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The Long-Run Effects of Recessions on Education and Income*

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Abstract

This paper examines the long-run effects of the 1980-1982 recession on education and income. Using confidential Census data, I estimate difference-in-differences regressions that exploit variation across counties in recession severity and across cohorts in age at the time of the recession. For individuals age 0-10 in 1979, a 10 percent decrease in earnings per capita in their county of birth reduces four-year college degree attainment by 9 percent and income in adulthood by 3 percent. Simple calculations suggest that, in aggregate, the 1980-1982 recession led to 1-3 million fewer college graduates and $64-$145 billion less earned income per year.

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1 Introduction

Recessions receive tremendous attention from economists, policymakers, and the public. Most of this attention focuses on the short-run effects of recessions on workers' labor market outcomes and firms' investment and employment decisions. In this paper, I examine the long-run effects of recessions on children's and adolescents' education and income. Although these long-run effects have received less attention, they could have substantial welfare consequences, given the millions of children and adolescents exposed to each recession. Furthermore, these effects could inform topics of long-standing debate, including the welfare costs of recessions and the relationship between recessions and subsequent economic activity.

I focus on the 1980-1982 double-dip recession, which followed large increases in interest rates and the price of oil. The recession was concentrated in certain industries, like durable goods manufacturing and wood products, and counties with pre-existing specialization in these industries experienced a more severe recession. Notably, I show that the recession led to a persistent relative decrease in earnings per capita, the employment-population ratio, and median family income in negatively affected counties. The 1980-1982 recession is a valuable setting because its timing permits the study of counties' pre-recession economic conditions and individuals' long-run outcomes.

I estimate the long-run effects of the 1980-1982 recession using newly available confidential data. I link the 2000 Census and 2001-2013 American Community Surveys to the Social Security Administration NUMIDENT file, which allows me to observe outcomes in adulthood and county of birth for 23 million individuals born from 1950-1979. With these data, I estimate generalized difference-in-differences regressions that compare education and income in adulthood of individuals born in counties with a more versus less severe recession (first difference) and individuals who were younger versus older when the recession began (second difference). I isolate the effect of local labor demand shifts that emerged during the recession by instrumenting for the 1978-1982 change in log real earnings per capita with the log employment change predicted by the interaction of a county's pre-existing industrial structure and aggregate employment changes.

I find that the 1980-1982 recession led to sizable long-run reductions in education and income. For individuals age 0-10 in 1979, a 10 percent decrease in real earnings per capita in their county of birth, which is around one standard deviation, leads to a 3.0 percentage point (9.4 percent) decrease in four-year college degree attainment. The negative effects on college graduation are most severe and essentially constant for individuals age 0-13 in 1979. This age profile suggests that the underlying mechanisms are a decline in childhood human capital or a long-term decline in parental resources to pay for college. Because I estimate small and statistically insignificant effects on college graduation for individuals age 14-19 in 1979, short-term credit constraints in paying for college appear less important. I find little evidence of an effect on college attendance or high school graduation. For individuals age 0-10 in 1979, a 10 percent decrease in real earnings per capita leads to a $1,300 (3.2 percent) decrease in earned income and a 1.7 percentage point (13.9 percent) increase in the probability of living in poverty. Simple calculations and additional regressions suggest that much of the long-run effects on income stem from the effects on education. I find little evidence that states with more generous or more progressive transfer systems mitigated the long-run effects.

Several pieces of evidence support the validity of my empirical strategy. First, I show that earnings per capita evolved similarly before 1980 in counties with a more versus less severe recession. Second, I find no evidence of a relationship between the severity of the recession and the evolution of maternal education, infant birth weight, or infant mortality before 1980. Finally, I conduct falsification tests by estimating the effect of the recession on education for individuals age 23-28 in 1979, using 29 year olds as a comparison group. Reassuringly, I find no evidence of an effect for 23-28 year olds, who largely completed their schooling before the recession. These findings strongly suggest that my estimates reflect the long-run effects of the 1980-1982 recession.

The magnitude of my estimates and the large number of affected individuals suggest that the 1980-1982 recession depresses aggregate economic output today. To gauge the aggregate effects, I scale my estimates by the 105 million individuals born in the U.S. from 1951-1979. Depending on the assumed evolution of earnings per capita in the absence of the recession, back of the envelope

calculations suggest that the 1980-1982 recession led to 0.9-2.1 million fewer four-year college graduates, $64-$145 billion less earned income per year (as of 2000-2013), and 0.5-1.3 million more adults living in poverty each year. These numbers represent 1-3 percent of the stock of college-educated adults in 2015, 0.4-0.8 percent of 2015 GDP, and 1-3 percent of the number of individuals in poverty in 2015. While these calculations could understate or overstate the true aggregate effects, as I discuss in detail, the long-run effects that I document clearly are important channels through which recessions affect welfare and economic growth.

This paper contributes to three distinct literatures. First is the growing literature on the role of early life conditions in shaping human capital and productivity (for recent reviews, see Almond and Currie, 2011; Heckman and Mosso, 2014; Almond, Currie and Duque, 2017). Perhaps surprisingly, this literature provides very little direct evidence on the long-run effects of recessions on education and income.[1] Furthermore, Chetty and Hendren (2016*b*) find little relationship between local economic conditions and the effect of a place on children's long-run outcomes. As a result, considerable uncertainty exists about the magnitude, and even sign, of recessions' long-run effects. Evidence on the size of these effects is necessary for weighing the potential benefits of mitigating policies, and for assessing whether these long-run effects should be incorporated into theoretical and empirical models of recessions and the economy. My primary contribution, facilitated by newly available data, is estimating the long-run effects of a recession on education and income. Notably, I find that the long-run effects on children's and adolescents' income are more severe than the effects on individuals entering, or already in, the labor market at the time of the recession.[2]

This paper also contributes to work on the welfare costs of recessions. Most of this literature

[1]Most closely related is recent work by Cutler, Huang and Lleras-Muney (2016) and Rao (2016), who examine the long-run effects of detrended GDP and unemployment rate fluctuations that occur during childhood. These fluctuations equal zero on average, and below-trend fluctuations tend to be followed by above-trend fluctuations, so their estimates do not speak directly to the effects of a recession. Studies on the long-run effects of parental job displacement (Page, Stevens and Lindo, 2007; Bratberg, Nilsen and Vaage, 2008; Oreopoulos, Page and Stevens, 2008; Coelli, 2011; Hilger, 2016) also are related, but do not directly assess the long-run effects of recessions, which might operate through additional channels besides parental job loss, such as schools, neighborhoods, and peers. Similarly, studies on the effects of parental income do not directly assess the long-run effects of recessions.

[2]Recent studies on the effect of entry labor market conditions on workers include Kahn (2010); Hershbein (2012); Oreopoulos, von Wachter and Heisz (2012); Speer (2016).

focuses on the costs of intertemporal substitution in consumption (see the review in Lucas, 2003). In contrast, I study costs that stem from long-run declines in children's and adolescents' human capital attainment. My results imply that recessions are costlier than previously thought and point to new possible targets for social insurance and economic stabilization policies.[3]

Finally, this paper contributes to the literature studying how recessions affect subsequent economic activity. An influential strand of this literature examines recessions' cleansing effects, which increase productivity as less productive firms exit and resources are reallocated to remaining firms (e.g., Schumpeter, 1939, 1942; Caballero and Hammour, 1994; Davis, Haltiwanger and Schuh, 1996; Foster, Grim and Haltiwanger, 2016). My results demonstrate that recessions also affect productivity in a markedly different way, by reducing children's and adolescents' human capital attainment.

2 Background: The 1980-1982 Recession

The 1980-1982 double-dip recession had sizable short-run effects on the U.S. economy.[4] The recession followed large increases in interest rates and the price of oil, as Paul Volcker and the Federal Reserve fought inflation and the Iranian Revolution curbed oil production and created panic in energy markets. The unemployment rate was stable from 1978-1980, then increased from 6.3 percent in January 1980 to 10.8 percent in November 1982. As seen in Table 1, employment declines were concentrated in certain industries. The manufacturing sector lost 881,000 jobs from 1978-1982, and the construction sector lost 171,000 jobs.[5] Within manufacturing, 546,000 jobs were lost in three industries alone: transportation equipment, primary metal (which includes steel mills), and lumber and wood products. Not all industries experienced employment declines. Total employment increased by 4.5 million from 1978-1982, with notable growth in the mining sector

[3]This paper does not analyze the desirability of social insurance or economic stabilization policies, but such an analysis should depend in part on the long-run effects documented in this paper.

[4]The NBER recession dates are January to July 1980 and July 1981 to November 1982. I treat these as a single episode.

[5]Here and below, I use 1978 as the pre-recession year because some economic indicators, including earnings per capita, began to decline in 1979.

(which includes oil and gas extraction) and the service sector.

To measure the effect of the recession on local economic activity, I use Bureau of Economic Analysis (BEA) data on earnings per capita. Total earnings of a county's residents, available starting in 1969, primarily comes from administrative unemployment insurance and tax data. The earnings concept is comprehensive, including income from the labor market and asset ownership, and the denominator of earnings per capita comes from Census annual population estimates. Throughout, I use the CPI-U to express all monetary variables in 2014 dollars. For each county, I measure the severity of the recession as the 1978-1982 decrease in log real earnings per capita. This variable captures several ways a recession might affect a county's residents, such as extensive margin employment changes, replacement of full-time with part-time jobs, replacement of high-wage with low-wage jobs, and decreasing wages or hours within a job.

Figure 1 shows that the severity of the recession varied considerably across counties. Categories on the map correspond to deciles, with darker shades of red indicating a more severe recession. Twenty percent of counties experienced a decline in earnings per capita of 16.5 percent or more, while twenty percent grew.[6] The map displays regional patterns in recession severity that mirror patterns in industrial specialization. Oil-exporting states, like Kansas, Oklahoma, and Texas, benefited from high oil prices, and states specializing in durable goods manufacturing, like Indiana, Michigan, and Ohio, saw particularly large declines. New England, with more high tech and defense manufacturing, fared relatively well, while the Pacific Northwest, which specialized in logging, fared poorly. Parts of the agricultural upper Midwest also fared poorly, in conjunction with the "farm crisis" (Barnett, 2000). Although the regional patterns are striking, 92 percent of the variation in the severity of the recession is within-region and 63 percent is within-state.

Earnings per capita declined suddenly in counties where the recession was more severe, and the relative earnings decline between more versus less severe recession counties has persisted. To show this simply, Figure 2 plots population-weighted mean earnings per capita for counties with

[6]The unweighted average decrease in log earnings per capita is 7.4 percent, and the standard deviation is 12.0 percent. Using 1978 population weights, the average decrease is 5.8 percent, and the standard deviation is 7.6 percent. The histogram of log earnings per capita changes closely approximates a normal distribution (Appendix Figure A.1).

a recession more and less severe than the nationwide (1978 population-weighted) median.[7] I shift the less severe recession line down by $2,110, so that the two lines are equal in 1978, to focus on the evolution of earnings per capita over time. Mean earnings per capita evolves identically in more versus less severe recession counties from 1969-1978, then diverges with the onset of the recession. From 1978-1982, mean earnings per capita falls by $2,708 (10.4 percent) in more severe recession counties, while increasing by $44 (0.2 percent) in less severe recession counties. After 1982, mean earnings per capita evolves similarly in both sets of counties, including during later recessions, leaving severe recession counties with a persistent relative decline.[8]

The persistence of the relative decline in Figure 2 might seem surprising, given the conventional wisdom, based largely on Blanchard and Katz (1992), that local wages and employment rates converge after negative labor demand shocks. However, several studies find lasting wage and employment rate reductions (Bartik, 1991, 1993; Bound and Holzer, 2000; Greenstone and Looney, 2010; Autor, Dorn and Hanson, 2013; Dix-Carneiro and Kovak, 2016; Yagan, 2016), and economic forces can rationalize this finding.[9] For example, in areas experiencing a decline in comparative advantage, a recession could catalyze a lasting reduction in economic activity by inducing employers to pay fixed adjustment costs and shut down or move to other areas (Foote, 1998). Greater out-migration rates of high income workers following a decrease in local labor demand also could contribute to a persistent decrease in earnings per capita (Topel, 1986; Bound and Holzer, 2000; Notowidigdo, 2013). Quantifying the sources of the persistent relative decline is beyond the scope of this paper. Instead, I focus on the long-run effects of the recession on children and adolescents.

[7] I limit the figure to 2002 to focus on years that are most relevant for long-run effects on educational attainment, as the youngest cohort in my sample is 23 years old in 2002. Appendix Figure A.2 contains results for 1969-2013.

[8] The employment-population ratio displays a similar pattern (Appendix Figure A.3). Appendix A provides additional details on the persistent decline in local economic activity following the 1980-1982 recession.

[9] My results on the persistence of the 1980-1982 recession agree closely with Greenstone and Looney (2010), but differ from the conclusion of Feyrer, Sacerdote and Stern (2007). Appendix B describes the relationship between my work and these papers in detail.

3 Possible Long-Run Effects of a Recession on Education and Income

This section draws on previous theoretical and empirical work to describe the possible long-run effects of a recession on education and income. Economic theory does not provide a sharp prediction about the magnitude or even sign of long-run effects, but it does highlight potential channels.

A recession could affect educational attainment and lifetime income by increasing or decreasing human capital obtained during childhood. The stock of childhood human capital depends on material and time investments from parents, community investments from schools, neighborhoods, and peers, and an initial human capital endowment (Almond and Currie, 2011; Heckman and Mosso, 2014). A recession-induced decrease in the local wage could produce income and substitution effects. The income effect predicts a decrease in parents' material investments.[10] The substitution effect, due to a decrease in the cost of spending time with children, predicts an increase in parents' time investments.[11] Community investments could fall due to a reduction in government expenditures or the quality of schools, neighborhoods, or peers.[12] I focus on individuals born before 1980, for whom the recession does not affect initial human capital endowments.

A recession could influence high school or college degree attainment independently of any effects on childhood human capital. In choosing their desired level of schooling, individuals trade off higher lifetime earnings against the opportunity cost of forgone earnings and the cost of tuition (Mincer, 1958; Becker, 1962; Ben-Porath, 1967). A recession-induced decrease in the earnings of less educated workers could reduce the opportunity cost, leading to long-run increases in education and income.[13] However, in the presence of credit constraints, a recession might decrease parents'

[10] An income effect also could arise from a decline in house prices and parental wealth. Some studies find that children's long-run outcomes are sensitive to changes in family resources (Aizer et al., 2016; Hoynes, Schanzenbach and Almond, 2016), while others do not (Jacob, Kapustin and Ludwig, 2015; Bleakley and Ferrie, 2016). Bulman et al. (2016) find that college attendance is sensitive only to very large increases in income.

[11] Aguiar, Hurst and Karabarbounis (2013) find that parents spent more time with children during the Great Recession, and Del Boca, Flinn and Wiswall (2014) find that parental time produces cognitive skills in children. Additional time might have limited benefits, or even be harmful, if the recession increases parental stress (McLoyd et al., 1994; Leininger and Kalil, 2014; Akee et al., 2015; Brand, 2015).

[12] Existing work documents long-run effects of both disruptive peers (Carrell, Hoekstra and Kuka, 2016) and neighborhoods (Chetty and Hendren, 2016*a*; Chetty, Hendren and Katz, 2016; Chyn, 2016).

[13] Empirical work finds an important role for opportunity cost in educational attainment (Black, McKinnish and Sanders, 2005; Cascio and Narayan, 2015; Charles, Hurst and Notowidigdo, 2015; Atkin, 2016). Bound and Holzer

ability to pay for college, leading to long-run decreases in education and income.[14]

This conceptual framework informs the unit of geography that I use to measure recession exposure in the empirical analysis. A recession's long-run effects could arise from mediating effects on parents, schools, neighborhoods, peers, and the local labor market. Counties, which are the most detailed unit of geography in my data, do not map exactly to school districts, neighborhoods, or peer groups, but they resemble these sources of local community investments more closely than do commuting zones or metropolitan areas. Moreover, BEA data report earnings by county of residence, so they reflect commuting patterns throughout the local labor market and could be especially relevant for perceived labor market opportunities. These considerations lead me to prefer counties over commuting zones in measuring recession exposure. However, I examine the sensitivity of my results to this choice, as described below.

4 Data and Empirical Strategy

4.1 Data on Long-Run Outcomes and County of Birth

To estimate the long-run effects of the 1980-1982 recession, I use newly available confidential data, consisting of the 2000 Census and 2001-2013 American Community Surveys linked to the Social Security Administration NUMIDENT file. The linked data contain both outcomes in adulthood and county of birth. My sample consists of individuals born in the continental U.S. from 1950-1979 who are 25-64 years old at the time of the survey. I exclude individuals living in group quarters, who are not in the 2001-2005 ACS data, and individuals with imputed age, sex, race, or state of birth. I also exclude individuals with imputed dependent variables, leading to three nested samples. My first sample contains 23.5 million individuals with non-imputed years of

(2000) and Hoynes, Miller and Schaller (2012) show that the 1980-1982 recession especially reduced the wages and employment of less educated workers.

[14]Several studies conclude that short-term credit constraints are relatively unimportant for college attendance or graduation (Cameron and Heckman, 2001; Cameron and Taber, 2004; Stinebrickner and Stinebrickner, 2008; Bulman et al., 2016), but some evidence from college decisions made in the early 2000s suggests a larger role for credit constraints (Belley and Lochner, 2007; Bailey and Dynarski, 2011; Lovenheim, 2011). Charles, Hurst and Notowidigdo (2015) find that the early 2000s housing boom decreased college enrollment, consistent with opportunity cost being more important than parental resources in their setting.

education. My second sample contains 18.4 million individuals that also have non-imputed labor market outcome variables, and my third sample contains 15.6 million individuals that also have positive personal income, earned income, family income, and hourly wages.[15] I limit these samples to the 89 percent of individuals with a unique Protected Identification Key (PIK), which is an anonymized identifier, and unique birth county.[16]

4.2 Generalized Difference-in-Differences Specification

I estimate the recession's long-run effects with a generalized difference-in-differences specification that compares education and income in adulthood of individuals born in counties with a more versus less severe recession (first difference) and individuals who were younger versus older when the recession began (second difference). In particular, consider the individual-level regression

$$y_{i,a,c,t} = R_c^{78-82}\pi_a + x_{i,a,c,t}\beta + \gamma_c + \theta_{a,s(c)} + \delta_t + \varepsilon_{i,a,c,t}, \tag{1}$$

where $y_{i,a,c,t}$ is a measure of educational attainment or income in adulthood of individual i, who was age a in 1979, born in county c, and observed in survey year t. The explanatory variable of interest is R_c^{78-82}, which measures recession severity as the decrease in log real earnings per capita from 1978-1982 in county c. The vector $x_{i,a,c,t}$ includes indicators for sex and race, plus a cubic in age at the time of the survey to capture life-cycle patterns. $x_{i,a,c,t}$ also includes interactions between indicators for age in 1979 and the 1950-1970 change in log median family income in county c to

[15] These samples balance the goals of using as much information as possible, given non-trivial imputation rates for labor market outcomes, and limiting the number of samples to ensure that no confidential information is disclosed. In publicly available 2000-2013 Census/ACS data, for people born in the U.S. from 1950-1979 who are age 25-64 at the time of the survey, 8.1 percent of individuals have imputed age, sex, race, or state of birth. Among individuals with no imputations in these variables, 1.8 percent are in group quarters. A further 1.1 percent of individuals have imputed years of education, and 21.3 percent have imputed education or labor market variables (any of the seven individual income variables, total family income, weeks worked, hours worked, marital status, and labor force status).

[16] The Census Bureau assigns PIKs to individuals in the Census and ACS using information on respondents' name, address, date of birth, and gender. Sometimes a PIK is assigned to more than one respondent in a survey year. While technically possible (e.g., if an individual receives a survey at multiple residences), this outcome likely reflects an error in PIK assignment. An individual may be assigned to multiple birth counties if the 12-character string from the NUMIDENT does not identify a single county. For example, there are two towns named Arcadia in North Carolina, and a respondent who writes "Arcadia" could be matched to two counties. Appendix C describes the algorithm that identifies county of birth using the 12-character place of birth string in the NUMIDENT.

control for the fact that counties with a more severe recession saw greater income growth from 1950-1970 (see Appendix A.1). Birth county fixed effects, γ_c, absorb cross-county differences in initial human capital endowments, plus fixed characteristics of parents and communities. Age in 1979-by-birth state fixed effects, $\theta_{a,s(c)}$, control flexibly for changes over time in state-level higher education access, transfer programs, and other factors.[17] Survey year fixed effects are given by δ_t.

