EC only covers the in utero period (and controls for wage index ages 0-6). ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Appendix Table 7. *The Effect of the Wage Index and WWII Mobilization Rates on Human Capital, Metabolic Syndrome, and Physical Limitations*

	Human Capital Index	Metabolic Syndrome	Physical Limitations Index
	(1)	(2)	(3)
Not controlling for WWII Mobilization Rates			
Wage index ages -3 to -2	0.00466	-0.00056	0.00045
	[0.00508]	[0.00352]	[0.00289]
Wage index in utero-post birth	**0.00501*** **	**-0.01248*** **	**-0.00626** **
	[0.00153]	**[0.00442]**	**[0.00306]**
Controlling for WWII Mobilization Rates			
Wage index ages -3 to -2	0.00504	-0.00069	0.00037
	[0.00468]	[0.00350]	[0.00287]
Wage index in "early-life"	**0.00569*** **	**-0.01259*** **	**-0.00666** **
	[0.00162]	**[0.00466]**	**[0.00299]**
Wage index IU-EC * HMR	**-0.00183*** **	0.00022	**0.00142* **
	[0.00065]	[0.00142]	**[0.00074]**
N	33,621	61,850	48,602
YOB FE	X	X	X
SOB FE	X	X	X
HRS Survey Year FE	X	X	X
Individual Covariates	X	X	X
HMR dummy	X	X	X
Birth Region FE*YOB FE	X	X	X
Add'l state controls*linear trends	X	X	X
Share of Manufacturing*YOB FE	X	X	X

Notes: Please see notes in Table 3. The data on WWII mobilization rates are from Acemoglu, Autor, and Lyle (2004). HMR is a dummy that indicates whether a state had a high mobilization rate, or a rate above the national average. All three models also control for the main effect of HMR. Wage index IU – EC refers to the wages from in utero up to the relevant age when the shock affects the outcome according to results shown in Tables 3 and 4. For instance, Wage index IU – EC in Column 1 covers the period from in utero up to age 6 while in columns 2 and 3, Wage index IU – EC only covers the in utero period (and controls for wage index ages 0-6). ***p < 0.01, **p < 0.05, *p < 0.10.

Appendix Table 8. *The Effect of the Wage Index on Human Capital, Metabolic Syndrome, and Physical Limitations by Mother's Education*

	<HS	HS+
	(1)	(2)
Outcome: Human Capital Index	N=21,165	N=12,456
Index ages -3 to -2	-0.00106	-0.00315
	[0.00945]	[0.00823]
Index - in utero	**0.01069***	0.00613
	[0.00566]	[0.00827]
Index - post birth	0.00236	**0.00604***
	[0.00206]	**[0.00316]**
Mean (SD) - outcome	0.19 (1.01)	0.68 (0.88)
Effect of a 1 SD decline in salaries in utero	0.22	
Outcome: Metabolic Syndrome Index	N=38,888	N=22,962
Index ages -3 to -2	0.00514	-0.00883
	[0.00593]	[0.00750]
Index - in utero	**-0.01361*****	-0.01209
	[0.00474]	[0.00799]
Index - post birth	-0.00053	0.00167
	[0.00167]	[0.00213]
Mean (SD) - outcome	0.02 (0.97)	-0.12 (0.90)
Effect of a 1 SD decline in salaries in utero	-0.26	
Outcome: Physical Limitations Index	N=30,417	N=18,185
Index ages -3 to -2	0.00031	-0.000106
	[0.00527]	[0.00393]
Index - in utero	**-0.01184*****	0.00318
	[0.00359]	[0.00371]
Index - post birth	0.00036	**-0.00210***
	[0.000155]	**[0.00108]**
Mean (SD) - outcome	-0.14 (0.72)	-0.24 (0.57)
Effect of a 1 SD decline in salaries in utero	-0.24	

Notes: Please see notes in Table 3. Mother's education is defined as whether a respondent's mother had less than a high school degree versus more. ***p < 0.01, **p < 0.05, *p < 0.10.

Appendix Table 9. *The Effect of the Wage Index on Height (in meters)*

Wage index ages -3 to -2	0.00033
	[0.00049]
Wage index in utero	-0.00013
	[0.00045]
Wage index ages 0-6	-0.000153
	[0.00009]
N	61,850
Mean (SD)	1.71 (0.10)

Note: Please see notes in Table 3.