The parameter of interest, π_a, measures the effect of the recession on individuals who were age a in 1979. This parameter reflects the persistent relative decline in local economic activity in counties where the recession was more severe. I allow π_a to vary flexibly with age in 1979 because the operative mechanisms and sensitivity to the recession might vary with age. To facilitate the inclusion of birth county fixed effects, I normalize the parameter $\pi_{29} = 0$. As a result, the identified parameters are the effects on individuals age a minus the effect on 29 year olds, $\pi_a - \pi_{29}$. For education outcomes, 29 year olds provide a useful comparison group because they largely completed their schooling before the recession. Individuals between the ages of 23-28 also largely completed their schooling before the recession, which suggests a falsification test of whether $\pi_a = 0$ for $a = 23, \ldots, 28$.[18] For income, this approach could yield estimates that are biased upwards if 29 year olds experience a long-run decrease in income (i.e., $\pi_{29} < 0$) because of job loss (Davis and von Wachter, 2011) or a decline in local job quality (Hagedorn and Manovskii, 2013; Kahn and McEntarfer, 2015). This suggests that any negative estimated effects on income are too conservative.

Earnings per capita might have decreased from 1978-1982 in a county because of a recession-induced decrease in labor demand or an unrelated change in the composition of a county's residents, such as an increase in the relative number of low income workers. To isolate the role of the recession, I construct an instrumental variable that predicts the 1978-1982 log employment change

[17] Recessions could affect higher education access and transfer program expenditures, but there are many other determinants of these programs. Given the conceptual and practical challenges of controlling for changes due to factors besides the recession, I prefer to include age in 1979-by-birth state fixed effects. I examine the sensitivity of my results to this choice, as described below.

[18] For individuals born from 1957-1964, about 75 percent of four-year college degree attainment is completed by age 25 and 85 percent is completed by age 29 (see Appendix Figure A.10).

using a county's 1976 industrial structure and aggregate employment changes,

$$D_c^{78-82} = \sum_j \eta_{c,j,1976}(e_{-s(c),j,1982} - e_{-s(c),j,1978}). \tag{2}$$

In equation (2), $\eta_{c,j,1976}$ is the share of county c's employment in two-digit industry j in 1976, and $(e_{-s(c),j,1982} - e_{-s(c),j,1978})$ is the log employment change from 1978-1982 for industry j in all states in the same region besides the state of county c.[19] This instrumental variable strategy is common in studies of local labor markets (e.g., Bartik, 1991; Blanchard and Katz, 1992; Bound and Holzer, 2000; Notowidigdo, 2013; Diamond, 2016). It exploits the fact that the recession was more severe in counties that specialized in industries, like durable goods manufacturing or wood products, that were more sensitive to fluctuations in interest rates, oil prices, and the business cycle. I estimate equation (1) with two stage least squares, where the predicted log employment change from 1978-1982, D_c^{78-82}, is an instrument for R_c^{78-82}.

The ideal variable for measuring recession exposure is individuals' county of residence in 1979. Recession exposure should not depend on post-recession migration, which is one of many actions that parents might take to mitigate the effects of the recession. However, I only observe individuals' county of birth. This generates measurement error which likely attenuates estimates of π_a. Appendix E describes this measurement error in detail and reports estimates of the attenuation bias from auxiliary data sets.

To reduce computational burden, I collapse Census and ACS individual-level data into cells defined by age in 1979, birth county, survey year, race, and sex, and I estimate grouped regressions with weights equal to the number of observations in each cell.[20] I cluster standard errors by birth

[19] I use the predicted log employment change because earnings data are not available at a sufficiently detailed industry level. I exclude the contribution from a county's own state to remove a mechanical relationship between the actual and predicted change in economic activity. Using other states in the same region, as opposed to all other states, slightly improves explanatory power by allowing industry-level employment changes to differ by region. I construct D_c^{78-82} using Census County Business Patterns (CBP) data. CBP data frequently suppress employment for county-by-industry cells to protect respondent confidentiality, but never suppress the number of establishments within establishment size categories. I impute CBP employment using the number of establishments and nationwide information on employment by establishment size, as described in Appendix D.

[20] This grouped regression produces point estimates that are nearly identical to those from an individual-level regression. If I used indicator variables instead of a cubic for age in $x_{i,a,c,t}$, the grouped regression would produce the

state to allow for arbitrary serial and spatial correlation within states.

5 Results: The Long-Run Effects of the 1980-1982 Recession

This section presents my main results. I first show that the recession led to sizable long-run reductions in education and income. I then provide evidence supporting the validity of my empirical strategy and the robustness of my results. Finally, I discuss mechanisms and policies that might have mitigated the recession's long-run effects.

5.1 Long-Run Effects on Education

Figure 3 shows that the 1980-1982 recession reduced children's four-year college degree attainment. The figure displays 2SLS estimates of equation (1), where I use three-year age bins to estimate π_a more precisely.[21] Estimates for individuals who were 23-28 years old in 1979 are small and indistinguishable from zero ($p = 0.52$), indicating that the severity of the recession is not related to college degree attainment for this group. Because college degree attainment is largely completed by age 23, this finding supports the validity of my empirical strategy. Negative effects emerge for individuals who were younger when the recession began, with these effects being most severe, essentially constant, and statistically significant for individuals age 0-13 in 1979. For this group, the point estimates imply that a 10 percent decrease in earnings per capita from 1978-1982, which is slightly smaller than one standard deviation, reduces four-year college degree attainment by three percentage points, or around nine percent of mean attainment.

The age profile in Figure 3 informs the mechanisms underlying these long-run effects. As discussed in Section 3, negative long-run effects on children could stem from a decrease in childhood human capital development or a decrease in parental resources to finance college in the presence of credit constraints. In principle, a decrease in parental resources to finance college also could affect teenagers, who are close to the typical college-entry age, and individuals already enrolled

same point estimates as the individual-level regression.

[21] The bins are for 1979 ages 0-1, 2-4, 5-7, 8-10, 11-13, 14-16, 17-19, 20-22, 23-25, and 26-28.

in college. However, I estimate small and statistically insignificant effects for individuals age 14-22 in 1979, which suggests that the short-term decrease in parental resources plays a minor role. Nonetheless, a long-term decrease in parental resources could explain the effects on children.

Table 2 reports estimates of long-run effects on several measures of educational attainment, grouping together individuals age 0-10, 11-19, and 20-28 in 1979. There is no evidence of an effect on the attainment of at least a high school diploma or GED. The point estimates for college attendance are negative, but small and indistinguishable from zero. Column 3 shows sizable and statistically significant negative effects on any college degree attainment for individuals age 0-19 in 1979. Columns 4 and 5 separate college degree attainment into two mutually exclusive categories: four- and two-year degree attainment.[22] There is evidence of a decrease in four-year degree attainment, as shown in Figure 3, and an increase in two-year degree attainment for individuals age 0-10 in 1979, consistent with partial substitution from four- to two-year colleges. The estimates in column 6 on total years of schooling are small and imprecisely estimated, masking the sizable and statistically significant effects on college degree attainment.[23] For individuals age 0-10 in 1979, a 10 percent decrease in earnings per capita from 1978-1982 leads to a 1.8 percentage point (4.4 percent) decrease in any college degree attainment, a 3.0 percentage point (9.4 percent) decrease in four-year degree attainment, and a 1.2 percentage point (12.8 percent) increase in two-year degree attainment. Overall, the negative effects of the recession are concentrated at higher levels of educational attainment, for which childhood human capital and parental resources seem to have the largest impacts (Belley and Lochner, 2007; Bailey and Dynarski, 2011).

Previously studied policies provide a useful comparison for understanding the size of these effects. A 10 percent decrease in earnings per capita from 1978-1982 for individuals age 0-10 in 1979 has an effect on any college degree attainment comparable in magnitude to the Tennessee Student/Teacher Achievement Ratio (STAR) Experiment, which randomly reduced kindergarten to grade 3 class sizes by roughly 30 percent and increased college degree attainment by 1.6 percent-

[22]Census/ACS data measure the highest degree completed, so an individual with a two- and four-year degree is recorded as having a four-year degree.

[23]The estimates in column 6 are consistent with those in columns 1-5, as I construct all of the dependent variables using the Census/ACS educational attainment variable.

age points (Dynarski, Hyman and Schanzenbach, 2013). The effect of the recession on four-year college degree attainment is larger than the STAR Experiment, which increased four-year degree attainment by 0.9 percentage points (Dynarski, Hyman and Schanzenbach, 2013), and is comparable in magnitude to statewide scholarship programs that offered free tuition and fees for qualified students (Dynarski, 2008).

For completeness, Appendix Table A.10 reports OLS and reduced-form estimates, and Appendix Table A.11 reports first stage estimates.[24] First stage F-statistics are reasonably strong, ranging from 18 to 20. Appendix G discusses heterogeneity by sex and race.

5.2 Long-Run Effects on Income, Wages, and Poverty

Table 3 shows that the recession led to long-run decreases in income and wages and increases in poverty. For individuals age 0-10 in 1979, the estimates imply that a 10 percent decrease in earnings per capita from 1978-1982 reduces personal income by 2.2 percent ($900), earned income by 3.2 percent ($1,300), and hourly wages by 1.8 percent ($0.45).[25] For the same group, total family income falls by 3.7 percent ($3,000), and the probability of living in poverty increases by 13.9 percent (1.7 percentage points).[26] Individuals age 11-19 in 1979 experience a similar decrease in income and wages and a somewhat smaller increase in poverty. Notably, the long-run effects of the recession on income, wages, and poverty are more severe for individuals who were children and adolescents when the recession began than for individuals who were young adults and already

[24] OLS estimates generally are attenuated relative to 2SLS estimates. One explanation is that a labor demand shock has more severe effects than a labor supply shock, and the OLS estimates reflect labor supply shocks more than the 2SLS estimates. A related explanation is that the local average treatment effect of an earnings decrease due to a change in the number of jobs is larger in magnitude than the effect of a general earnings decrease. A third explanation is that the 2SLS estimates reduce attenuation bias from measurement error in the 1978-1982 decrease in log earnings per capita. Measurement error could arise when the BEA converts earnings reported by place of work to place of residence (see also Charles and Stephens, 2013). This is distinct from the measurement error that arises due to some individuals' county of residence in 1979 differing from their place of birth.

[25] Earned income is wage and salary plus business and farm income. Personal income is the sum of earned, welfare, Social Security, Supplementary Security, investment, retirement, and other income. To limit the influence of potential outliers in the self-reported income data, for each income category I replace values above the 99.5th percentile in each survey year by state of residence cell with the average among those above the 99.5th percentile. I construct earned and personal income as the sum of the non-imputed, top-code-adjusted components.

[26] In constructing family income and poverty rates, I separate extended families living in the same household (see Hoynes, Page and Stevens, 2006). I create family interrelationship variables in the confidential Census/ACS data that mirror those constructed by Ruggles et al. (2015) in IPUMS data.

in the labor market. This points to the importance of human capital attainment in explaining these results. As the recession might have negatively affected individuals who were 29 years old in 1979, these estimates could be biased upwards (i.e., too conservative).[27]

Recent work by Chetty and Hendren (2016*a*,*b*) provides a valuable comparison for understanding the size of these effects. Chetty and Hendren study what happens when children grow up in worse or better places, where neighborhood (i.e., commuting zone or county) quality is fixed over time and measured by the income in adulthood of permanent residents. As a result, Chetty and Hendren's neighborhood quality measure reflects many determinants of long-run outcomes besides local economic conditions. Nonetheless, the effects of the recession are sizable relative to Chetty and Hendren's measure: for individuals age 0-10 in 1979, a 1 standard deviation increase in recession severity has similar effects on family income as a 0.5 standard deviation decrease in Chetty and Hendren's county quality measure throughout childhood.[28]

The age profiles in Table 3 differ somewhat from Table 2, which shows more severe effects on college degree attainment for individuals who were younger when the recession began. One likely explanation is life-cycle bias due to my inability to observe all individuals at the same age (Haider and Solon, 2006). In particular, the effect of the recession on income early in an individual's career could be biased upwards relative to the effect on lifetime income. As a result, I likely understate the size of the lifetime effect for individuals who were younger when the recession began.[29]

Simple calculations suggest that the effects of the recession on children's education can explain much of the effects on income and wages. For individuals age 0-10 in 1979, the effects of the

[27]For completeness, Appendix Tables A.12 and A.13 present results for other labor market outcomes. Many of these results are difficult to interpret because the sign of the long-run effect on 29 year olds, π_{29}, is uncertain.

[28]A 1 SD increase in the severity of the recession amounts to a 11.4 percent decrease in earnings per capita from 1978-1982, which leads to a 4.2 percent decrease in family income. Chetty and Hendren (2016*b*) find that each additional year of childhood spent in a 1 SD worse county leads to a 0.4 percent decrease in family earnings at age 26, so spending 20 years in a 1 SD worse county leads to an 8 percent decrease in earnings (p. 14).

[29]Because the recession reduces college degree attainment, the effect of the recession on early career income is likely less negative than the effect on lifetime income. The effect on late career income (e.g., for individuals age 29 in 1979) could be more negative than the effect on lifetime income, in part because early career income is earned before the recession. Both considerations lead to an upwards bias in the difference-in-differences estimates, with this bias being more severe for younger individuals. Haider and Solon (2006) find substantial life-cycle bias up to age 30. Because the 2000 Census has more observations than the 2001-2013 ACS samples, my estimates place higher weight on earlier ages, which suggests that life-cycle bias could be quantitatively important.

recession on college degree attainment and the cross-sectional income-schooling gradient suggest that a 10 percent decrease in earnings per capita should reduce earned income by 1.8 percent through the education channel alone.[30] This accounts for 56 percent of the estimated effect on earned income in Table 3. For the same group, the education channel predicts negative effects on wages and family income of 1.6 and 1.8 percent, which account for 90 and 48 percent of the estimates in Table 3.

To further examine the role of education in explaining long-run effects on income and wages, I estimate regressions that control for high school/GED attainment, college attendance, two-year college degree attainment, and four-year college degree attainment. If these variables eliminate the relationship between recession severity and income, then education could be the key mechanism. However, this approach likely overstates the importance of education by attributing to it unobserved determinants of income that are positively correlated with education, such as cognitive skills. As seen in Table 4, the point estimates indicate that education can explain up to 56 percent of the effect on earned income, 90 percent of the effect on wages, and 42 percent of the effect on family income for individuals age 0-10 in 1979. These results, which are extremely similar to those based on the cross-sectional income-schooling gradient, reinforce the importance of education as a mediating factor.

The negative effects on income and wages also might arise from individuals' tendency to live and work near their place of birth, which experienced a persistent decrease in local economic activity following the 1980-1982 recession. To examine this, I estimate regressions that include fixed effects for individuals' commuting zone of residence. This approach could overstate the importance of location if unobserved determinants of income are positively correlated with living in a high income labor market. For individuals age 0-10 in 1979, the point estimates in Table 4 indicate that location can explain up to 65 percent of the effect on earned income, 101 percent of the effect on wages, and 53 percent of the effect on family income. Consequently, location also

[30] In 2000-2013 Census/ACS data, the Mincerian returns to a two- and four-year degree are 0.285 log points and 0.705 log points for earned income, 0.237 and 0.623 for wages, and 0.294 and 0.696 for family income. I estimate these coefficients with an OLS regression for individuals born in the U.S. from 1950-1979 who are age 25-64 in the survey year, controlling for a cubic in potential experience and race, sex, and survey year fixed effects.

appears to be an important mediating factor. In interpreting these results, it is important to note that individuals' location could depend on their educational attainment (e.g., Wozniak, 2010; Malamud and Wozniak, 2012).

5.3 Evidence Supporting the Empirical Strategy and Robustness

The main threat to my empirical strategy is that, even in the absence of the 1980-1982 recession, long-run outcomes of individuals born in counties with a more severe recession would have evolved differently across cohorts than individuals born in the same state in counties with a less severe recession. An example of this threat is a relative decline in infant health from 1950-1979 in counties with a larger predicted log employment decrease from 1978-1982.

Several pieces of evidence suggest that this threat is unimportant. My empirical strategy exploits sudden changes in local economic activity driven by the interaction of pre-existing industrial specialization and aggregate employment changes that emerged during the 1980-1982 recession. This research design mitigates many potential concerns about selective migration or fertility before 1980. As discussed in Appendix A.1, the industrial specialization that led to severe earnings and employment losses during the 1980-1982 recession is uncorrelated with counties' median family income growth from 1970-1980 and correlated with higher income growth from 1950-1970, for which I control. Furthermore, there is little correlation between the predicted log employment change from 1978-1982 and the severity of other recessions from 1973-2009 or Chinese import competition in the 1990s and 2000s.[31]

I use birth certificate data to provide more direct evidence on the validity of my empirical strategy. As detailed in Appendix H, I find no evidence that the county-level evolution of infant mortality from 1950-1979 is correlated with the severity of the 1980-1982 recession. There is also no evidence of a relationship between the severity of the recession and the 1970-1979 evolution of

[31] Appendix Table A.15 shows very small within-state correlations between the change in log earnings per capita from 1978-1982 and during other recessions, and very small within-state correlations between the predicted log employment change from 1978-1982 and the log earnings per capita change during other recessions. As described in Appendix A, there is little correlation between the log earnings per capita change or predicted log employment change from 1978-1982 and Chinese import competition as measured by Autor, Dorn and Hanson (2013).

maternal education or infant birth weight.[32] These results directly rule out the possibility that my estimates simply reflect changes in infant health.

Appendix I describes the results of several additional specifications that demonstrate the robustness of my estimates to different sets of control variables and different measures of recession severity.

5.4 Mechanisms

The age profile in Figure 3 suggests that the negative effects of the recession on children's college degree attainment stem from a decrease in childhood human capital development or a long-term decline in parental resources to finance college. I now consider these and other mechanisms in more detail.

Both human capital development during childhood and parental resources to finance college could fall because of a decline in parental earnings. While my data do not contain information on parents' labor market outcomes, estimates of the long-run effects of parental job displacement provide a benchmark. If job loss generated all of the county-level decrease in earnings per capita from 1978-1982 and the recession only affected children whose parents lost a job, then previous work suggests that a 10 percent decrease in earnings per capita would decrease college attendance by 0.5 percentage points (Hilger, 2016), 1.5 percentage points (Page, Stevens and Lindo, 2007), or 10 percentage points (Coelli, 2011).[33] These studies typically focus on children who are teenagers at the time of job loss. For this group, Table 2 implies that a 10 percent decrease in earnings per capita leads to an imprecisely estimated 1.0 percentage point decrease in college attendance. This point estimate lies within the wide range predicted by past work, suggesting that parental job loss could explain the effects of the recession on college attendance. A similar conclusion holds when looking at the long-run effects of the recession on income.[34] However, these conclusions are

[32]Data limitations preclude examining maternal education and birth weight over the full 1950-1979 period.

[33]These papers find that job displacement leads to long-run reductions in family income of around 10 percent. They do not estimate the effect of parental job displacement on college degree attainment.

[34]Previous studies suggest that if job loss generated all of the county-level decrease in earnings per capita from 1978-1982 and the recession only affected children whose parents lost a job, then a 10 percent decrease in earnings per capita would decrease earned income by 0-9 percent (Page, Stevens and Lindo, 2007; Bratberg, Nilsen and Vaage,

tempered by the wide range of estimates from the parental job displacement literature.

Human capital development during childhood could fall because of a decline in community investments. While I cannot measure most forms of community investment, like neighborhood or school quality, data on local government expenditures are readily available. As described in Appendix J, expenditures per capita fell starting in the early 1990s in counties with a more severe recession, but there is little evidence of a change before then. The decline in expenditures is driven by spending on welfare and health, and not education. These results imply that, in principle, the decrease in expenditures could contribute to the effects of the recession on individuals born in the 1970s, but not the effects on individuals born in the 1960s.

Other mechanisms could shape the long-run effects. The opportunity cost channel, which previous work finds to be quantitatively important, predicts positive effects of the recession on high school graduation, college attendance, and college graduation. While this channel might be operative, my results indicate that it is dominated by the mechanisms that reduce educational attainment.[35] Previous studies also find that individuals who graduate from college during a recession experience a lasting decline in earnings and wages relative to graduates who enter a stronger labor market, partly due to working at lower paying employers (Kahn, 2010; Oreopoulos, von Wachter and Heisz, 2012). This channel could explain some of the decrease in income and wages, especially for individuals age 18-22 in 1979, as suggested by the similarity between previous estimates and those in Table 3.[36]

2008; Oreopoulos, Page and Stevens, 2008; Hilger, 2016). For individuals age 11-19 in 1979, Table 2 implies that a 10 percent decrease in earnings per capita leads to a 3 percent decrease in earned income.

[35] After adjusting for attenuation due to individuals' 1979 county of residence differing from their county of birth, my estimates for individuals age 14-19 in 1979 are broadly similar to prior work on the role of opportunity cost. As shown in Appendix Figures A.16 and A.17, the upper ranges of 95 percent confidence intervals indicate that a 10 percent decrease in earnings per capita from 1978-1982 leads to no more than a 1.7 percentage point (1.8 percent) increase in high school graduation for individuals age 14-16 in 1979 and a 1.6 percentage point (3.0 percent) increase in college attendance for individuals age 17-19 in 1979. Black, McKinnish and Sanders (2005), who study the coal boom and bust in the 1970s and 1980s in Appalachia, find that a 10 percent decrease in earnings per worker leads to a 4.4-7.2 percent increase in high school enrollment. Cascio and Narayan (2015), who study the fracking boom in the 2000s, find that a 10 percent decrease in the high school wage premium leads to a 4.7 percent increase in high school enrollment. Charles, Hurst and Notowidigdo (2015), who study the housing boom in the 2000s, find that a 10 percent increase in log wages of adults age 18-25 is associated with a 1.8 percent decrease in college attendance.

[36] Estimates in Kahn (2010) suggest that a 10 percent decrease in earnings per capita from 1978-1982 might decrease wages of four-year college graduates by up to 7.6 percent in the long-run. In particular, she finds that a 1 percentage point increase in the state unemployment rate is associated with up to a 9.8 percent decrease in wages 15 years after

Distinguishing between the long-run effects of temporary versus persistent decreases in local economic activity also could point to relevant mechanisms. If long-run effects on children were driven by temporary declines in local economic activity, then the decrease in childhood human capital would appear to be more relevant than a long-term decline in parents' ability to finance college. In contrast, if long-run effects were driven by persistent declines in local economic activity, then both mechanisms could be operative. Appendix K describes regressions that separately estimate the effects of temporary and persistent declines in earnings per capita that emerged during the recession. I find some evidence that the negative effects on children's four-year college degree attainment are driven by persistent declines in earnings per capita. However, this comparison is ultimately inconclusive, as the temporary and persistent declines in economic activity are highly correlated, which limits my ability to distinguish between the two sets of effects.

5.5 Potentially Mitigating Policies

Finally, I examine policies that might have mitigated the recession's long-run effects. To do so, I estimate interactions between the severity of the recession and features of individuals' birth state. This augments my baseline specification in equation (1), which includes birth state-by-birth year fixed effects. I focus on four-year college degree attainment because of its importance for individuals and the economy.

States might have mitigated the recession's long-run effects with more generous transfer programs that insured families and communities against earnings declines. In measuring states' transfer generosity, I control for economic and demographic characteristics that could relate mechanically to higher transfers by regressing, at the state-level, log transfers per capita in 1970 on log

graduating from college (see column 4 of her Table 4). At the county-level, a 10 percent decrease in earnings per capita from 1978-1982 is associated with a 7.7 percentage point increase in the unemployment rate, conditional on state fixed effects. Because 29.2 percent of individuals age 20-28 in 1979 obtain a four-year college degree, Kahn's estimates imply a decrease in wages for 20-28 year olds of 2.2 percent ($= 0.292 \times 0.076$) if only college graduates' wages decline. This prediction is slightly more negative than the point estimate in column 3 of Table 3, but within the 95 percent confidence interval. Some estimates in Kahn (2010) and the estimates in Oreopoulos, von Wachter and Heisz (2012) imply that college graduates' wages and earnings recover after 10 or 15 years, which is also broadly consistent with the estimates in Table 3. Prior work does not find persistent effects of labor market conditions at entry on workers with less than a college degree (Hershbein, 2012; Speer, 2016).

median family income in 1969 and the share of the 1970 population that is black, female, foreign born, urban, a high school graduate, a college graduate, and age 5-19, 20-64, and 65 and above.[37] Columns 1 and 2 of Table 5 divide the sample into states with more and less generous transfers per capita using the residuals from this regression. For individuals age 0-10 in 1979, the effect of the recession is 32 percent less severe in states with more generous transfers, but the estimates are not statistically distinguishable ($p = 0.50$). As a result, there is little evidence that states with more generous transfer programs mitigated the recession's effects.

Another possibility is that states which transferred more money to poor counties mitigated the long-run effects of the recession. To characterize states' transfer progressivity, I regress log transfers per capita in 1970 on log median family income in 1969, state fixed effects, and the previously listed control variables, with the dependent and explanatory variables measured at the county-level. Columns 3 and 4 of Table 5 present results from dividing states into two groups using the state-specific slope coefficient on log median family income.[38] The effects of the recession are considerably less severe in states with more progressive transfers. However, the estimates are not statistically distinguishable ($p = 0.96$), providing little evidence that states with more progressive transfers mitigated the recession's effects. More research is needed to understand whether any policies mitigated the recession's long-run effects.

6 Conclusion: The Long-Run Effects of Recessions

This paper provides new evidence on the long-run effects of recessions on education and income. Using confidential Census data linked to county of birth and a generalized difference-in-differences framework, I estimate the long-run effects of the 1980-1982 recession on individuals who were children, adolescents, and young adults when the recession began. I find that the recession gener-

[37] In constructing the dependent variable, I focus on transfers over which states have some statutory or administrative control: retirement and disability insurance (excluding Social Security), Medicare, public assistance medical care benefits (primarily Medicaid), income maintenance benefits (including SSI, Food Stamps, and AFDC), unemployment insurance compensation, and education and training assistance. Appendix Table A.26 characterizes the dimensions of state transfer systems.

[38] Card and Payne (2002) use a similar approach to characterize state-level school aid systems.

ated sizable long-run reductions in education and income. For individuals age 0-10 in 1979, a 10 percent decrease in earnings per capita from 1978-1982 in their county of birth leads to a 3.0 percentage point (9.4 percent) decrease in four-year college degree attainment, a $1,300 (3.2 percent) decrease in earned income, and a 1.7 percentage point (13.9 percent) increase in the probability of living in poverty as of 2000-2013. The negative effects on college graduation are most severe and essentially constant for individuals age 0-13 in 1979, and small and statistically insignificant for individuals age 14-22, which suggests that the underlying mechanisms are a decline in childhood human capital or a long-term decline in parental resources to pay for college.

The magnitude of my estimates and the large number of affected individuals suggest that the 1980-1982 recession depresses aggregate economic output today. Table 6 reports back of the envelope calculations that scale my difference-in-differences estimates by the 105 million individuals born in the U.S. from 1951-1979. In particular, I calculate the aggregate effect of the recession for individuals who were age a in 1979 as $\sum_c N_{a,c}(R_c^{78-82} - R_c^{CF})\hat{\pi}_a$, where $N_{a,c}$ is the number of individuals born in county c who would have been age a in 1979, R_c^{78-82} is the observed decrease in log real earnings per capita from 1978-1982, R_c^{CF} is the counterfactual decrease, and $\hat{\pi}_a$ is the difference-in-differences estimate from equation (1). If I assume that all counties would have experienced no change in real earnings per capita in the absence of the recession, these calculations imply that the recession led to 899,000 fewer four-year college graduates, $64 billion less earned income per year, and 554,000 more adults living in poverty each year. If I instead assume that all counties would have experienced the average growth in real earnings per capita from 1969-1978 of 1.9 percent per year, these calculations suggest that the recession led to 2.1 million fewer four-year college graduates, $145 billion less earned income per year, and 1.3 million more adults living in poverty each year. These numbers amount to 1-3 percent of the stock of college-educated adults in 2015, 0.4-0.8 percent of GDP in 2015 and 0.9-2.0 percent of GDP in 1979, and 1-3 percent of the number of individuals in poverty in 2015.[39] While these simple calculations could understate or

[39]In 2015, there were 69 million individuals with a four-year college degree (Ryan and Bauman, 2016) and 43 million individuals living in poverty (Proctor, Semega and Kollar, 2016). In 2014 dollars, U.S. GDP was $7.2 billion in 1979 and $18.2 billion in 2015.

overstate the true aggregate effects, they suggest that the 1980-1982 recession markedly reduces aggregate economic output and welfare today.[40]

This paper shows that the 1980-1982 recession persistently decreased earnings per capita in negatively affected counties, and children and adolescents born in these counties have less education and income as adults. While I have not examined whether other recessions have similar long-run effects, Figure 4 provides reason for concern: every U.S. recession since 1973 has led to a persistent relative decrease in earnings per capita in negatively affected counties.[41] This novel stylized fact indicates that the 1980-1982 recession is not unique in its persistent effects on county-level earnings per capita, which suggests that it might not be unique in its long-run effects on children. Similar long-run effects could arise from other shocks leading to persistent declines in local economic activity, such as Chinese import competition (Autor, Dorn and Hanson, 2013) and NAFTA (McLaren and Hakobyan, 2016).

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[41] The figure plots the percent difference in earnings per capita between counties with a more versus less severe recession, normalized to equal zero at the onset of the recession. The counties with a more versus less severe recession are defined separately for each recession.

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Table 1: Aggregate Employment Changes from 1978-1982, by Industry

	Share of total 1978 employment (1)	Log employment change (2)	Employment change (3)
Panel A: Overall and one-digit industries			
All industries	1.000	0.064	4,545,523
Manufacturing	0.289	-0.045	-880,902
Construction	0.058	-0.043	-170,951
Agriculture, forestry, and fisheries	0.004	0.198	59,091
Transportation and public utilities	0.062	0.070	310,444
Mining	0.012	0.358	353,059
Wholesale trade	0.070	0.082	418,200
Finance, insurance, and real estate	0.070	0.112	576,696
Retail trade	0.206	0.057	840,051
Services	0.221	0.190	3,214,746
Panel B: Two-digit industries with largest employment decrease			
Auto dealers (retail trade)	0.028	-0.120	-212,068
Transportation equipment (manufacturing)	0.025	-0.135	-206,023
Primary metal (manufacturing)	0.017	-0.183	-185,395
Lumber and wood products (manufacturing)	0.011	-0.239	-154,868
General contractors (construction)	0.017	-0.132	-140,851
Textile mill products (manufacturing)	0.013	-0.171	-135,377
Apparel and other textile products (manufacturing)	0.019	-0.098	-120,553
Stone, clay, and glass products (manufacturing)	0.010	-0.157	-92,833
Fabricated metal products (manufacturing)	0.024	-0.059	-91,861
Trucking and warehousing (transportation)	0.019	-0.054	-66,322
Panel C: Two-digit industries with largest employment increase			
Nondurables (wholesale trade)	0.028	0.088	174,462
Social services (services)	0.013	0.183	177,258
Durables (wholesale trade)	0.041	0.074	210,445
Depository institutions (finance)	0.021	0.145	212,866
Oil and gas extraction (mining)	0.005	0.602	284,491
Food stores (retail trade)	0.031	0.141	309,392
Miscellaneous services (services)	0.011	0.376	342,560
Eating and drinking places (retail trade)	0.060	0.118	501,927
Business services (services)	0.038	0.236	678,268
Health services (services)	0.070	0.223	1,166,838

Notes: I construct this table by aggregating county-level data for the continental United States. Because employment is often suppressed at the county-level, I impute employment using the number of establishments and nationwide information on average employment by establishment size, as described in Appendix D.
Source: Census County Business Patterns

Table 2: The Long-Run Effects of the 1980-1982 Recession on Educational Attainment

	Dependent variable:					
	HS/GED attainment (1)	Any college attendance (2)	Any college degree attainment (3)	Four-year college degree attainment (4)	Two-year college degree attainment (5)	Years of schooling (6)
Panel A: Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979						
0-10	0.0394	-0.0377	-0.184***	-0.303***	0.119**	-0.417
	(0.0392)	(0.0522)	(0.0678)	(0.109)	(0.0600)	(0.373)
11-19	0.0380	-0.0987	-0.122**	-0.159**	0.0369	-0.0831
	(0.0311)	(0.0664)	(0.0586)	(0.0801)	(0.0481)	(0.309)
20-28	0.0172	-0.0540	0.0263	0.0306	-0.0043	0.361*
	(0.0263)	(0.0507)	(0.0363)	(0.0426)	(0.0333)	(0.204)
Panel B: Average value of dependent variable in years 2000-2013, by age in 1979						
0-10	0.936	0.588	0.414	0.321	0.093	13.57
11-19	0.932	0.537	0.380	0.288	0.093	13.39
20-28	0.933	0.540	0.381	0.292	0.090	13.41

Notes: Panel A reports estimates of the interaction between the 1978-1982 decrease in log real earnings per capita in individuals' birth county and indicators for age in 1979. The interaction for individuals age 29 is normalized to equal zero. Regressions include fixed effects for race, sex, birth county, age in 1979-by-birth state, and survey year, plus age in 1979 interacted with the 1950-1970 change in log real median family income in individuals' birth county and a cubic in age at time of survey. Regressions are estimated by 2SLS, using the predicted log employment change from 1978-1982 as an instrumental variable. Standard errors in parentheses are clustered by birth state. The sample in Panel A contains 23.5 million individuals born in the continental U.S. from 1950-1979 with a unique birth county and non-imputed variables. Panel B reports average values of the dependent variable for a comparable sample from publicly available 2000 Census and 2001-2013 ACS data.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file, Publicly available 2000-2013 Census/ACS data from Ruggles et al. (2015)

Table 3: The Long-Run Effects of the 1980-1982 Recession on Income, Wages, and Poverty

	Dependent variable:				
	Log personal income (1)	Log earned income (2)	Log hourly wage (3)	Log family income (4)	In poverty (5)
Panel A: Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979					
0-10	-0.217*	-0.321**	-0.178*	-0.366**	0.168***
	(0.120)	(0.126)	(0.0994)	(0.166)	(0.0493)
11-19	-0.228**	-0.272***	-0.318***	-0.351***	0.0766**
	(0.0976)	(0.0984)	(0.115)	(0.122)	(0.0349)
20-28	-0.0872	-0.0819	-0.118*	-0.135*	0.0182
	(0.0817)	(0.0902)	(0.0699)	(0.0760)	(0.0254)
Panel B: Average value of dependent variable in years 2000-2013, by age in 1979, in levels					
0-10	42,666	40,942	25.52	80,892	0.122
11-19	51,232	48,391	29.81	93,896	0.103
20-28	54,089	48,880	32.04	98,157	0.092

Notes: See notes to Table 2. The sample in columns 1-4 contains 15.6 million individuals born from 1950-1979 in the continental U.S. with a unique birth county, non-imputed variables, and positive values of family income, earned income, personal income, and wage. The sample in column 5 contains 18.4 million individuals born from 1950-1979 in the continental U.S. with a unique birth county and non-imputed variables. All monetary variables are in 2014 dollars.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file, Publicly available 2000-2013 Census/ACS data from Ruggles et al. (2015)

Table 4: The Long-Run Effects of the 1980-1982 Recession on Income and Wages, Conditional on Educational Attainment and Commuting Zone of Residence

	Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979			Share of effect explained by	
				Education	CZ of Residence
	(1)	(2)	(3)	(4)	(5)
Panel A: Dependent variable is log earned income					
0-10	-0.321**	-0.143	-0.114	0.555	0.645
	(0.126)	(0.108)	(0.110)		
11-19	-0.272***	-0.143	-0.121	0.474	0.555
	(0.0984)	(0.0878)	(0.0798)		
20-28	-0.0819	-0.0601	-0.0165	0.266	0.799
	(0.0902)	(0.0883)	(0.0963)		
Panel B: Dependent variable is log hourly wage					
0-10	-0.178*	-0.0171	0.0025	0.904	1.014
	(0.0994)	(0.0854)	(0.0769)		
11-19	-0.318***	-0.202**	-0.185**	0.365	0.418
	(0.115)	(0.0912)	(0.0820)		
20-28	-0.118*	-0.0971	-0.0620	0.177	0.475
	(0.0699)	(0.0638)	(0.0624)		
Panel C: Dependent variable is log family income					
0-10	-0.366**	-0.214	-0.174	0.415	0.525
	(0.166)	(0.145)	(0.130)		
11-19	-0.351***	-0.240**	-0.209**	0.316	0.405
	(0.122)	(0.101)	(0.0903)		
20-28	-0.135*	-0.116*	-0.0752	0.141	0.443
	(0.0760)	(0.0687)	(0.0757)		
Conditional on					
Education		X			
CZ of residence			X		

Notes: See notes to Table 2. Education controls include high school or GED attainment, college attendance, two-year college degree attainment, and four-year college degree attainment. CZ of residence control is a fixed effect. Column 4 equals the ratio of column 1 minus column 2 and column 1. Column 5 equals the ratio of column 1 minus column 3 and column 1. The sample contains 15.6 million individuals born from 1950-1979 with a unique birth county, non-imputed variables, and positive values of family income, earned income, personal income, and wage.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table 5: The Long-Run Effects of the 1980-1982 Recession on Four-Year College Degree Attainment, Potentially Mitigating Policies

Policy:	State transfer generosity		State transfer progressivity	
	Less generous (1)	More generous (2)	Less progressive (3)	More progressive (4)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979				
0-10	-0.378**	-0.257*	-0.339**	-0.235*
	(0.173)	(0.133)	(0.149)	(0.139)
11-19	-0.161	-0.157	-0.193**	-0.0955
	(0.131)	(0.103)	(0.0965)	(0.152)
20-28	0.0130	0.0417	0.0135	0.0625
	(0.0657)	(0.0586)	(0.0509)	(0.0899)
p-value, equal effects	0.498		0.956	

Notes: See notes to Table 2. Each column reports the results of a separate 2SLS regression. The p-value is for the null hypothesis that the effects of the recession are equal across columns. States with less generous transfers are those with below-median transfers per capita in 1970, conditional on demographic and economic covariates. States with less progressive transfers are those with an above-median slope coefficient from a county-level regression of log transfers per capita on log median family income in 1970, conditional on demographic and economic covariates.

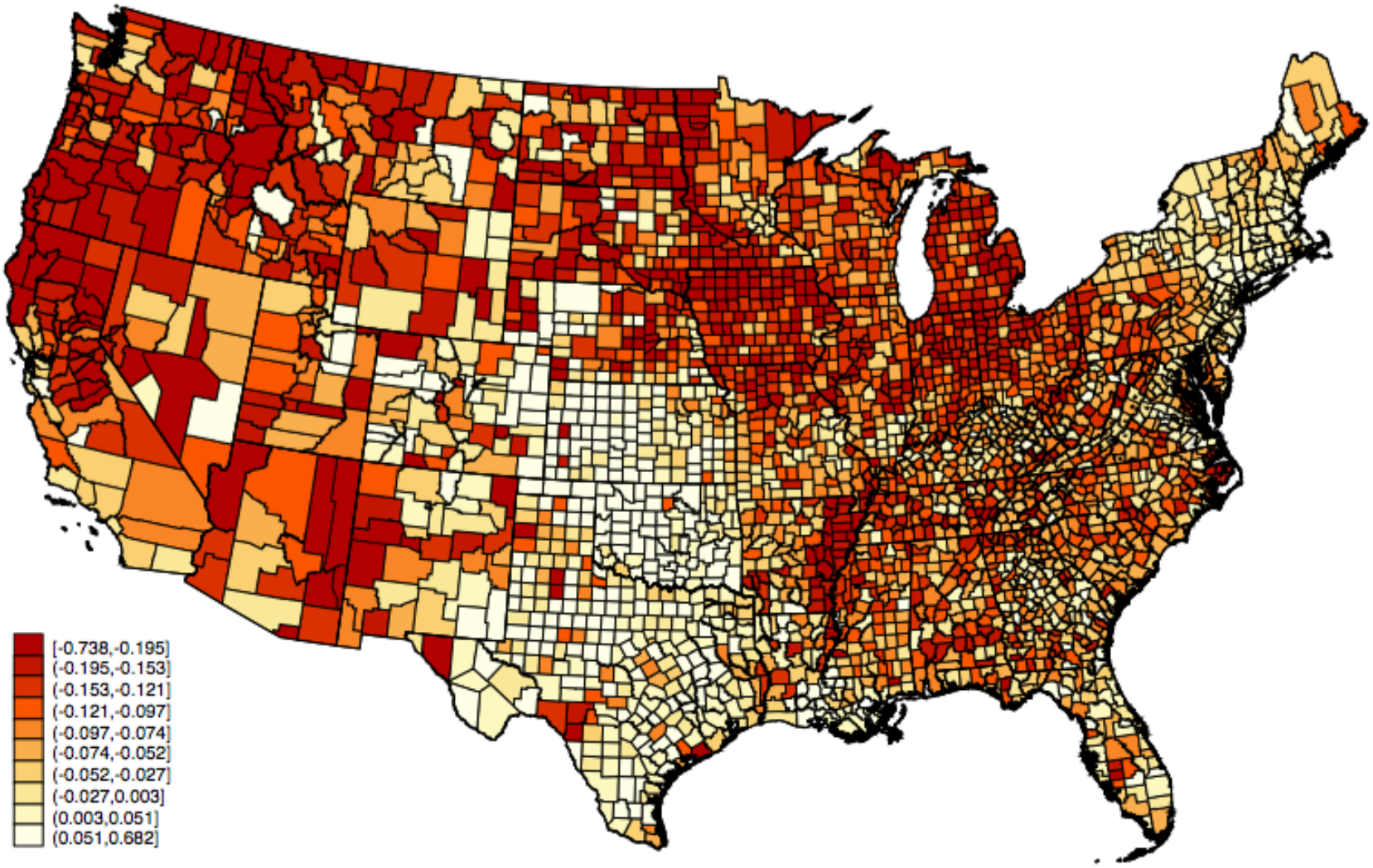
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file, Census County Data Book

Table 6: Back of the Envelope Calculations of the Aggregate Long-Run Effects of the 1980-1982 Recession