Appendix Table 10. *The Effect of the Wage Index on the Probability of Moving from the State of Birth to a Different State During Primary Schooling Years*

	Moved to a different state during primary schooling years	
Wage index ages -3 to -2	-0.00261	-0.00290
	[0.00229]	[0.00226]
Wage index in utero (IU) - age 6	**-0.00128****	-0.00120
	[0.00063]	[0.00094]
Wages IU-age 6 * Child is female		-0.00008
		[0.00027]
Wages IU-age 6 * Child is Black		-0.00030
		[0.00033]
Wages IU-age 6 * Child is other race		0.00092
		[0.00085]
Wages IU-age 6 * Mother has no educ		0.00005
		[0.00054]
Wages IU-age 6 * Mother has HS		0.00006
		[0.00059]
Wages IU-age 6 * Mother's educ is missing		-0.00070
		[0.00061]
Wages IU-age 6 * Father not present		-0.00019
		[0.00035]
Wages IU-age 6 * Father's location is missing		0.00017
		[0.00026]
N	61,850	61,850
Mean	0.222	
YOB FE	X	X
SOB FE	X	X
HRS Survey Year FE	X	X
Individual Covariates	X	X
Birth Region FE*YOB FE	X	X
Add'l state controls*linear trends	X	X
Share of Manufacturing*YOB FE	X	X

Note: Each column is obtained from a separate regression of the outcome variable on the wage index at different ages. The outcome variable is a dummy that takes the value of one if an individual reports a state of residence by age 10 different to the state of birth, and zero otherwise. Standard controls and fixed effects are included in the model. Estimates are weighted using the HRS weights and robust standard errors are jointly clustered at the state of birth and individual level. ∗∗∗p < 0.01, ∗∗p < 0.05, ∗p < 0.10.

Appendix Table 11. *The Association between the Wage Index and Women's Fertility using Data from the 1940 U.S. Census*

	Total fertility		Timing between births	
	(1)	(2)	(3)	(4)
Wage index ages -3 to -2	-0.0001	-0.0000	0.0000	0.0001
	[0.0001]	[0.0001]	[0.0001]	[0.0001]
Wage index in utero to age 6	**0.0004***	-0.0025	-0.0003	-0.0001
	[0.0002]	[0.0018]	[0.0003]	[0.0020]
Wages in utero to age 6 * Child is female		0.0001		-0.0003
		[0.0002]		[0.0003]
Wages in utero to age 6 * Mother is white		0.0008		0.0004
		[0.0013]		[0.0014]
Wages in utero to age 6 * Mother is Black		0.0001		0.0019
		[0.0013]		[0.0017]
Wages in utero to age 6 * Mother is married		**0.0014*****		-0.0011
		[0.0005]		[0.0010]
Wages in utero to age 6 * Mother has<HS		**0.0014****		-0.0010
		[0.0006]		[0.0009]
Wages in utero to age 6 * Mother has HS		**0.0009***		-0.0010
		[0.0005]		[0.0010]
Wages in utero to age 6 * Mother's age<30		0.0011		**0.0030*****
		[0.0011]		**[0.0008]**
Wages in utero to age 6 * Mother's age 31-39		**0.0024*****		**0.0010***
		[0.0007]		**[0.0005]**
Wages in utero to age 6 * Urban household		**-0.0014****		0.0002
		[0.0005]		[0.0004]
N	109,650	109,650	76,782	76,782
Mean	3 children		3.2 years	
YOB FE	X	X	X	X
SOB FE	X	X	X	X
Individual controls	X	X	X	X
Birth Region FE*YOB FE	X	X	X	X
State-controls in 1930 * birth year	X	X	X	X
State-specific linear time trends	X	X	X	X

Notes: the sample includes children observed in the 1940 Census. Models include child characteristics (sex, age, and age^2), family characteristics (mother's age, education, race, marital status, whether the household lives in the urban area of the state), child's birth state, birth year, and birth region*birth year FE, state-level controls measured in 1930 interacted with linear time trends, state-specific linear time trends, and a state's manufacturing share in 1930*year of birth FE. Standard errors are clustered at the state of birth level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

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