		Counterfactual 1: No real earnings per capita growth, 1978-1982			Counterfactual 2: Trend real earnings per capita growth, 1978-1982		
	Number of births, mil. (1)	Four-year college graduates (2)	Earned income, bil. $ (3)	Adults living in poverty (4)	Four-year college graduates (5)	Earned income, bil. $ (6)	Adults living in poverty (7)
Age in 1979							
0-10	36.0	-643,700	-27.9	356,903	-1,473,351	-63.9	816,908
11-19	34.1	-324,478	-26.9	156,321	-737,019	-61.0	355,067
20-28	34.6	68,998	-9.0	41,038	149,447	-19.6	88,887
0-28	104.8	-899,180	-63.8	554,261	-2,060,924	-144.5	1,260,861

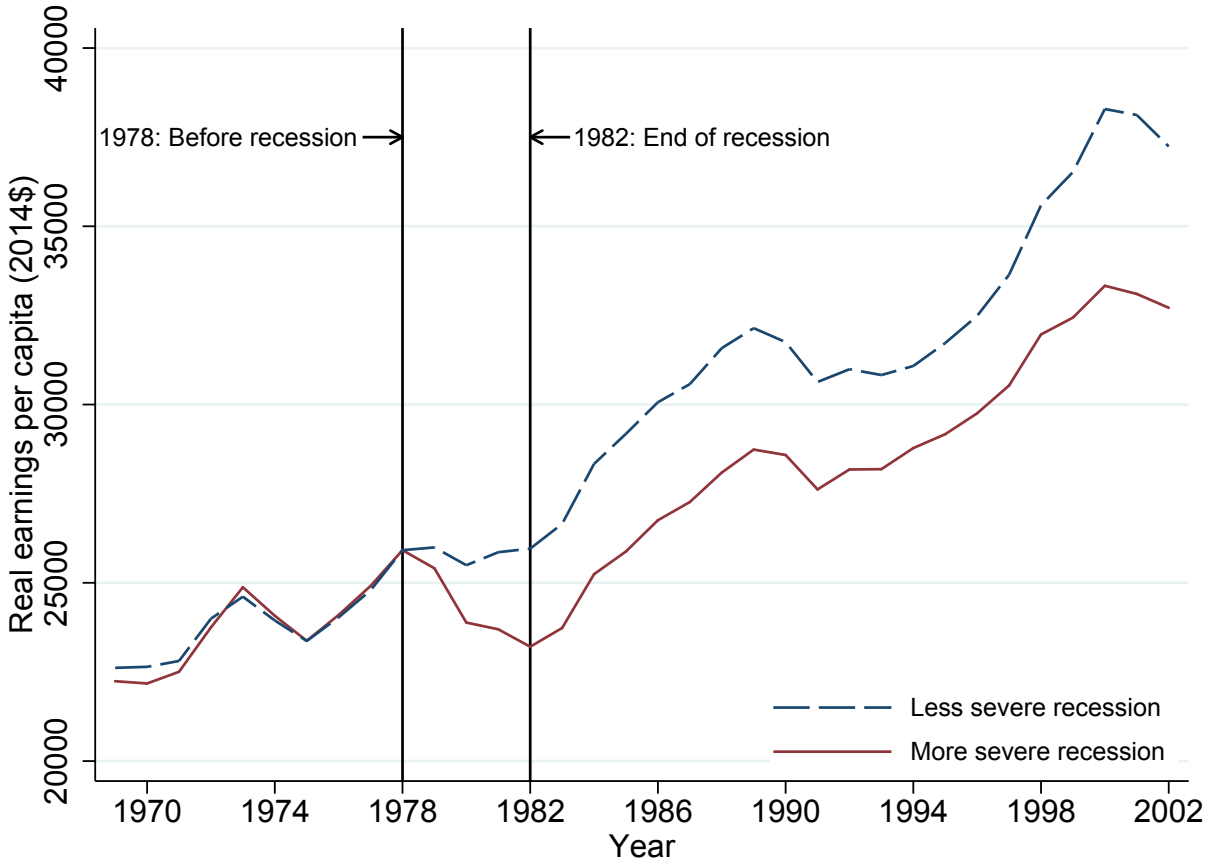
Notes: Table displays back of the envelope calculations of the aggregate long-run effects of the 1980-1982 recession. For individuals who were a years old in 1979, I calculate these as $\sum_c N_{a,c}(R_c^{78-82} - R_c^{CF})\hat{\pi}_a$, where $N_{a,c}$ is the number of individuals born in county c net of infant mortality, R_c^{78-82} is the observed decrease in log real earnings per capita from 1978-1982 in county c, R_c^{CF} is the counterfactual decrease in log real earnings per capita from 1978-1982, and $\hat{\pi}_a$ is the difference-in-differences estimate. In counterfactual 1, I set $R_c^{CF} = 0$ and in counterfactual 2, $R_c^{CF} = -0.076$, which corresponds to the average annual growth in earnings per capita from 1969-1978 of 1.9 percent. Column 1 reports the total number of births for each age group, net of infant mortality ($\sum_c N_{a,c}$). Columns 2 and 5 use difference-in-differences estimates from column 4 of Table 2. Columns 3 and 6 use estimates from column 2 of Table 3. Columns 4 and 7 use estimates from column 5 of Table 3.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file, Birth and infant mortality data from Bailey et al. (2016)

Figure 1: Change in Log Real Earnings per Capita, 1978-1982



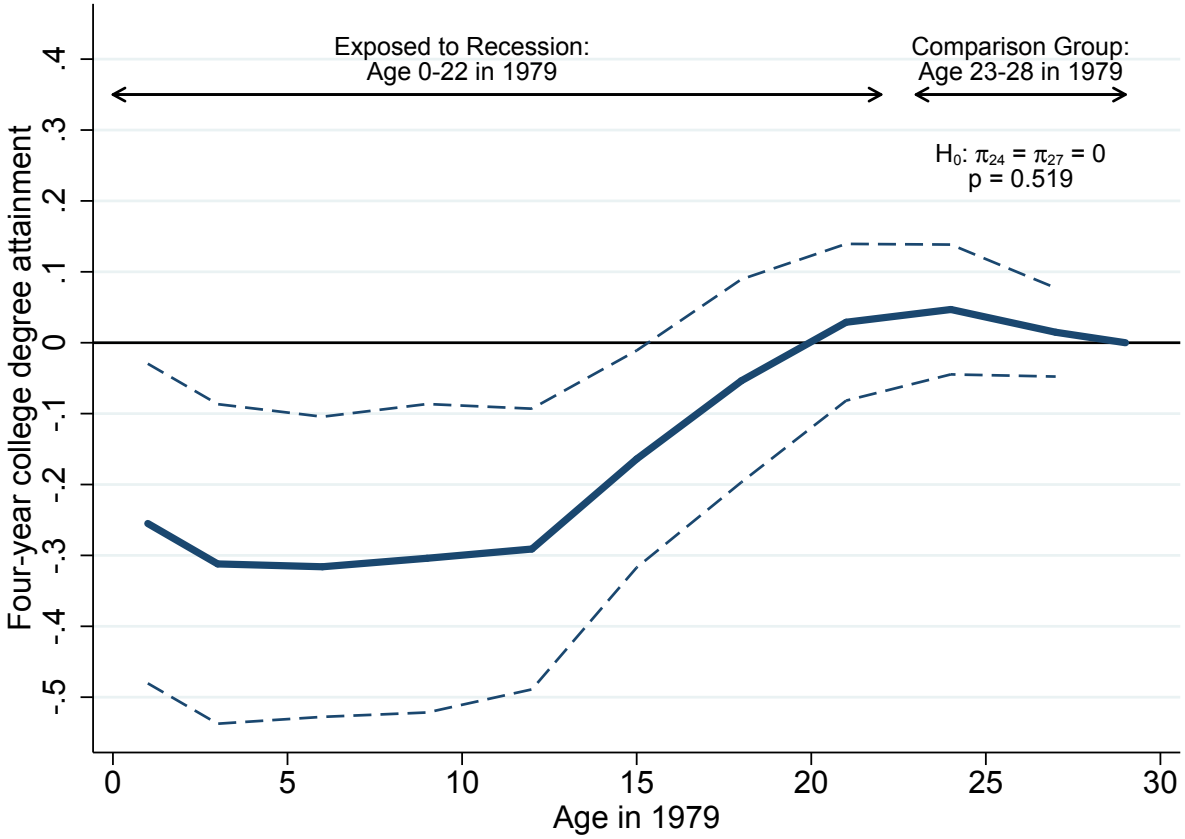
Notes: Figure displays the county-level change in log real earnings per capita from 1978-1982, which I use to measure the severity of the 1980-1982 recession. Categories correspond to unweighted deciles, with darker shades of red representing a larger earnings decrease.
Source: BEA Regional Economic Accounts

Figure 2: Normalized Mean Real Earnings per Capita, by County-Level Severity of the 1980-1982 Recession



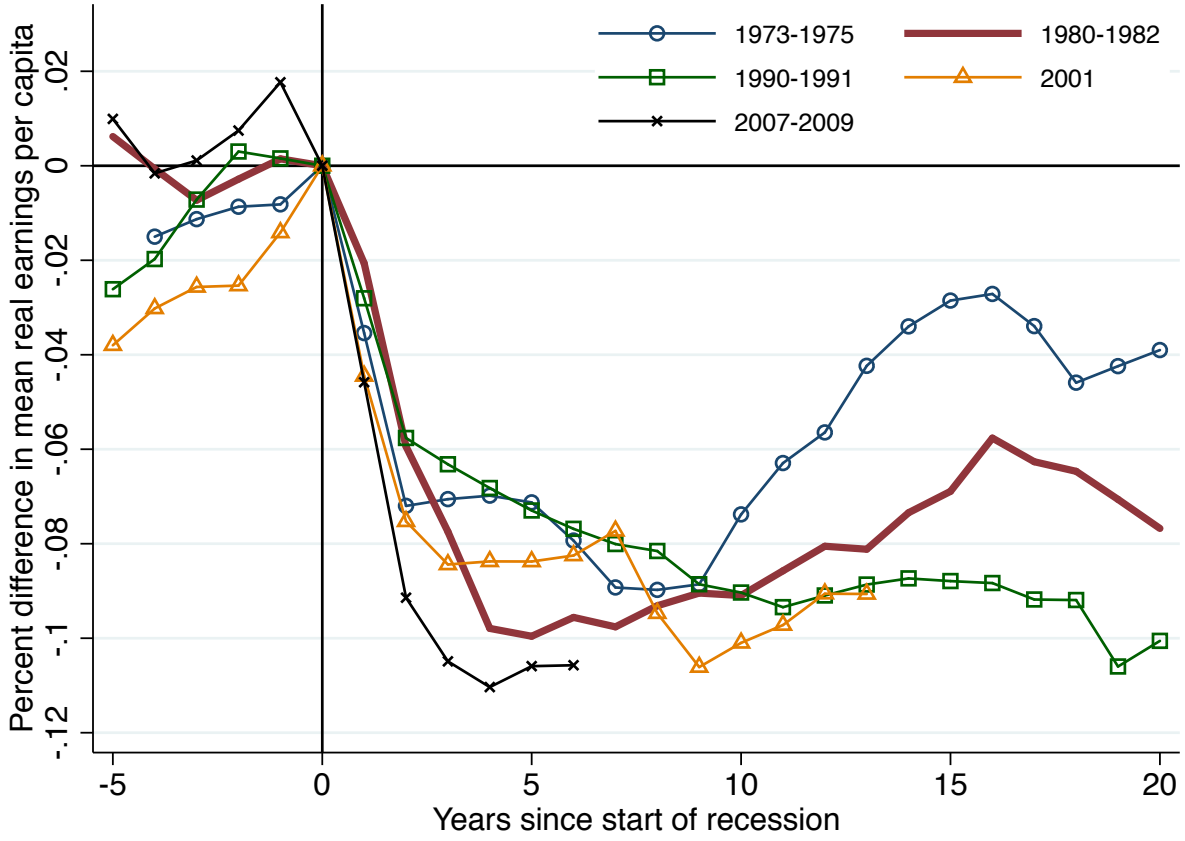
Notes: Figure displays population-weighted mean real earnings per capita, among counties with a below and above median 1978-1982 decrease in log real earnings per capita. I calculate the median using 1978 population weights. I adjust the less severe recession line to equal the more severe recession line in 1978, which amounts to a downward shift of $2,110. Sample contains 3,076 counties in the continental U.S.
Source: BEA Regional Economic Accounts

Figure 3: The Long-Run Effects of the 1980-1982 Recession on Four-Year College Degree Attainment



Notes: Figure plots estimates of the interaction between the 1978-1982 decrease in log real earnings per capita in individuals' county of birth and indicators for age in 1979. The interaction for individuals age 29 is normalized to equal zero. The dependent variable is an indicator for four-year college degree attainment. The regression includes fixed effects for race, sex, birth county, age in 1979-by-birth state, and survey year, plus age in 1979 interacted with the 1950-1970 change in log real median family income in individuals' birth county and a cubic in age at time of survey. The regression is estimated by 2SLS, using the predicted log employment change from 1978-1982 as an instrumental variable. The dashed lines are pointwise 95 percent confidence intervals based on standard errors clustered by state. To increase precision, I combine ages 0-1, 2-4, 5-7, 8-10, 11-13, 14-16, 17-19, 20-22, 23-25, and 26-28. The sample contains 23.5 million individuals born in the continental U.S. from 1950-1979 with a unique birth county and non-imputed variables.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Figure 4: Percent Difference in Mean Real Earnings per Capita between Counties with More versus Less Severe Recession



Notes: Figure displays the difference in population-weighted mean real earnings per capita between counties with a more versus less severe recession, as a share of the less severe recession mean. Separately for each recession, I define counties with a more severe recession as those with an above median decrease in log real earnings per capita from 1973-1975, 1978-1982, 1989-1991, 2000-2002, and 2007-2010. I calculate the medians using population weights in the starting years. The starting years are the years in which aggregate real earnings per capita decline. Each line is normalized to equal zero in the starting year via a parallel shift upwards or downwards. Sample contains 3,076 counties in the continental U.S.
Source: BEA Regional Economic Accounts

Appendices - For Online Publication

A Additional Results on the Effects of the 1980-1982 Recession on Local Economic Activity

A.1 The Evolution of Median Family Income from 1950-2000

To provide evidence on the validity of my empirical strategy, I examine the relationship between the evolution of median family income from 1950-2000 and the severity of the recession predicted by pre-existing industrial specialization. My empirical strategy, which compares long-run outcomes of individuals born from 1950-1979, could confound the effect of the recession with pre-recession economic conditions if severe recession counties were on a downward trend from 1950-1980. In fact, I show that counties with a more severe recession saw greater income growth from 1950-1970. Because of this, I control for the 1950-1970 change in log median family income when estimating long-run effects on individuals using equation (1). I also show that controlling for this pre-trend does not change the estimated effects of the recession on post-recession family income.

I examine the evolution of median family income from 1950-2000 by estimating the regression

$$y_{c,t} = R_c^{78-82}\alpha_t + x_{c,t}\beta + \gamma_c + \theta_{s(c),t} + \epsilon_{c,t}, \tag{A.1}$$

where $y_{c,t}$ is log real median family income in county c and year t.[42] The key explanatory variable is the 1978-1982 decrease in log real earnings per capita, R_c^{78-82}. In some specifications, $x_{c,t}$ contains time-varying covariates described below. The regression includes county fixed effects, γ_c, to absorb time-invariant differences across counties and state-by-year fixed effects, $\theta_{s(c),t}$, which I include in equation (1) when estimating long-run effects on individuals. I normalize $\alpha_{1980} = 0$, so that $(\alpha_{1950}, \alpha_{1960}, \alpha_{1970})$ describe how the pre-recession evolution of log median family income is correlated with the severity of the 1980-1982 recession, and $(\alpha_{1990}, \alpha_{2000})$ describe the post-recession evolution. I estimate equation (A.1) with two stage least squares (2SLS), where the instrument for R_c^{78-82} is the predicted log employment change, D_c^{78-82}. I cluster standard errors by state to allow for arbitrary serial and spatial correlation within states. I initially exclude the 526 counties with at least 5 percent of 1976 employment in the mining sector, which includes oil and gas extraction, to minimize the countercyclical boom-bust cycle in this sector. These high-mining counties account for only 6 percent of the U.S. population, but receive considerably more weight in 2SLS estimates of equation (A.1) because pre-existing industrial specialization strongly influences their earnings per capita.

The estimates of α_t in Figure A.4 characterize the 1980-1982 recession as a reversal of post-war fortune: counties with a more severe recession saw greater median family income growth from 1950-1970. This pattern arises from estimates of model 1, which contains county and state-by-year fixed effects but no other covariates. Model 2, which adds an interaction between year and the 1950-1970 log median family income change, eliminates this pre-trend, but has little effect on the estimates for 1990 and 2000. The model 2 estimates imply that a 10 percent decrease in

[42] I use median family income because it is available at the county-level from decennial censuses for 1950-2000 and is an important measure of local economic conditions. Unfortunately, county-level census data do not consistently report other quantiles of the family income distribution from 1950-2000. Earnings per capita, from the BEA, is only available for 1969-forward.

earnings per capita from 1978-1982 led to an 10 percent decrease in real median family income in 1990 and an 11 percent decrease in 2000.[43]

A.2 The Effect of the Recession on Earnings per Capita and the Employment-Population Ratio

Figure 2 shows that the 1980-1982 recession led to a persistent decrease in earnings per capita for negatively affected counties. This section provides a more formal characterization of the persistence of the recession.

A simple way of measuring the persistence of the recession is by relating the 1978-1992 and 1978-1982 changes in log real earnings per capita,

$$\ln(E_{c,1992}) - \ln(E_{c,1978}) = \alpha + \beta \left(\ln(E_{c,1982}) - \ln(E_{c,1978})\right) + v_c, \tag{A.2}$$

where $E_{c,t}$ is real earnings per capita for county c in year t. In equation (A.2), the average degree of persistence is captured by β, with full persistence represented by $\beta = 1$ and no persistence represented by $\beta = 0$. However, equation (A.2) has the unattractive property that, even if earnings per capita displays no serial correlation, the model implies a non-zero degree of persistence, $\beta = 0.5$. This arises because $\ln(E_{c,1978})$ appears on both the left and right hand sides of equation (A.2) and occurs even in the absence of measurement error.

To quantify the average degree of persistence, I estimate the regression

$$\ln(E_{c,1992}) = \alpha + \beta \ln(E_{c,1982}) + \gamma \ln(E_{c,1978}) + X_c\delta + v_c. \tag{A.3}$$

X_c includes state fixed effects and the 1950-1970 change in log real median family income in county c, which I include in equation (1) when estimating long-run effects on individuals. Equations (A.2) and (A.3) are equivalent when $\beta+\gamma = 1$ and X_c is included in equation (A.2). However, equation (A.3) eliminates the bias that arises from estimating equation (A.2).

Table A.1 shows that the 1980-1982 recession led to a statistically and economically significant persistent decrease in earnings per capita. The OLS estimate of β in column 1 indicates that, conditional on earnings per capita in 1978 and X_c, a 10 percent decrease in earnings per capita from 1978-1982 leads to 6.4 percent lower earnings per capita in 1992.[44] Column 2 reports 2SLS estimates using D_c^{78-82}, the predicted log employment change from 1978-1982, as an instrument. I exclude the 526 counties with at least 5 percent of 1976 employment in the mining sector to limit the countercyclical boom-bust cycle in this sector. A 10 percent decrease in earnings per capita from 1978-1982 leads to 13.2 percent lower earnings per capita in 1992. Column 3, which uses the same instrument but includes counties with a large mining employment share, shows less persistence, as expected. Column 4, which uses the predicted log employment change in

[43] When including the 526 counties with at least 5 percent of 1976 employment in mining, log median family income evolves similarly from 1950-1970, but does not decline after the recession (Appendix Figure A.5). Because relatively few people live in high mining counties, my estimates of long-run effects on children more closely reflect the persistence seen in Figure A.4, which excludes high mining counties.

[44] This interpretation is clear when rewriting equation (A.3) as

$$\ln(E_{c,1992}) = \alpha + \beta(\ln(E_{c,1982}) - \ln(E_{c,1978})) + (\gamma + \beta)\ln(E_{c,1978}) + X_c\delta + v_c.$$

manufacturing alone, also reveals full persistence. Results are similar when examining the log employment-population ratio (Appendix Table A.2).[45] The degree of persistence is similar for years 1987, 1992, and 1997, but economic activity declined further in 2002, 2007, and 2012 in counties which experienced a more severe 1980-1982 recession (Appendix Table A.3).

Possible explanations for the further decline in the 2000s include the long-run decline in human capital associated with the 1980-1982 recession or the long-run adjustment of employers (Dix-Carneiro and Kovak, 2016). In principle, the decline in the 2000s could also be due to additional negative economic shocks, but Appendix Figure A.2 provides little support for this. Furthermore, the shock to local labor markets from increased Chinese import competition studied by Autor, Dorn and Hanson (2013) is only weakly correlated with the severity of the 1980-1982 recession.[46]

A.3 The Effect of the Recession on Housing Prices

This section shows that the median price of housing fell from 1980-1990 in counties with a more severe recession, but by less than the decrease in median income.

The price of housing and other local goods could decrease after the recession, mitigating the earnings decrease. To see this, suppose that household utility, $u(x, y)$, depends on consumption of a numeraire traded good x and a non-traded good y with local price p. The household budget constraint is

$$(1 - \tau)w = x + py, \tag{A.4}$$

where τ is the marginal tax rate and w is family earnings. For simplicity, I assume that labor supply is fixed. The expenditure function is $e(p, u) = (1 - \tau)w$, where u is the level of utility. Using Shepherd's Lemma and rearranging, it is straightforward to show that a household will be indifferent to a change in earnings and local prices as long as

$$(1 - \tau)\hat{w} = s_y\hat{p}, \tag{A.5}$$

where the proportional change in earnings is $\hat{w} \equiv dw/w = d\ln(w)$, the proportional change in the price of the non-traded good is $\hat{p}$, and $s_y \equiv py/w$ is the share of earnings spent on the non-traded good. After accounting for taxes and deductions, a reasonable approximation is $\tau = 0.32$ and $s_y = 0.33$ (Albouy, 2012). Consequently, the cost of the non-traded good would need to fall in proportional terms by around twice as much as the fall in earnings for households to be indifferent.[47]

[45]The denominator of the employment-population ratio comes from BEA employment data. Like County Business Patterns data, BEA employment data do not distinguish between full- and part-time jobs and are reported by county of work.

[46]A one standard deviation increase in the average of 1990-2000 and 2000-2007 increase in import competition is associated with a 0.5 percent decrease in earnings per capita from 1978-1982 and a 0.8 percent decrease in predicted employment. A one standard deviation increase in average predicted import competition is associated with a 0.8 percent decrease in earnings per capita and a 1.0 percent decrease in predicted employment. The average change in log earnings per capita is -0.071, and the standard deviation is 0.114. The average predicted log employment change is 0.037, and the standard deviation is 0.083. These calculations come from matching my county-level data to the CZ-level data from Autor, Dorn and Hanson (2013), estimating regressions with state fixed effects, and calculating unweighted summary statistics.

[47]This simple analysis could be extended so that households also value local quality of life amenities (Albouy and

Appendix Table A.4 shows that the median price of housing fell from 1980-1990 in counties with a more severe recession, but by less than the decrease in median income. The table reports 2SLS regressions of the 1980-1990 change in log median family income, log median rent, and log median house value on the 1978-1982 change in log earnings per capita. As elsewhere, the regressions control for state fixed effects and the 1950-1970 change in log median family income. Panel A excludes counties with a high mining employment share and uses the predicted log employment change in all industries as the instrumental variable. A 10 percent decrease in earnings per capita from 1978-1982 leads to a 10.0 percent decrease in median family income from 1980-1990, but only a 7.2 and 7.8 percent decrease in median rent and median house value. As expected, these patterns are attenuated when including counties with a high mining employment share in Panel B. This evidence is consistent with past work in finding that negative labor demand shocks reduce house prices by much less than twice as much as wages or earnings.[48]

A.4 The Effect of the Recession on Commuting Zones

It is of some interest to examine patterns for commuting zones (CZs), which have been used in previous work to approximate local labor markets. Appendix Figures A.6 and A.7 display the evolution of mean real earnings per capita and the employment-population ratio for CZs with an above and below median decrease in log real earnings per capita from 1978-1982.[49] Appendix Figure A.6 shows that mean real earnings per capita in CZs with a more and less severe recession evolved similarly before 1979, but diverged persistently after 1982; this pattern is very similar to the county-level results in Figure 2. Appendix Figure A.7 shows that the employment-population ratio converged within a decade, in contrast to the lack of convergence seen at the county-level (Appendix Figure A.3).[50] Appendix Figures A.6 and A.7 suggest that there was greater scope for the recovery of jobs across CZs than counties, but that the new jobs offered lower earnings than the jobs that were lost. Understanding the household- and firm-level behavior that generate these patterns, and the distinction between counties and CZs, is an interesting direction for future work.

Stuart, 2016). If a decrease in labor demand does not affect quality of life, then equation (A.5) remains the relevant condition. If a decrease in labor demand also decreases quality of life, then households would require an even greater decrease in house prices to remain indifferent.

The analysis also could be extended to the model described in Section 3, where parents purchase traded and non-traded goods for their children and allocate their time between market work, investment in child human capital, and leisure. In this case, the relevant indifference condition is

$$t_{\text{work}}(1-\tau)\hat{w} = s_y\hat{p},$$

where $t_{\text{work}} \in [0,1]$ is the share of time allocated to market work and $\hat{w}$ is the proportional change in the wage. For a given decrease in wages, parents require a smaller non-traded price decrease to remain indifferent because the price of time with children and leisure falls.

[48] Bartik (1991) finds similar effects on local prices and wages. Blanchard and Katz (1992) find that median house prices initially decline more than wages, but that both approximately converge within 12 years (Figures 12 and 15). Bound and Holzer (2000) find that wages decrease by more than local price levels (Table 3 and footnote 28). Notowidigdo (2013) finds that a decrease in labor demand reduces income per adult slightly more than the price of housing, but reduces wages by less than the price of housing (Tables 2 and 4).

[49] I aggregate county-level data to 1990 CZ definitions using the crosswalk provided by Autor and Dorn (2013).

[50] Using state-level data, Yagan (2016) finds employment-population ratio convergence from the 1980-1982 recession in 8 years (see his Figure A.1.D).

B Relationship to Previous Work on the Persistence of the 1980-1982 Recession

Section 2 and Appendix A demonstrate that the 1980-1982 recession led to a persistent relative decline in earnings per capita, the employment-population ratio, and median family income at the county-level. This section details the relationship between my work and closely related papers by Feyrer, Sacerdote and Stern (2007) and Greenstone and Looney (2010). My finding that the 1980-1982 recession had persistent effects on counties agrees closely with Greenstone and Looney (2010), who document a persistent decline in income per capita and the employment-population ratio. However, my conclusion differs from that of Feyrer, Sacerdote and Stern (2007, hereafter FSS), who find rapid recovery of unemployment rates following auto and steel job losses during the recession. Two factors help explain this difference. First, the unemployment rate recovers more quickly than earnings per capita or the employment-population ratio, consistent with greater adjustment of labor force participation than location. Second, FSS focus on auto and steel job losses, while I use variation from all industries. The different sources of variation could lead to different effects, but the estimates are not precise enough to support sharp conclusions.

B.1 Relationship to Greenstone and Looney (2010)

Greenstone and Looney (2010) show that real income per capita and the employment-population ratio declined persistently for counties in the bottom 20 percent of the 1979-1982 income per capita change distribution, relative to the other 80 percent of counties. My Figure 2 closely resembles their Figure 2, although I use earnings instead of income per capita, use the 50th instead of 20th percentile to define a severe recession county, and use 1978 instead of 1979 as the pre-recession year.[51]

Relative to Greenstone and Looney (2010), Appendix A contains new evidence on the evolution of median family income from 1950-2000 and results at the commuting zone level. I characterize the persistence of the recession more formally and show that the high degree of persistence holds within states. I also show the relationship between pre-existing industrial structure and the severity of the recession.

B.2 Relationship to Feyrer, Sacerdote and Stern (2007)

FSS study the effects of job losses in the auto and steel industries from 1977-1982 and find that county-level unemployment rates recovered within 5 years. FSS use OLS to estimate the regression

$$\Delta Y_c = \alpha + \beta \text{shock size}_c + \gamma_{d(c)} + \delta \text{MSA status}_c + \epsilon_c, \tag{A.6}$$

where ΔY_c is the change in some outcome over some horizon for county c. The shock size is the 1977-1982 employment change in the auto and steel industries divided by 1977 total employment. In some specifications, FSS use a binary measure which defines a shock county as one losing at least two percent of initial jobs. Equation (A.6) includes indicator variables for Census division,

[51] My Appendix Figure A.3 also resembles their Figure 3. My figures also differ from theirs in that I normalize the more and less severe recession lines to be equal in 1978.

$\gamma_{d(c)}$, and a county's Metropolitan Statistical Area (MSA) status.[52] FSS limit their sample to counties with at least 10,000 residents in 1977.

In assessing the persistence of the auto and steel shock, FSS emphasize results where the dependent variable is the change in one minus the unemployment rate, or the employment-labor force ratio. I follow FSS in referring to this as the employment rate. This variable comes from Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics data, which are constructed using the Current Population Survey, the Current Employment Statistics survey, and state unemployment insurance data. Besides the unemployment rate, BLS data also report estimates of the number of people who are employed, unemployed, and in the labor force. Data are available annually from 1976-forward and are adjusted to reflect county of residence. The BLS states that, "[a]lthough substate data for 1976-89 exist in archived files, they are not consistent with data for the 1990s, nor are they consistent within the pre-1990 period. Moreover, substate estimates for years prior to 1990 are no longer official BLS data" (Bureau of Labor Statistics, 1998).[53] From 1976-1984, BLS constructed county-level variables by disaggregating labor market area statistics, assuming a uniform employment-population ratio throughout a labor market area (Bureau of Labor Statistics, 1998).[54]

Several reasons could explain why FSS arrive at a different conclusion than I do. First, they emphasize results based on the unemployment rate, while I emphasize results for earnings per capita and the employment-population ratio.[55] The unemployment rate might recover more quickly than other outcomes if individuals respond to a negative labor demand shock by exiting the labor force.[56] Second, FSS focus on job losses in the steel and auto industries, while I focus on job losses in all industries. Third, the comparison group in FSS includes counties with a high share of employment in mining, which experienced a countercyclical boom-bust cycle during the 1970s and 1980s. Finally, FSS exclude counties with less than 10,000 residents in 1977 and include division and MSA fixed effects, while I include all counties and include state fixed effects.

I am able to closely replicate the shock size variable used by FSS, which suggests that I have inferred their data processing decisions.[57] I believe FSS use County Business Patterns (CBP) employment counts to measure the employment change in the auto and steel industries (i.e., the numerator of the shock size). This approach could be problematic, as CBP data frequently suppress employment counts to protect respondent confidentiality, and FSS appear to treat suppressed employment as zero employment.[58] A potentially more accurate approach is to use establishment counts, which are never suppressed, and impute employment as described in Appendix D and

[52] I use the 1999 MSA definitions, which appear to be consistent with the MSAs that FSS list in their Table 1.

[53] Official data, for 1990-forward, are available on the BLS website. I received the 1976-1989 data from the BLS via e-mail.

[54] Previous studies question how much valuable information the BLS county-level unemployment rate data contain, especially conditional on county and year fixed effects (Bartik, 1996; Hoynes, 2000).

[55] FSS find a persistent relative decrease in income per capita in shock counties (see their Table 11), as do Greenstone and Looney (2010) and I.

[56] Using county-level BLS data from 2000-2010, Foote, Grosz and Stevens (2015) find that mass layoffs lead to greater reductions in labor force than population.

[57] The only difference between Table 1 of FSS and my replication is that I have Neosho, KS, Laclede, MO, and St. Louis, MO as shock counties, but FSS do not.

[58] In 1977, 1,144 counties had at least one establishment in the steel industry (SIC 3300), and 861 of these counties (75 percent) had suppressed employment. In the auto industry (SIC 3700), 1,515 counties had at least one establishment, and 1,167 counties (77 percent) had suppressed employment.

Holmes and Stevens (2002). I believe that FSS measure 1977 total employment from BLS data.

I have not been able to replicate the non-shock counties used by FSS. In Table 2, FSS list 66 shock counties (62 of which have non-missing 1977 population) and 1,373 non-shock counties (1,253 of which have non-missing 1977 population). My sample contains 69 shock counties and 2,257 non-shock counties (all of which have non-missing 1977 population).

Appendix Figure A.8 displays the differences that arise when using CBP employment versus establishment counts to measure the shock size. Panel A shows the bivariate relationship for the 2,326 counties with at least 10,000 residents in 1977 (the same sample restriction used by FSS). Employment suppression is visible in the cases where the shock size based on employment counts equals 0, while the shock size based on establishment counts (horizontal axis) does not. The linear correlation between the two measures is 0.2. Panel B displays an analogous figure for all counties. The basic pattern is similar, but the linear correlation falls to 0.01. Classical measurement error does a poor job of describing the relationship between these two variables, as the employment count shock size varies less than the potentially better-measured establishment count shock size.[59]

Appendix Table A.5 shows that I can closely approximate the results of FSS on how the auto and steel shock affected the employment rate. The table reports estimates of equation (A.6) where the dependent variable is the change over different horizons in the employment rate (i.e., one minus the unemployment rate). Panels A and C repeat Tables 3 and 4 of FSS, and Panels B and D report my estimates. The point estimates and standard errors are extremely similar, although the number of observations and R^2 differ.

Appendix Table A.6 examines different dependent variables using the FSS specification and assesses the impact of using CBP establishment counts to construct the shock size. Panel A, which uses CBP employment counts to construct the shock size, demonstrates that a negative shock reduced the employment rate, employment-population ratio, and earnings per capita from 1977-1982. For example, the point estimate in column 1 indicates that a decrease in auto and steel employment equal to 1 percent of a county's initial employment decreased the employment rate by 0.2 percent from 1977-1982.[60] The employment rate elasticity is less than half that of other outcomes. Panel B presents results using CBP establishment counts to measure the shock size. The results in Panels A and B differ somewhat, especially for dependent variables measured using BEA data. Panels C and D examine the change in outcome variables from 1977-1987. Panel C, which uses CBP employment counts as in FSS, cannot reject complete convergence of the employment rate, but finds persistent effects on the employment-population ratio and earnings per capita. Most of the point estimates are attenuated and indistinguishable from zero in Panel D, which uses CBP establishment counts, but the upper range of the confidence intervals admit moderate effects.[61]

Appendix Table A.7 shows that (1) the employment rate appears to recover more quickly than the employment-population ratio or earnings per capita and (2) the effects of the FSS shock are typically attenuated and estimated with less precision than the effects of the 1980-1982 recession

[59] When limiting to counties with at least 10,000 residents in 1977, the variance of the establishment count shock size is over five times that of the employment count shock size. When not making this population restriction, the multiple is over two.

[60] This estimate is similar to the analogous estimate in FSS (see column 1 of their Table 6, Panel A).

[61] There are some differences between the point estimates in columns 2 and 3 of Appendix Table A.6. The dependent variable in both columns is the ratio of employment to population age 15 and older, with employment in column 2 coming from BLS data and in column 3 from BEA data. BLS data refer to place of residence and count the number of people employed, while BEA employment data refer to place of work and count the number of jobs.

shock that I use. Panel A displays results from a specification similar to equation (A.6), but without controlling for MSA status.[62] Panel B measures the shock size using CBP establishment counts, and Panel C includes counties with fewer than 10,000 residents in 1977. Estimates are attenuated when using CBP establishment counts, but are very similar when including all counties. Panel D replaces the FSS shock size with the 1978-1982 change in log real earnings per capita. The coefficient on the employment rate is a precisely estimated 0, but there are lasting effects on the employment-population ratio and earnings per capita. Panel E uses the predicted log employment change from 1978-1982 as an instrumental variable. Panels F-H repeat Panels C-E, but exclude the 526 counties with at least 5 percent of 1976 employment in the mining sector, which experienced a countercyclical boom-bust cycle. Estimates using the FSS shock variable in Panel F are somewhat imprecise and indistinguishable from zero, while the OLS and 2SLS estimates in Panels G and H show significant effects of the change in log earnings per capita on all variables, with much smaller effects on the employment rate. To compare the FSS shock size and the predicted log employment change in all industries, Panel I reports results of instrumenting for the 1978-1982 change in log earnings per capita with the shock size based on CBP establishment counts.[63] The rescaled estimates are typically within one standard error of the point estimates in Panel H, but the 2SLS estimates using the FSS shock size are very imprecise.

Appendix Figure A.9 provides additional evidence on differences between the predicted log employment change in all industries and the shock size variable used by FSS. When using CBP employment counts (Panel A) or establishment counts (Panel B), there are many counties that experience no job losses in the steel or auto industries, but are predicted to experience considerable job losses in other industries. These variables do not appear to capture the same underlying phenomenon. While the auto and steel industries are important and interesting, the recession affected many other industries as well (see Table 1).

C Matching NUMIDENT Data to Counties

This section describes the procedure used to match the Social Security Administration NUMIDENT file to FIPS county codes. The procedure described here was developed alongside Martha Bailey, Evan Taylor, and Reed Walker. Researchers with access to confidential Census data can read a technical memo with more information on this procedure and will be able to access the code and output from this procedure (Taylor, Stuart and Bailey, 2016).

We seek to match information on individuals' place of birth to county FIPS codes. The NUMIDENT file, which draws on Social Security card applications, contains a 12-character string identifying the place of birth (city and/or county) and a 2-character string identifying the state of birth postal code.[64] We identify a set of target locations using U.S. Geological Survey data on current and historical locations from the Geographic Names Information System (GNIS).[65] GNIS data contain place names and county FIPS codes.

[62] I cluster standard errors by state in Appendix Table A.7 as in my preferred specification.

[63] The first stage slope coefficient is 0.270 (0.107), with an F-statistic of 6.41, so there is some concern about a weak instrument.

[64] We use the 2012 version of the NUMIDENT file, accessed through the Michigan Census Research Data Center. For individuals born outside the United States, the 2-character string identifies the country of birth.

[65] We restrict attention to geographic features that are plausibly populated (those with a Populated Place, Census, or Civil feature class) or have a federal location code.

Several challenges prevent exact, unique matching of the NUMIDENT 12-character strings to GNIS counties. First, some place names in a state are indistinguishable with only 12 characters.[66] Second, place names are frequently misspelled. Third, the place of birth string sometimes contains acronyms and abbreviations, such as "Mnpls" for Minneapolis. Fourth, some NUMIDENT records contain the wrong postal code for their state of birth (e.g., "Anchorage, AL").

Our algorithm yields four broad categories of matches. Each step proceeds sequentially and only applies to NUMIDENT strings not previously matched. In a preliminary processing step, we correct for common acronyms and abbreviations by hand for any string that occurs more than 50 times in the NUMIDENT data for the 1950-1985 birth cohorts. First, we obtain exact matches for correctly spelled place names that can be uniquely identified in a birth state with 12 characters. Second, we obtain "duplicate" matches for correctly spelled place names that can, in principle, be identified uniquely in 12 characters. We assign individuals to a single birth county if at least 75 percent of the exact matches are to a single county, and we assign multiple birth counties otherwise.[67] Third, we use hand matches from Isen, Rossin-Slater and Walker (Forthcoming), described in their Appendix C. Fourth, we use probabilistic matching algorithms.[68] Finally, we hand check all strings that are matched in the probabilistic step, disagree with the match found in the Isen, Rossin-Slater and Walker (Forthcoming) algorithm but were not hand checked by them, and have at least 50 occurrences in the NUMIDENT file for the 1950-1985 cohorts.

Appendix Table A.8 summarizes match rates for individuals observed in the 2000 Census and 2001-2013 ACS. I limit the sample to individuals who were born from 1950-1980 and were age 25-64 at the time of the survey. I also limit the sample to individuals with non-imputed values of sex, age, race, and state of birth, and who report being born in the U.S on the census survey. 95.9 percent of the sample has a non-missing protected identification key (PIK), which is the anonymous identifier used to link Census and SSA data. Of these individuals, 99.6 percent have a PIK which is not duplicated within a survey year. We identify a unique birth county for 93.6 percent of the individuals with non-duplicated PIKs. Ultimately, these restrictions leave 89.4 percent of the initial sample. The majority of matches, 80.4 percent, are exact matches, while 11.0 percent are duplicates, 5.1 percent are matched probabilistically, and 3.5 percent are hand matches.

D Imputing Employment in County Business Patterns Data

This section describes how I impute employment in Census CBP data.

[66] For example, there are three different Populated Places in North Carolina beginning with "Bells Crossroads" located in different counties. Repeated place names pose less of a problem if the place name has less than 12 characters. For example, there are two places named Arcadia in North Carolina: one in Davidson County and the other in Forsyth County. These can be distinguished if "Arcadia Davi" or "Arcadia Fors" appear in the NUMIDENT.

[67] For example, a person born in North Carolina who writes "Arcadia Fors" or "Arcadia Davi" is matched to the correct Arcadia (in Forsyth or Davidson county) in the exact matching step. However, if an individual writes "Arcadia," we do not know in which Arcadia they were born. If at least 75 percent of the exact Arcadia matches are attributed to one county, then we match "Arcadia" to that county.

[68] In the probabilistic matching step, we only match NUMIDENT strings to GNIS places that have census codes to control the number of false positive matches. We first use the Stata command reclink2 (Wasi and Flaaen, 2015), with the tolerance set to 0.1, to obtain a set of potential matches for each NUMIDENT string. We then use the Stata command jarowinkler (Feigenbaum, 2015) to select the best match as the one with the highest Jaro-Winkler score among the potential matches. If no potential match has a Jaro-Winkler score of at least 0.8, then the string remains unmatched. If multiple places have the same Jaro-Winkler score, then this step matches to each place.

CBP data always report establishment counts by county, industry, and establishment size, but frequently suppress employment at the county-by-industry level. From 1974-forward, the establishment size groups are 1-4, 5-9, 10-19, 20-49, 50-99, 100-249, 250-499, 500-999, 1000-1499, 1500-2499, 2500-4999, and 5000 or more employees.

I impute employment at the county-by-industry level using establishment counts and nationwide information on employment by establishment size. For establishments with fewer than 1000 employees, I impute employment as the number of establishments times average 1977 employment in the establishment size group, where the average comes from nationwide data across all industries.

Nationwide CBP data report total employment among establishments with at least 1000 employees, but not by establishment size group. To impute employment for these large establishments, I assume that employment follows a log normal distribution, with mean μ and standard deviation σ, and estimate (μ, σ) using the generalized method of moments (GMM), as in Holmes and Stevens (2002). I estimate (μ, σ) using the following four moments:

$$p_1 = \Phi\left(\frac{\ln(1499) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(1000) - \mu}{\sigma}\right) \tag{A.7}$$

$$p_2 = \Phi\left(\frac{\ln(2499) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(1500) - \mu}{\sigma}\right) \tag{A.8}$$

$$p_3 = \Phi\left(\frac{\ln(4999) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(2500) - \mu}{\sigma}\right) \tag{A.9}$$

$$E[y] = \exp(\mu + \sigma^2/2), \tag{A.10}$$

where p_1 is the share of establishments (with at least 1000 employees) with 1000-1499 employees, p_2 is the share with 1500-2499 employees, p_3 is the share with 2500-4999 employees, $\Phi(\cdot)$ is the standard normal CDF, and $E[y]$ is average employment among establishments with at least 1000 employees.

I use equations (A.7)-(A.10) to estimate (μ, σ) with GMM, using the identity matrix as the weighting matrix.[69] Using 1977 data across all industries in the U.S., there are 1947 establishments with 1000-1499 employees, 1202 with 1500-2499 employees, 678 with 2500-4999 employees, and 275 with 5000 or more employees. Total employment among these establishments is 9,442,953. Consequently, $\hat{p}_1 = 1947/4102 \approx 0.475, \hat{p}_2 \approx 0.293, \hat{p}_3 \approx 0.165$ and $\hat{E}[y] \approx 2302$. The GMM estimates are $\hat{\mu} = 7.506$ and $\hat{\sigma} = 0.686$. Standard facts about the log-normal distribution imply

[69] When using equation (A.10) as a moment condition, data limitations prevent estimating standard errors or using the optimal weighting matrix. For example, one input in the variance and optimal weighting matrices is

$$\frac{1}{N}\sum_i \left[y_i^2 - 2y_i \exp(\mu + \sigma^2/2) + \exp(\mu + \sigma^2/2)\right],$$

where N is the total number of establishments and y_i is employment at establishment i. Because y_i is not observed, y_i^2 cannot be formed. An alternative would be to use only moment conditions (A.7) - (A.9).

that the imputed means for the four establishment size groups are 1247, 1952, 3414, and 7055.[70]

E Addressing Measurement Error in Recession Exposure

This section describes measurement error that arises because some individuals' county of residence in 1979, which is the ideal variable for measuring recession exposure, differs from their county of birth, which is all I observe. I show that this measurement error likely attenuates estimates of π_a in equation (1), and I quantify the size of this attenuation.

For reference, I repeat equation (1), which is the feasible regression of interest:

$$y_{i,a,c,t} = R_c^{78-82}\pi_a + x_{i,a,c,t}\beta + \gamma_c + \theta_{a,s(c)} + \delta_t + \varepsilon_{i,a,c,t}. \tag{A.11}$$

The explanatory variable of interest in equation (A.11) is R_c^{78-82}, the change in log earnings per capita from 1978-1982 in birth county c.

Let $R_{i,a,c,t}^{78-82*}$ be the change in log earnings per capita from 1978-1982 in the county where individual i resided in 1979. This variable more accurately measures exposure to the recession, but is unobserved. If I observed county of residence in 1979, the regression of interest would be

$$y_{i,a,c,t} = R_{i,a,c,t}^{78-82*}\pi_a^* + x_{i,a,c,t}\beta^* + \gamma_c^* + \theta_{a,s(c)}^* + \delta_t^* + \varepsilon_{i,a,c,t}^*. \tag{A.12}$$

True recession exposure, $R_{i,a,c,t}^{78-82*}$, and observed recession exposure, R_c^{78-82}, are connected through an auxiliary measurement error equation,

$$R_{i,a,c,t}^{78-82*} = R_c^{78-82}\lambda_a + \tilde{x}_{i,a,c,t}\tilde{\beta} + \tilde{\theta}_{a,s(c)} + \tilde{\delta}_t + v_{i,a,c,t}, \tag{A.13}$$

where the explanatory variables in equation (A.13) are a subset of those in equations (A.11) and (A.12), $\tilde{x} \subset x$. In equations (A.11) and (A.12), the vector x contains fixed effects for race, sex, a cubic in age at the time of survey, and interactions between age in 1979 and the 1950-1970 change in log median family income in county c. Unlike x, $\tilde{x}$ does not contain the cubic in age at the time of survey because the measurement error arises from the difference between county of birth and county of residence in 1979, and so there is no life cycle variation for a given birth cohort. Equation (A.13) does not contain birth county fixed effects because the attenuation bias arises from cross-county variation. By definition, $v_{i,a,c,t}$ is uncorrelated with the variables in equation (A.13).

To analyze the consequences of measurement error, I use the Frisch-Waugh-Lovell theorem (Frisch and Waugh, 1933; Lovell, 1963). I first partial out $\tilde{x}_{i,a,c,t}$, age in 1979 by birth state fixed effects, and survey year fixed effects from equations (A.11)-(A.13). Let $M^1 z$ represent the resulting residual for some vector z, where M^1 is the "annihilator matrix." Equations (A.11)-(A.13) can

[70] In particular, if $\ln(y) \sim \mathcal{N}(\mu, \sigma^2)$, then

$$E(y|a < y \leq b) = E(y)\frac{\Phi(\sigma - a_0) - \Phi(\sigma - b_0)}{\Phi(b_0) - \Phi(a_0)}, \quad a_0 \equiv (\ln a - \mu)/\sigma, \quad b_0 \equiv (\ln b - \mu)/\sigma$$

$$E(y|y > a) = E(y)\frac{\Phi(\sigma - a_0)}{\Phi(-a_0)}$$

now be written:

$$M^1 y_{i,a,c,t} = M^1 R_c^{78-82} \pi_a + M^1 x_{i,a,c,t} \beta + M^1 \gamma_c + M^1 \varepsilon_{i,a,c,t} \tag{A.14}$$

$$M^1 y_{i,a,c,t} = M^1 R_{i,a,c,t}^{78-82*} \pi_a^* + M^1 x_{i,a,c,t} \beta^* + M^1 \gamma_c^* + M^1 \varepsilon_{i,a,c,t}^* \tag{A.15}$$

$$M^1 R_{i,a,c,t}^{78-82*} = M^1 R_c^{78-82} \lambda_a + M^1 v_{i,a,c,t}. \tag{A.16}$$

Plugging equation (A.16) into (A.15) leads to:

$$M^1 y_{i,a,c,t} = (M^1 R_c^{78-82} \lambda_a + M^1 v_{i,a,c,t}) \pi_a^* + M^1 x_{i,a,c,t} \beta^* + M^1 \gamma_c^* + M^1 \varepsilon_{i,a,c,t}^* \tag{A.17}$$

$$= M^1 R_c^{78-82} \lambda_a \pi_a^* + M^1 x_{i,a,c,t} \beta^* + M^1 \gamma_c^* + (M^1 \varepsilon_{i,a,c,t}^* + M^1 v_{i,a,c,t} \pi_a^*). \tag{A.18}$$

Because $\tilde{x} \subset x$, $M^1 x_{i,a,c,t}$ is a vector of residuals of the variables that are in x but not $\tilde{x}$ (i.e., the cubic in age at the time of the survey). Partialling out these variables leads to

$$M^2 M^1 y_{i,a,c,t} = M^2 M^1 R_c^{78-82} \lambda_a \pi_a^* + M^2 M^1 \gamma_c^* + (M^2 M^1 \varepsilon_{i,a,c,t}^* + M^2 M^1 v_{i,a,c,t} \pi_a^*), \tag{A.19}$$

where M^2 is the second annihilator matrix. Applying the same transformation to the feasible regression of interest, equation (A.14), yields

$$M^2 M^1 y_{i,a,c,t} = M^2 M^1 R_c^{78-82} \pi_a + M^2 M^1 \gamma_c + M^2 M^1 \varepsilon_{i,a,c,t}. \tag{A.20}$$

If $\varepsilon_{i,a,c,t}^*$ is orthogonal to both $R_{i,a,c,t}^{78-82*}$, conditional on the covariates in equation (A.12), and the measurement error, $v_{i,a,c,t}$, then equations (A.19) and (A.20) imply that plim $\hat{\pi}_a = \lambda_a \pi_a^*$, where $\hat{\pi}_a$ is the OLS or 2SLS estimate from equation (A.11).[71] Consequently, the estimated effects of the recession will be attenuated if $\lambda_a \in (0, 1)$, and I can eliminate this attenuation bias with an estimate of λ_a.[72]

To quantify the extent of attenuation, I estimate λ_a using two data sets that provide valuable, but imperfect, information.[73] First, I use 2000-2013 Census/ACS data for individuals born from 1990-2013. These data contain county of birth from the NUMIDENT, like the data I use to estimate the long-run effects of the 1980-1982 recession, and county of residence. However, they measure the relationship between county of birth and county of residence after the 1980-1982 recession and might not accurately characterize the relevant measurement error if family migration patterns have changed over time. To address this concern, I use confidential Panel Study of Income Dynamics (PSID) data. PSID data allow me to estimate λ_a for individuals born from 1968-1979 and observed in 1979, but they only contain information on county of residence.[74] As seen in Appendix Figure

[71] These orthogonality conditions imply that $\varepsilon_{i,a,c,t}^*$ is orthogonal to R_c^{78-82}, and hence that $\varepsilon_{i,a,c,t}$ is orthogonal to R_c^{78-82}. Alternatively, I could assume that $\varepsilon_{i,a,c,t}$ is orthogonal to R_c^{78-82}, which would imply that $\varepsilon_{i,a,c,t}^*$ is orthogonal to R_c^{78-82}, and hence that $\varepsilon_{i,a,c,t}^*$ is orthogonal to $R_{i,a,c,t}^{78-82*}$.

[72] An alternative approach is to define $R_{a,c}^{78-82*}$ as the average change in log earnings per capita for individuals age a in 1979 and born in county c, and note that $R_{a,c}^{78-82*} = \sum_k p_{a,c,k} R_k^{78-82}$, where $p_{a,c,k}$ is the share of individuals age a in 1979 who were born in county c and resided in county k in 1979. Estimates of $p_{a,c,k}$ would allow me to construct $R_{a,c}^{78-82*}$ directly. I do not pursue this approach because the measurement error correction for each cohort depends on nearly 9.5 million parameters ($\approx 3076^2$), and adequate data on county-to-county migration flows are not available.

[73] The ideal data set is the 1980 Census linked to the NUMIDENT. Unfortunately, these files are not currently linked.

[74] I limit the PSID sample to individuals who are first observed before age 3 to make early life county of residence a better proxy for county of birth.

A.11, point estimates of λ_a from Census/ACS data range from 0.75 for 0 year olds to 0.58 for 17 year olds. Point estimates from PSID data display a similar age profile, but are larger because county of residence is more strongly related to county of residence in early life than county of birth. Appendix Figure A.11 suggests that my estimates of the recession's long-run effects are attenuated.

I prefer to adjust for this attenuation using the Census/ACS data because they contain the relevant information on place of birth. The validity of this adjustment depends on two assumptions. First, I assume that unobserved measurement error, $v_{i,a,c,t}$, is uncorrelated with unobserved determinants of long-run outcomes, $\varepsilon^*_{i,a,c,t}$, conditional on the covariates in equation (A.11). For example, this rules out the possibility that parents of young children with high $\varepsilon^*_{i,a,c,t}$ anticipated the recession and moved to less severe recession counties before 1980. The suddenness of the changes in local economic activity that emerged during the recession support this assumption. Second, I assume that estimates of λ_a for individuals born from 1990-2013 accurately characterize the measurement error relationship for individuals born from 1950-1979. Support for this assumption comes from the fact that estimates of λ_a are stable across the 1968-2013 birth cohorts in the PSID, as shown in Appendix Table A.9.[75]

Appendix Figure A.15 shows the consequences of adjusting the effects of the recession on four-year college degree attainment for attenuation bias. The adjusted effects are larger in magnitude, but they lie within the 95 percent confidence interval of the unadjusted estimates. The age profiles of the unadjusted and adjusted effects also are similar.

F Pre-Recession Migration is Not Correlated with the Severity of the Recession

This appendix shows that there is little evidence that pre-recession out-migration propensities are correlated with the severity of the recession. This finding is not necessary for the measurement error approach described in Section E, but provides additional information about pre-recession migration patterns.

Based on publicly available 1980 Census data (Ruggles et al., 2015), 2SLS regressions do not reveal a significant relationship between children's 1975-1980 migration and the recession severity in their 1975 commuting zone (CZ): a 10 percent decrease in earnings per capita from 1978-1982 is associated with a 3.8 (standard error: 3.4) percentage point increase in the probability of moving across CZs.[76] There is also no evidence of a significant relationship between the probability that a child lives outside his or her birth state and the severity of the recession in their 1975 CZ: a 10

[75] My adjustment divides point estimates $\hat{\pi}_a$ by $\hat{\lambda}_a$. I use the estimate of λ_a for 17 year olds in Appendix Figure A.11 for individuals 18 and older in 1979. Migration rates increase after age 17, as children leave their parents' household, but parents' location seems most relevant for educational attainment. Because the unadjusted estimates of π_a are close to zero for individuals age 18 and older in 1979, the adjusted estimates will be small regardless of the specific approach. Appendix Figure A.12 shows that migration rates are remarkably stable across the 1968-2013 birth cohorts in the PSID.

[76] The regression includes birth state-by-age fixed effects, plus indicator variables for race and sex. I estimate the regression on individuals under age 18 and cluster standard errors by birth state. I use maternal migration for children born after 1975. On average, 13.7 percent of children move across CZs from 1975-1980. OLS estimates imply that a 10 percent decrease in earnings per capita is associated with a 0.8 (1.3) percentage point increase in the probability of moving across CZs.

percent decrease in earnings per capita is associated with a 7.1 (11.9) percentage point increase in the probability of living outside one's birth state.[77]

G The Long-Run Effects of the 1980-1982 Recession on Education: Heterogeneity by Sex and Race

To better understand who was affected by the recession, I separately estimate the long-run effects on men and women. Men experienced a greater decline in employment and wages during the recession (Bound and Holzer, 2000; Hoynes, Miller and Schaller, 2012), and if this pattern persisted, the opportunity cost channel would predict a greater increase in educational attainment for them. Because men and women grew up in the same families and neighborhoods, they likely experienced similar conditions in childhood and had similar levels of parental resources when making schooling decisions. However, exposure to the recession during childhood might have different effects on men and women. Some recent work finds that disadvantage in childhood has more severe effects on the long-run outcomes of men than women (Autor et al., 2016; Chetty et al., 2016), while other papers find that women are equally or more sensitive to childhood disadvantage (Chetty, Hendren and Katz, 2016; Chyn, 2016).

Panel A of Appendix Table A.14 shows that the recession reduced long-run educational attainment of both men and women. The recession had more severe effects on the college attendance and overall college degree attainment of men, consistent with greater sensitivity to early life disadvantage among men. The recession had more severe effects on the four-year college degree attainment of women, and this appears to be driven by greater substitution among women from four- to two-year colleges. A natural explanation for this differential substitution is a higher return to two-year degrees for women (Kane and Rouse, 1995; Jepsen, Troske and Coomes, 2012).

I also separately estimate the long-run effects of the recession on white and non-white individuals. Non-white workers experienced greater reductions in employment and wages during the recession (Bound and Holzer, 2000; Hoynes, Miller and Schaller, 2012), but it is unclear whether this differential persisted. If it did, the opportunity cost channel would predict a greater increase in educational attainment for non-white individuals. Non-white individuals may or may not have experienced greater reductions in childhood human capital and parental resources to pay for college, as the long-term effects on parents' labor market outcomes and the effects on other inputs are unknown. The lower homeownership rate likely led to smaller wealth reductions for non-white individuals in response to house price declines. Panel B of Appendix Table A.14 shows that the negative effects of the recession on educational attainment are concentrated among whites. For non-white individuals, there is evidence of an increase in high school graduation and college attendance, but little evidence of an effect on college degree attainment. I leave for future research the task of explaining the differences in the effects among white and non-white children, as this clearly requires additional data.

[77] I use the same covariates and sample to estimate this regression. On average, 18 percent of my sample lives outside their birth state. OLS estimates imply that a 10 percent decrease in earnings per capita is associated with a 0.9 (3.8) percentage point increase in the probability of living outside one's birth state.

H Additional Support for the Empirical Strategy from Birth Certificate Data

To provide evidence on the validity of my empirical strategy, I examine whether the pre-recession evolution of infant mortality, parental characteristics, and infant health are correlated with the severity of the 1980-1982 recession. I do not detect meaningful relationships, which provides evidence that my estimates of the long-run effects of the recession are not driven by pre-recession trends in infant health or parental characteristics.

I examine the evolution of the infant mortality rate (deaths per 1,000 births) by estimating 2SLS regressions similar to equation (A.1). The regression includes county of residence and state of residence-by-birth year fixed effects, the share of births that are nonwhite, and birth year interacted with the 1950-1970 change in log median family income. My sample contains individuals born from 1950-1979. I normalize the interaction between the severity of the recession and birth year to equal 0 for individuals born in 1950, and I aggregate the remaining interactions into three-year bins. I use the predicted log employment change as an instrumental variable, and exclude the 526 counties with at least 5 percent of 1976 employment in the mining sector.

Appendix Figure A.13 shows that there is no evidence of a relationship between the evolution of infant mortality from 1950-1979 and the severity of the 1980-1982 recession. The point estimates are centered around zero, generally small in magnitude, and indistinguishable from zero ($p = 0.93$). When including counties with a high mining employment share, there is also no evidence of a significant relationship ($p = 0.64$).

Information on parental characteristics (such as education) and infant birth weight are not available for the full 1950-1979 period, but are available from 1970-1979.[78] To examine these outcomes, I estimate similar regressions, normalizing the interaction between the severity of the recession and birth year to equal 0 for individuals born in 1970. The control variables are the same, and I continue to exclude counties with a high share of employment in mining.[79]

Appendix Table A.16 provides no evidence of a relationship between the evolution of maternal education or infant birth weight and the severity of the 1980-1982 recession. I examine five dependent variables: average mothers' years of schooling, the share of births classified as low birth weight (no more than 2,500 grams), very low birth weight (1,500 grams), and extremely low birth weight (1,000 grams), and average birth weight. For each dependent variable, the coefficients are small and individually and jointly indistinguishable from zero at standard levels.

I The Long-Run Effects of the 1980-1982 Recession on Education: Robustness Checks

This section summarizes results that demonstrate the robustness of my estimates to different specifications. Given its importance, I focus on the effect of the recession on four-year college degree

[78] Data on infant birth weight are available starting in 1968, and data on maternal education are available starting in 1969. I focus on 1970-forward because the 1969 data handle births to nonresident aliens differently than the 1970-forward data.

[79] For results on maternal education, I restrict the sample to states that reported education throughout the 1970-1979 period. This results in the exclusion of 13 states (Alabama, Arkansas, California, Connecticut, Delaware, the District of Columbia, Georgia, Idaho, Maryland, New Mexico, Pennsylvania, Texas, and Washington).

attainment.

Appendix Table A.17 shows that results are similar when replacing age in 1979 by birth state fixed effects with age by birth division or region fixed effects.[80] Appendix Table A.18 shows that results are robust to not controlling for interactions between age in 1979 and the 1950-1970 change in log median family income in individuals' birth county, to controlling instead for the 1950-1980 change in log median family income, and to controlling for both the 1950-1970 and 1970-1980 change.

Appendix Table A.19 shows that results are similar when replacing the 1978-1982 decrease in log earnings per capita with other measures of recession severity: the decrease in log earnings, the decrease in log income per capita, the decrease in log employment, and the decrease in earnings per capita.[81] Appendix Table A.20 shows that results are similar when using all other states in the continental U.S., instead of other states in the same region, to construct the predicted log employment change instrumental variable; estimates are similar but less precise when using the predicted log employment change in manufacturing, which was the largest industry in 1978 and experienced a severe decline in the 1980-1982 recession.

My main specification measures recession severity at the county-level. I also estimate regressions that measure recession severity at the commuting zone (CZ)-level. In comparing these two sets of results, an important issue is whether the effect of the recession on local economic activity differs at the county or CZ-level. To examine this, I re-estimate equation (A.1), where the dependent variable is the log real median family income in a county, using the change in log earnings per capita from 1978-1982 in each county's CZ as the key explanatory variable. I also construct the predicted log employment change at the CZ-level. The results, in Appendix Figure A.14, differ somewhat from the results in Appendix Figure A.4, where the change in log earnings per capita and predicted log employment change are measured at the county-level. When measuring recession severity at the CZ-level, there is a slight decline in log median family income from 1970-1980 in counties whose CZ experienced a more severe recession; in contrast, Appendix Figure A.4 shows no change in log median family income from 1970-1980 in counties where the recession was more severe. In Appendix Figure A.14, the decline in log median family income in 1990 is smaller in magnitude than the decline in 2000; in contrast, Appendix Figure A.4 shows a similar decline in log median family income for 1990 and 2000, and this decline is similar to the 2000 decline in Appendix Figure A.14. In sum, the nature of the recession differs somewhat at the county and CZ-level. These results suggest that controlling for the 1970-1980 change in log median family income and separating the temporary and persistent effects of the recession could be important when comparing specifications that measure recession severity at the county versus CZ-level.

Column 1 of Appendix Table A.21 presents the baseline effects on four-year college degree attainment, where recession severity is measured at the county-level. In column 2, I separate the effects of the temporary and persistent declines in earnings per capita, as described in Appendix K. Columns 3 and 4 present results when measuring the severity of the recession at the CZ-level, without making any other changes to the specification. In both columns, the effects are small and

[80] There are nine divisions and four regions, as defined by the Census Bureau.

[81] Mean real earnings per capita in 1978 is \$21,964, so a 10 percent decrease in earnings per capita at the mean amounts to \$2,196. The estimates using the decrease in earnings per capita in Appendix Table A.19 imply that a \$2,196 decrease in earnings per capita leads to a 3.5 percentage point ($= 0.159 \times 0.2196$) decrease in four-year degree attainment for 0-10 year olds and a 1.9 percentage point decrease for 11-19 year olds. These estimates are similar to those which use the change in log real earnings per capita, which imply a 3.0 and 1.6 percentage point decrease.

indistinguishable from zero. Columns 5-8 add interactions between individuals' age in 1979 and the 1970-1980 change in log median family income in their county of birth. Columns 5-6, which measure recession severity at the county-level, are similar to columns 1-2, as expected given the lack of a relationship between recession severity and the 1970-1980 change in log median family income (see Appendix Figure A.4). Columns 7-8 measure recession severity at the CZ-level. Column 7, which does not separate the temporary and persistent declines in earnings per capita, again reveals small and indistinguishable effects. However, when separating the temporary and persistent declines in column 8, the results are broadly consistent with those in column 6, which measure recession severity at the county-level. In particular, the decrease in log real earnings per capita from 1978-1992 (i.e., the persistent component) has a negative, statistically significant, and similarly-sized effect on four-year college degree attainment. In sum, these results indicate that after modifying the specification to account for differences in the nature of the recession at the county and CZ-level, the effects of the recession on four-year college degree attainment are broadly consistent when measuring recession severity at the county and CZ-level.

Columns 9-10 present an alternative assessment of the robustness of my results to the unit of geography. I replace the decrease in log earnings per capita in individuals' birth county with a population and distance weighted average for counties within 100 miles, and I use a similar weighted average for the predicted log employment change. In particular, I construct the weighted average of the decrease in log real earnings per capita as

$$\bar{R}_c^{78-82} = \sum_{j:D_{c,j}\leq 100} \frac{N_j D_{c,j}^{-1}}{\sum_{j':D_{c,j'}\leq 100} N_{j'} D_{c,j'}^{-1}} R_j^{78-82}. \tag{A.21}$$

The weight increases in N_j, the 1970 population of county j, and decreases in $D_{c,j}$, the distance in miles between counties c and j. These are desirable features because larger counties are likely more popular destinations for migrants or commuters and the cost of migrating or commuting increases in distance. I normalize $D_{c,c} = 1$. This approach has the benefit of distinguishing between counties within CZs, while allowing the severity of the recession in nearby counties to influence long-run outcomes. Columns 9-10 are extremely similar to columns 1-2, which provides further support for the robustness of my results.

J Effects on Local Government Expenditures and Revenues

This section examines the effects of the 1980-1982 recession on local government expenditures and revenues, which could affect human capital development in childhood. I find that expenditures per capita fell starting in 1992 in counties that experienced a more severe recession, but there is little evidence of a decrease before then, likely due to higher federal transfers. The decline in expenditures is driven by spending on welfare and health, and not education.

To examine the effect of the recession on local government expenditures and revenues, I estimate event study regressions similar to equation (A.1), where the dependent variable is log real expenditures or revenues.[82] I use data from the Census of Governments, which contains infor-

[82] In a very small number of instances, a county reports 0 expenditures or revenues for the outcomes I examine. To maintain a constant sample, I use the inverse hyperbolic sine, $\ln(y+\sqrt{1+y^2})$, instead of $\ln(y)$ throughout (Burbridge, Magee and Robb, 1988). The log and inverse hyperbolic sine yield very similar coefficients in linear regression models

mation on expenditures and revenues for all government units in years that end in a "2" or "7."[83] I collapse all government units to the county level for years 1972, 1977, 1982, 1987, 1992, and 1997. I normalize the interaction between year 1977 and the severity of the recession to equal zero. I estimate the model by 2SLS, using the predicted log employment change from 1978-1982 in all industries as the IV. To remove the countercyclical boom-bust cycle experienced by the mining sector, I exclude the 526 counties with at least 5 percent of 1976 employment in the mining sector. I control for log population and the share of the population age 0-4, 5-19, and 20-64, which could affect the amount and composition of expenditures and revenues.

Appendix Table A.22 shows that the recession had little effect on expenditures in the short-run, but is associated with reductions from 1992-forward. I focus on general direct expenditures, which represent all expenditures besides those for liquor stores, utilities, insurance trusts, or intergovernmental transfers, and amount to 89 percent of total expenditures in 1977.[84] The results in column 1 provide little evidence that the recession reduced expenditures per capita in 1982 or 1987, but there is a significant decrease in expenditures in 1992 and 1997. A 10 percent decrease in earnings per capita from 1978-1982 is associated with an 11.2 percent reduction in expenditures in 1992 and an 8.8 percent reduction in 1997. Columns 2-6 demonstrate that the long-run reduction is not driven by education or public safety spending, which account for 59 percent of spending in 1977, but instead by welfare and health, infrastructure, and other purposes.[85] Columns 7-8 show that both current and capital expenditures decreased in the 1990s; the point estimates indicate an earlier and larger decrease in capital spending.

Appendix Table A.23 provides suggestive evidence that intergovernmental transfers initially offset the decrease in tax revenues after the recession. As seen in column 1, there is a significant decrease in general direct revenues from 1992-forward.[86] Underlying this is an immediate decrease in tax revenue (column 2), possibly offset by an increase in intergovernmental transfers in 1982 and 1987 (column 4). Column 5 shows that property taxes, which account for 33 percent of general direct revenue and 89 percent of tax revenue, drive the decrease in total tax revenues. Columns 6-8 suggest that offsetting intergovernmental transfers came from federal and local, as opposed to state, governments.

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when y is sufficiently large.

[83] I downloaded these data from the NBER website, with thanks to Michael Greenstone for making them available. I exclude the five New York City counties from the analysis because they are combined into a single geographic unit.

[84] I exclude liquor stores, utilities (water supply, electric power, gas supply, and mass transit), and insurance trusts to focus on government activities most likely to affect children, but results are similar when including these categories. I exclude intergovernmental expenditures to avoid double counting, which could arise when a county government gives money to a school district, which then spends the money on teachers' salaries. The grouping of expenditures and revenues in Appendix Tables A.22 and A.23 is similar to that used by Bartik et al. (2016).

[85] Education expenditure purposes include elementary and secondary education, higher education, and libraries. Public safety expenditure purposes include police, correctional facilities, fire, judicial and legal, and protective inspection and regulation. Welfare and health expenditure purposes include welfare, health and hospital, transit subsidies, and housing and community development. Infrastructure expenditure purposes include airport, total highway, parking, sewerage, solid wage management, and water transport and terminals. Examples of other expenditure purposes are financial administration, central staffing, and parks and recreation.

[86] As expected given balanced budget requirements, the change in expenditures in Appendix Table A.22 approximately mirror the change in revenues in Appendix Table A.23.

K Separating the Long-Run Effects of Temporary and Persistent Earnings Decreases on Education

My baseline specification measures recession severity using the 1978-1982 decrease in log real earnings per capita, and uses the predicted log employment change from 1978-1982 as an instrumental variable. Counties with a larger predicted employment decrease experienced a persistent decrease in local economic activity, as described in Appendix A, and my baseline specification implicitly reflects this persistence.

Evidence on whether the long-run effects of the recession stem from temporary or persistent declines in local economic activity could shed light on the underlying mechanisms. For young children, a temporary decrease in economic activity could have negative long-run effects if the human capital production function features sufficiently strong dynamic complementarity or early childhood is a sensitive period of development.[87] Even in the absence of these features of childhood development, a persistent decrease in economic activity could have negative long-run effects by reducing the sequence of investments in childhood human capital or parental resources to pay for college.

To examine this, I estimate regressions that include the decrease in log real earnings per capita from 1978-1982 and from 1978-1992.[88] As instrumental variables, I use the predicted log employment change from 1978-1982 and 1978-1992, based on a county's 1976 industrial structure.[89] While this approach separates the temporary and persistent declines in earnings per capita that emerged at the onset of the 1980-1982 recession, a limitation that should be considered in interpreting these results is that not all of the industry-level employment changes from 1978-1992 are due to the 1980-1982 recession.

The point estimates in Appendix Table A.25 suggest that the negative long-run effects on four-year degree attainment arise from the persistent decline in log earnings per capita, but there is little evidence of this for any college degree attainment, and the standard errors prevent sharper conclusions.[90]

[87] Dynamic complementarity implies that less investment in one period reduces the return to investment in later periods (Cunha and Heckman, 2007; Cunha, Heckman and Schennach, 2010; Aizer and Cunha, 2012; Caucutt and Lochner, 2012).

[88] As discussed in Appendix A, the recession displays a similar degree of persistence for years 1987-2002, so the choice of 1992 is probably not important.

[89] The 1978-1982 and 1978-1992 predicted log employment changes are highly, but not perfectly, correlated (see Appendix Figure A.20). Among all counties, state fixed effects and the 1978-1982 predicted log employment change explain 45 percent of the variation in the 1978-1992 predicted change. Appendix Table A.24 describes industry-level employment changes from 1978-1992. Comparing this with Table 1 reveals the patterns that distinguish the temporary and persistent effects. For example, oil and gas extraction did relatively well from 1978-1982, but poorly from 1978-1992. Auto dealers experienced large employment losses from 1978-1982, but gains from 1978-1992. Primary metal manufacturing experienced employment losses over both horizons.

[90] In the future, I will report p-values from the test of whether the effects of temporary and persistent earnings decreases are equal. This requires submitting an additional disclosure request to the Census Bureau.

Table A.1: The Effect of the 1980-1982 Recession on Earnings per Capita, OLS and 2SLS Estimates

Instrument:	OLS - (1)	2SLS All Industries (2)	2SLS All Industries (3)	2SLS Manufacturing (4)
Panel A: OLS and 2SLS estimates (dependent variable: log earnings per capita, 1992)				
Log earnings per capita, 1982 ($\hat{\beta}$)	0.636***	1.318***	0.447*	1.157***
	(0.0574)	(0.119)	(0.254)	(0.105)
Log earnings per capita, 1978 ($\hat{\gamma}$)	0.289***	-0.348***	0.469*	-0.206*
	(0.0558)	(0.112)	(0.241)	(0.107)
$\hat{\beta} + \hat{\gamma}$	0.925***	0.971***	0.916***	0.951***
	(0.020)	(0.020)	(0.025)	(0.018)
Panel B: First stage estimates (dependent variable: log earnings per capita, 1982)				
Predicted log employment change,		0.412***	0.386***	0.537***
1978-1982		(0.0666)	(0.0679)	(0.108)
F-statistic, slope coefficient		38.19	32.42	24.73
Exclude high mining counties	No	Yes	No	No
Observations	3,076	2,550	3,076	3,076

Notes: Panel A reports OLS and 2SLS estimates of equation (A.3), where the dependent variable is log real earnings per capita in 1992. Panel B reports the associated first stage coefficient on the predicted log employment change, where the dependent variable is log real earnings per capita in 1982. All regressions include state fixed effects and control for log real earnings per capita in 1978 and the 1950-1970 change in log real median family income. High mining counties have at least 5 percent of 1976 employment in the mining sector. Standard errors in parentheses are clustered by state.

Sources: BEA Regional Economic Accounts, County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Table A.2: The Effect of the 1980-1982 Recession on the Employment-Population Ratio, OLS and 2SLS Estimates

Instrument:	OLS - (1)	2SLS All industries (2)	2SLS All industries (3)	2SLS Manufacturing (4)
Panel A: OLS and 2SLS estimates (dependent variable: log employment-population ratio, 1992)				
Log employment-pop. ratio, 1982 ($\hat{\beta}$)	0.610***	1.430***	0.369	1.006***
	(0.118)	(0.156)	(0.235)	(0.184)
Log employment-pop. ratio, 1978 ($\hat{\gamma}$)	0.288**	-0.491***	0.521**	-0.0949
	(0.109)	(0.153)	(0.223)	(0.180)
$\hat{\beta}+\hat{\gamma}$	0.898***	0.939***	0.890***	0.911***
	(0.017)	(0.014)	(0.020)	(0.016)
Panel B: First stage estimates (dependent variable: log employment-population ratio, 1982)				
Predicted log employment change,		0.355***	0.375***	0.458***
1978-82		(0.0456)	(0.0395)	(0.0668)
F-statistic, slope coefficient		60.39	90.13	46.96
Exclude high mining counties	No	Yes	No	No
Observations	3,076	2,550	3,076	3,076

Notes: Panel A reports OLS and 2SLS estimates of equation (A.3), where the dependent variable is the log employment-population ratio in 1992. Panel B reports the associated first stage coefficient on the predicted log employment change, where the dependent variable is the log employment-population ratio in 1982. See notes to Appendix Table A.1.

Sources: BEA Regional Economic Accounts, County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Table A.3: The Effects of the 1980-1982 Recession on Earnings per Capita and the Employment-Population Ratio, 2SLS Estimates, At Different Horizons

Dependent variable measured in year:	1987 (1)	1992 (2)	1997 (3)	2002 (4)	2007 (5)	2012 (6)
Panel A: Dependent variable: log earnings per capita in indicated year						
Log earnings per capita, 1982 ($\hat{\beta}$)	1.236***	1.318***	1.310***	1.742***	2.251***	2.556***
	(0.122)	(0.119)	(0.134)	(0.204)	(0.249)	(0.294)
Log earnings per capita, 1978 ($\hat{\gamma}$)	-0.250**	-0.348***	-0.330***	-0.748***	-1.207***	-1.576***
	(0.118)	(0.112)	(0.127)	(0.203)	(0.248)	(0.294)
$\hat{\beta}+\hat{\gamma}$	0.986***	0.971***	0.980***	0.994***	1.044***	0.981***
	(0.014)	(0.020)	(0.025)	(0.023)	(0.027)	(0.035)
Observations	2,550	2,550	2,550	2,550	2,550	2,550
Panel B: Dependent variable: log employment-population ratio in indicated year						
Log employment-pop. ratio, 1982 ($\hat{\beta}$)	1.269***	1.430***	1.745***	2.659***	3.031***	3.238***
	(0.136)	(0.156)	(0.249)	(0.339)	(0.394)	(0.372)
Log employment-pop. ratio, 1978 ($\hat{\gamma}$)	-0.317**	-0.491***	-0.843***	-1.759***	-2.147***	-2.374***
	(0.136)	(0.153)	(0.239)	(0.327)	(0.382)	(0.366)
$\hat{\beta}+\hat{\gamma}$	0.951***	0.939***	0.902***	0.900***	0.885***	0.864***
	(0.011)	(0.014)	(0.022)	(0.034)	(0.038)	(0.042)
Observations	2,550	2,550	2,550	2,550	2,550	2,550

Notes: Panel A reports 2SLS estimates of equation (A.3), where the dependent variable is log real earnings per capita in the indicated year. In Panel B, the dependent variable is the log employment-population ratio in the indicated year. I use the predicted log employment change in all industries as an IV and exclude counties with at least 5 percent employment in the mining sector in 1976. All regressions include state fixed effects and control for log real earnings per capita in 1978 and the 1950-1970 change in log real median family income. Standard errors in parentheses are clustered by state.

Sources: BEA Regional Economic Accounts, County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Table A.4: The Effect of the 1980-1982 Recession on Log Median Family Income, Rents, and House Values, 2SLS Estimates

	Dependent variable: 1980-1990 change in		
	Log median family income (1)	Log median rent (2)	Log median house value (3)
Panel A: Excluding high mining counties			
Change in log real earnings per capita, 1978-1982	1.004***	0.721***	0.780**
	(0.166)	(0.246)	(0.349)
Observations	2,550	2,550	2,550
Panel B: All counties			
Change in log real earnings per capita, 1978-1982	0.221	0.003	0.220
	(0.182)	(0.156)	(0.244)
Observations	3,076	3,076	3,076

Notes: I use the predicted log employment change in all industries as an IV. Regressions include state fixed effects and the change in log real median family income from 1950-1970. High mining counties have at least 5 percent of 1976 employment in the mining sector. Standard errors in parentheses are clustered by state.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Table A.5: Approximate Replication of Tables 3 and 4 of Feyrer, Sacerdote and Stern (2007)

	Dependent variable: Change in employment rate			
	1977-1982	1982-1987	1977-1987	1987-2004
	(1)	(2)	(3)	(4)
Panel A: Table 3 of FSS				
Shock dummy	-0.013***	0.011***	-0.002	0.000
	(0.003)	(0.003)	(0.003)	(0.003)
Observations	1,439	1,439	1,439	1,439
R^2	0.37	0.40	0.47	0.31
Panel B: Approximate replication of Table 3 of FSS				
Shock dummy	-0.013***	0.012***	-0.001	-0.000
	(0.004)	(0.003)	(0.003)	(0.002)
Observations	2,326	2,326	2,326	2,326
R^2	0.28	0.32	0.38	0.24
Panel C: Table 4 of FSS				
Shock size	0.163***	-0.144***	0.019	0.020
	(0.051)	(0.052)	(0.047)	(0.039)
Observations	1,439	1,439	1,439	1,439
R^2	0.37	0.40	0.47	0.31
Panel D: Approximate replication of Table 4 of FSS				
Shock size	0.173***	-0.153***	0.020	0.019
	(0.058)	(0.058)	(0.048)	(0.036)
Observations	2,326	2,326	2,326	2,326
R^2	0.28	0.31	0.38	0.24

Notes: The dependent variable is 1 minus the unemployment rate, which FSS and I refer to as the employment rate. Shock size is the 1977-1982 employment change in the auto and steel industries divided by 1977 total employment. Shock dummy equals one if shock size is less than or equal to -0.02 (i.e., at least two percent of employment lost). All regressions include Census division indicators and an indicator for whether a county is in an MSA in 2000. Sample limited to counties with at least 10,000 residents in 1977. Heteroskedasticity robust standard errors in parentheses.

Sources: Panels A and C are from Tables 3 and 4 of Feyrer, Sacerdote and Stern (2007). Panels B and D are from BLS Local Area Statistics, Census County Business Patterns, and Census Annual Population Estimates

Table A.6: Comparison to Feyrer, Sacerdote and Stern (2007): Results from Different Dependent Variables with FSS Specification

	Dependent variable: Log change in				
	Employment rate (1)	Employment-pop. 15+ ratio (2)	Employment-pop. 15+ ratio (3)	Employment-pop. ratio (4)	Earnings per capita (5)
Panel A: Dependent variable is log change from 1977-1982					
Shock size	0.201***	0.485***	0.622***	0.647***	0.659***
	(0.0674)	(0.150)	(0.118)	(0.121)	(0.124)
R^2	0.267	0.061	0.111	0.107	0.248
Panel B: Dependent variable is log change from 1977-1982					
Shock size	0.194**	0.542***	0.417***	0.408***	0.414***
using estabs.	(0.0969)	(0.150)	(0.126)	(0.125)	(0.131)
R^2	0.280	0.075	0.122	0.117	0.255
Panel C: Dependent variable is log change from 1977-1987					
Shock size	0.0185	0.378	0.572***	0.575***	0.787***
	(0.0530)	(0.235)	(0.176)	(0.178)	(0.170)
R^2	0.368	0.071	0.105	0.134	0.268
Panel D: Dependent variable is log change from 1977-1987					
Shock size	-0.0287	0.0936	0.141	0.107	0.224
using estabs.	(0.0702)	(0.250)	(0.224)	(0.215)	(0.182)
R^2	0.368	0.071	0.102	0.132	0.265
Source of employment data:	BLS	BLS	BEA	BEA	N/A
Observations	2,326	2,326	2,326	2,326	2,326

Notes: The employment rate is 1 minus the unemployment rate. Shock size is the 1977-1982 employment change in the auto and steel industries divided by 1977 total employment. As defined by FSS, the employment change comes from CBP employment counts, which are frequently suppressed. Shock size using establishments uses CBP establishment counts, which are never suppressed. See text for details. All regressions include Census division indicators and an indicator for whether the county is in an MSA in 2000. Sample limited to counties with at least 10,000 residents in 1977. Heteroskedasticity robust standard errors in parentheses.

Sources: BLS Local Area Statistics, Census County Business Patterns, and Census Annual Population Estimates

Table A.7: Comparison to Feyrer, Sacerdote and Stern (2007): Results from Different Shock Measures and Different Samples

	Dependent variable: 1977-1987 log change in		
	Employment rate (1)	Employment-pop. 15+ ratio (2)	Earnings per capita (3)
Panel A: Counties with at least 10,000 residents in 1977, OLS ($N = 2,326$)			
Shock size	-0.0261	0.419**	0.647***
	(0.0723)	(0.182)	(0.237)
Panel B: Counties with at least 10,000 residents in 1977, OLS ($N = 2,326$)			
Shock size using estabs.	-0.0303	0.136	0.219
	(0.0708)	(0.241)	(0.197)
Panel C: All counties, OLS ($N = 3,076$)			
Shock size using estabs.	-0.0274	0.131	0.187
	(0.0684)	(0.219)	(0.177)
Panel D: All counties, OLS ($N = 3,076$)			
Change in log earnings per capita, 1978-1982	0.00891	0.295***	0.399***
	(0.00884)	(0.0439)	(0.0568)
Panel E: All counties, 2SLS, all industries ($N = 3,076$)			
Change in log earnings per capita, 1978-1982	-0.0969	0.370**	0.102
	(0.0689)	(0.169)	(0.234)
Panel F: Low mining counties, OLS ($N = 2,550$)			
Shock size using estabs.	-0.0513	0.0903	0.134
	(0.0688)	(0.233)	(0.187)
Panel G: Low mining counties, OLS ($N = 2,550$)			
Change in log earnings per capita, 1978-1982	0.0253**	0.357***	0.478***
	(0.0102)	(0.0591)	(0.0617)
Panel H: Low mining counties, 2SLS, all industries ($N = 2,550$)			
Change in log earnings per capita, 1978-1982	0.130**	1.111***	0.962***
	(0.0542)	(0.212)	(0.184)
Panel I: Low mining counties, 2SLS, shock size ($N = 2,550$)			
Change in log earnings per capita, 1978-1982	-0.190	0.335	0.496
	(0.312)	(0.750)	(0.530)
Source of employment data:	BLS	BEA	N/A

Notes: The employment rate is 1 minus the unemployment rate. Shock size is the 1977-1982 employment change in the auto and steel industries divided by 1977 total employment. As defined by FSS, the employment change comes from CBP employment counts, which are frequently suppressed. Shock size using establishments uses CBP establishment counts, which are never suppressed. All regressions include Census division indicators. Low mining counties have less than 5 percent of 1976 employment in the mining sector. Panels E and H use the predicted log employment change in all industries from 1978-1982 as an IV. Panel I uses the FSS shock size using establishments as an IV. Standard errors clustered by state in parentheses.

Sources: BLS Local Area Statistics, Census County Business Patterns, Census Annual Population Estimates, and BEA Regional Economic Accounts data

Table A.8: Sample Construction and Match Statistics

Panel A: Number of individuals satisfying sample criteria	
Meet baseline demographic criteria	27,374,000
and have non-missing PIK	26,253,000
and have non-duplicate PIK	26,147,000
and have unique birth county	24,462,000
Panel B: Birth county match type, as percent of total	
Exact	76.85
Exact - abbreviation	3.57
Duplicate	10.95
Probabilistic	5.11
Hand check	3.52

Notes: The baseline demographic criteria are having non-imputed values for state of birth, birth year, sex, and race, plus being born in the U.S. according to the Census/ACS survey. A duplicate PIK is one that appears more than once in a survey year. Sample contains individuals born from 1950-1980 who are age 25-64 at the time of the survey.
Source: Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.9: Stability of the Relationship between Severity of 1980-1982 Recession in County of Residence and County of Birth Across Cohorts

	Dependent variable: 1978-1982 decrease in log real earnings per capita in county of residence in year			
	1979	1991	2003	2013
	(1)	(2)	(3)	(4)
Interaction between 1978-1982 decrease in log real earnings per capita in county of birth and age				
0-1	0.970***	0.973***	1.001***	1.000***
	(0.0278)	(0.0214)	(0.00156)	(0.00110)
2-4	0.854***	0.878***	0.919***	0.855***
	(0.0321)	(0.0263)	(0.0318)	(0.0267)
5-7	0.803***	0.803***	0.779***	0.806***
	(0.0497)	(0.0583)	(0.0475)	(0.0311)
8-10	0.748***	0.621***	0.714***	0.810***
	(0.0469)	(0.0608)	(0.0769)	(0.0413)
11-13	0.716***	0.705***	0.667***	
	(0.0849)	(0.117)	(0.0717)	
Observations	3,684	4,028	3,336	3,358
p-value, coefficients equal to column 1	-	0.356	0.290	0.711
Sample: individuals born in years	1968-1979	1980-1991	1992-2003	2004-2013

Notes: Table reports estimates of OLS regressions. The dependent variable is the 1978-1982 decrease in log real earnings per capita in individuals' county of residence in the indicated year. Regressions include fixed effects for race, sex, and birth year-by-birth state, plus birth year interacted with the 1950-1970 change in log median family income in individuals' county of birth. The coefficients in column 1 are plotted in Appendix Figure A.11.
Sources: BEA Regional Economic Accounts, Confidential PSID data

Table A.10: The Long-Run Effects of the 1980-1982 Recession on Educational Attainment, OLS and Reduced-Form Estimates

	Dependent variable:					
	HS/GED attainment (1)	Any college attendance (2)	Any college degree attainment (3)	Four-year college degree attainment (4)	Two-year college degree attainment (5)	Years of schooling (6)
Panel A: OLS estimates						
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979						
0-10	0.0295**	0.0345	-0.0104	-0.0521*	0.0417**	0.0686
	(0.0130)	(0.0260)	(0.0296)	(0.0278)	(0.0187)	(0.166)
11-19	0.0242***	0.0519**	0.0309	0.0159	0.0150	0.279**
	(0.0089)	(0.0224)	(0.0212)	(0.0182)	(0.0141)	(0.119)
20-28	0.0149**	0.0268*	0.0311**	0.0308**	0.0003	0.234***
	(0.0060)	(0.0155)	(0.0133)	(0.0136)	(0.0102)	(0.0748)
Panel B: Reduced-form estimates						
Interaction between 1978-1982 predicted log employment decrease and age in 1979						
0-10	0.0198	-0.0154	-0.0987***	-0.163***	0.0648**	-0.242
	(0.0203)	(0.0264)	(0.0305)	(0.0427)	(0.0245)	(0.184)
11-19	0.0186	-0.0491	-0.0610**	-0.0785**	0.0175	-0.0462
	(0.0150)	(0.0310)	(0.0280)	(0.0330)	(0.0216)	(0.152)
20-28	0.0078	-0.0253	0.0156	0.0190	-0.0033	0.182*
	(0.0128)	(0.0231)	(0.0170)	(0.0210)	(0.0161)	(0.100)

Notes: Panel A reports estimates of the interaction between the 1978-1982 decrease in log real earnings per capita in individuals' county of birth and indicators for age in 1979. Panel B reports estimates of the interaction between the 1978-1982 predicted log employment decrease in individuals' county of birth and indicators for age in 1979. See notes to Table 2.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.11: The Long-Run Effects of the 1980-1982 Recession on Educational Attainment, First Stage Estimates

	Dependent variable: Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979		
	20-28	11-19	0-10
	(1)	(2)	(3)
Interaction between 1978-1982 predicted log employment decrease and age in 1979			
0-10	-0.0397***	-0.0336***	0.552***
	(0.00874)	(0.00791)	(0.0761)
11-19	-0.0251***	0.516***	-0.0138***
	(0.00722)	(0.0744)	(0.00458)
20-28	0.494***	-0.0110***	-0.00699***
	(0.0714)	(0.00363)	(0.00250)
F-statistic, all coefficients equal 0	20.20	18.13	19.55

Notes: Table reports first stage estimates of the 2SLS system. See notes to Table 2.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.12: The Long-Run Effects of the 1980-1982 Recession on Additional Individual and Spousal Outcomes

	Dependent variable:					
	Migration from birth county (1)	Migration from birth state (2)	In labor force (3)	Positive hours worked (4)	Total hours worked (5)	
Panel A: Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979						
0-10	-0.121	-0.0186	0.220***	0.151***	112.2	
	(0.0934)	(0.117)	(0.0567)	(0.0479)	(100.2)	
11-19	-0.161*	-0.0547	0.299***	0.237***	426.0***	
	(0.0916)	(0.0898)	(0.0784)	(0.0670)	(141.1)	
20-28	-0.0363	0.0039	0.179***	0.146***	297.4**	
	(0.0559)	(0.0554)	(0.0593)	(0.0561)	(125.8)	
Panel B: Average value of dependent variable in years 2000-2013, by age in 1979, in levels						
0-10	-	0.353	0.844	0.856	1692	
11-19	-	0.383	0.829	0.838	1692	
20-28	-	0.399	0.790	0.802	1613	
	Dependent variable:					
	Positive personal income (6)	Positive earned income (7)	Positive spousal income (8)	Personal income (9)	Earned income (10)	Spousal Income (11)
Panel A: Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979						
0-10	0.0309	0.152***	-0.156*	9,324*	2,927	5,174
	(0.0287)	(0.0483)	(0.0888)	(5,237)	(4,771)	(4,107)
11-19	0.0929**	0.236***	-0.0652	-8,276	-11,799**	-462.3
	(0.0409)	(0.0673)	(0.0643)	(5,216)	(5,667)	(4,693)
20-28	0.0519*	0.148**	0.0760*	-5,051	-5,844	4,386
	(0.0289)	(0.0574)	(0.0399)	(3,838)	(3,644)	(3,435)
Panel B: Average value of dependent variable in years 2000-2013, by age in 1979, in levels						
0-10	0.910	0.855	0.319	42,728	41,004	21,592
11-19	0.910	0.838	0.388	51,325	48,484	27,176
20-28	0.916	0.801	0.505	54,198	48,988	31,581

Notes: See notes to Table 2. The sample in columns 1 and 2 contains 23.5 million individuals born from 1950-1979 in the continental U.S. with a unique birth county and non-imputed demographic and education variables. The sample in columns 3-11 contains 18.4 million individuals born from 1950-1979 in the continental U.S. with a unique birth county and non-imputed demographic, education, and labor market variables. Information on migration from birth county is not available from publicly available Census/ACS data, and I have not disclosed these statistics from the confidential Census/ACS data.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file, Publicly available 2000-2013 Census/ACS data from Ruggles et al. (2015)

Table A.13: The Long-Run Effects of the 1980-1982 Recession on Additional Family Outcomes

	Dependent variable:				
	Family income (1)	Income to poverty ratio × 100 (2)	Positive family income (3)	Married (4)	Family size (5)
Panel A: Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979					
0-10	-5,573	-17.18	-0.0068	0.114**	1.874***
	(11,576)	(64.97)	(0.0117)	(0.0450)	(0.544)
11-19	-25,028*	2.577	-0.0036	-0.107*	0.384
	(12,818)	(56.16)	(0.0117)	(0.0647)	(0.277)
20-28	-10,010	32.89	0.0013	-0.0109	-0.206*
	(7,604)	(40.30)	(0.0120)	(0.0440)	(0.107)
Panel B: Average value of dependent variable in years 2000-2013, by age in 1979					
0-10	80,971	412.8	0.977	0.585	3.19
11-19	94,026	468.2	0.977	0.661	3.19
20-28	98,311	543.2	0.979	0.679	2.65

Notes: See notes to Table 2. The sample contains 18.4 million individuals born from 1950-1979 in the continental U.S. with a unique birth county and non-imputed education and labor market variables.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file, Publicly available 2000-2013 Census/ACS data from Ruggles et al. (2015)

Table A.14: The Long-Run Effects of the 1980-1982 Recession on Educational Attainment, Heterogeneity by Sex and Race

	Dependent variable:					
	HS/GED attainment (1)	Any college attendance (2)	Any college degree attainment (3)	Four-year college degree attainment (4)	Two-year college degree attainment (5)	Years of schooling (6)
Panel A: Heterogeneity by sex						
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979 for men						
0-10	-0.0118	-0.148**	-0.213**	-0.261**	0.0476	-0.290
	(0.0495)	(0.0733)	(0.0830)	(0.108)	(0.0469)	(0.422)
11-19	-0.0175	-0.181**	-0.188***	-0.165*	-0.0235	-0.280
	(0.0473)	(0.0878)	(0.0709)	(0.0876)	(0.0443)	(0.397)
20-28	-0.0081	-0.0737	-0.0081	0.0050	-0.0131	0.234
	(0.0392)	(0.0676)	(0.0480)	(0.0621)	(0.0443)	(0.303)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979 for women						
0-10	0.0864*	0.0793	-0.146**	-0.335***	0.189**	-0.495
	(0.0469)	(0.0619)	(0.0723)	(0.118)	(0.0873)	(0.416)
11-19	0.0895**	-0.0078	-0.0484	-0.147*	0.0983	0.136
	(0.0394)	(0.0605)	(0.0666)	(0.0847)	(0.0728)	(0.343)
20-28	0.0405	-0.0239	0.0684	0.0609	0.0074	0.512*
	(0.0367)	(0.0499)	(0.0497)	(0.0459)	(0.0346)	(0.287)
p-value, equal effects	0.007	0.001	0.034	0.014	0.170	0.013
Panel B: Heterogeneity by race						
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979 for whites						
0-10	-0.0045	-0.141**	-0.286***	-0.403***	0.116*	-0.989**
	(0.0334)	(0.0666)	(0.0949)	(0.146)	(0.0632)	(0.483)
11-19	0.0031	-0.166**	-0.192**	-0.229**	0.0372	-0.493
	(0.0278)	(0.0751)	(0.0757)	(0.108)	(0.0523)	(0.371)
20-28	0.0054	-0.0755	0.0081	0.0137	-0.0056	0.271
	(0.0234)	(0.0511)	(0.0409)	(0.0515)	(0.0369)	(0.205)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979 for non-whites						
0-10	0.425**	0.468**	0.168	-0.0064	0.174**	2.153*
	(0.181)	(0.199)	(0.144)	(0.110)	(0.0887)	(1.188)
11-19	0.325***	0.324**	0.175	0.111	0.0633	2.032**
	(0.0977)	(0.138)	(0.116)	(0.0926)	(0.0780)	(0.829)
20-28	0.134*	0.142	0.134	0.0956	0.0388	1.075*
	(0.0686)	(0.115)	(0.102)	(0.0912)	(0.0797)	(0.585)
p-value, equal effects	0.006	0.014	0.046	0.056	0.739	0.013

Notes: See notes to Table 2. I estimate separate 2SLS regressions for men and women (Panel A) and whites and non-whites (Panel B). The p-value is for the null hypothesis that the effects of the recession are equal for men and women or whites and non-whites.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.15: Correlation of County-Level Severity of Recessions

	Log earnings per capita change, 1973-75 (1)	Log earnings per capita change, 1978-82 (2)	Log earnings per capita change, 1989-91 (3)	Log earnings per capita change, 2000-02 (4)	Log earnings per capita change, 2007-10 (5)	Predicted log employment change, 1978-82 (6)
Panel A: Raw correlations						
Log earnings per capita change, 1973-75	1.000					
Log earnings per capita change, 1978-82	-0.027	1.000				
Log earnings per capita change, 1989-91	-0.023	0.050	1.000			
Log earnings per capita change, 2000-02	0.132	0.117	-0.010	1.000		
Log earnings per capita change, 2007-10	-0.171	-0.013	0.107	-0.104	1.000	
Predicted log employment change, 1978-82	0.036	0.366	0.201	0.149	0.025	1.000
Panel B: Conditional on state fixed effects						
Log earnings per capita change, 1973-75	1.000					
Log earnings per capita change, 1978-82	-0.064	1.000				
Log earnings per capita change, 1989-91	0.026	0.022	1.000			
Log earnings per capita change, 2000-02	0.077	0.063	0.004	1.000		
Log earnings per capita change, 2007-10	-0.072	-0.056	0.013	-0.090	1.000	
Predicted log employment change, 1978-82	-0.061	0.212	0.088	0.033	0.060	1.000

Notes: The predicted log employment change from 1978-82 is constructed using a county's 1976 industrial structure and the industry-level log employment change from 1978-1982 in other states within the same region, as defined in equation (2). Sample contains 3,076 counties in the continental U.S.
Sources: BEA Regional Economic Accounts, County Business Patterns

Table A.16: Maternal Education and Infant Health Did Not Evolve Differentially Before the 1980-1982 Recession

	Dependent variable:				
	Average mothers' years of schooling (1)	Share low birth weight (2)	Share very low birth weight (3)	Share extremely low birth weight (4)	Average birth weight, grams (5)
Interaction between 1978-1982 decrease in log real earnings per capita and birth year					
1971-1973	0.398	0.0132	-0.0141	-0.00233	122.0
	(0.374)	(0.0563)	(0.0161)	(0.0129)	(135.2)
1974-1976	0.250	0.0242	-0.00282	0.00983	-14.81
	(0.381)	(0.0434)	(0.0126)	(0.0126)	(118.7)
1977-1979	-0.301	0.0111	0.00475	0.0148	-54.33
	(0.411)	(0.0412)	(0.0149)	(0.0120)	(110.1)
Observations	18,799	25,497	25,497	25,497	25,497
p-value, all coefs. equal 0	0.506	0.909	0.761	0.117	0.109
Dep. var. mean, 1970-1979	11.91	0.069	0.010	0.005	3,336

Notes: The interaction between the 1978-1982 decrease in log real earnings per capita and birth year 1970 is normalized to equal zero. Regressions are estimated by 2SLS, using the predicted log employment change in all industries from 1978-1982 as an IV. Regressions include fixed effects for county and state-by-year, plus interactions between year and the 1950-1970 change in log median family income. Standard errors in parentheses are clustered by state. Low birth weight is defined as no more than 2,500 grams, very low birth weight is no more than 1,500 grams, and extremely low birth weight is no more than 1,000 grams.
Sources: National Center for Health Statistics (1970-1979), BEA Regional Economic Accounts, County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Table A.17: The Long-Run Effect of the 1980-1982 Recession on Four-Year College Degree Attainment, Robustness to Fixed Effects

	(1)	(2)	(3)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979			
0-10	-0.303***	-0.244***	-0.223***
	(0.109)	(0.0830)	(0.0789)
11-19	-0.159**	-0.102*	-0.0999*
	(0.0801)	(0.0614)	(0.0599)
20-28	0.0306	0.0409	0.0407
	(0.0426)	(0.0365)	(0.0345)
Age in 1979 by birth state fixed effects	X		
Age in 1979 by birth division fixed effects		X	
Age in 1979 by birth region fixed effects			X

Notes: The dependent variable is an indicator for four-year college degree attainment. See notes to Table 2. There are nine divisions and four regions, as defined by the Census Bureau.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.18: The Long-Run Effect of the 1980-1982 Recession on Four-Year College Degree Attainment, Robustness to Controlling for Pre-Recession Evolution of Median Family Income

	(1)	(2)	(3)	(4)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979				
0-10	-0.241**	-0.303***	-0.316***	-0.311***
	(0.102)	(0.109)	(0.113)	(0.115)
11-19	-0.0989	-0.159**	-0.165**	-0.162*
	(0.0821)	(0.0801)	(0.0829)	(0.0830)
20-28	0.0784	0.0306	0.0257	0.0280
	(0.0487)	(0.0426)	(0.0428)	(0.0427)
Interaction between age in 1979 and change in log real median family income in county of birth from				
1950-1970		X		X
1950-1980			X	
1970-1980				X

Notes: The dependent variable is an indicator for four-year college degree attainment. See notes to Table 2.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.19: The Long-Run Effect of the 1980-1982 Recession on Four-Year College Degree Attainment, Robustness to Measure of Recession Severity

	Measure of recession: 1978-1982 change in				
	Log earnings per capita (1)	Log earnings (2)	Log income per capita (3)	Log employment (4)	Earnings per capita, $10k (5)
Interaction between measure of recession severity and age in 1979					
0-10	-0.303***	-0.249***	-0.470**	-0.220***	-0.159**
	(0.109)	(0.0850)	(0.194)	(0.0580)	(0.0686)
11-19	-0.159**	-0.129**	-0.252*	-0.113**	-0.0851*
	(0.0801)	(0.0651)	(0.141)	(0.0467)	(0.0498)
20-28	0.0306	0.0238	0.0452	0.0227	0.0143
	(0.0426)	(0.0351)	(0.0675)	(0.0315)	(0.0235)

Notes: The dependent variable is an indicator for four-year college degree attainment. See notes to Table 2.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.20: The Long-Run Effect of the 1980-1982 Recession on Four-Year College Degree Attainment, Robustness to Instrumental Variable

	Instrumental variable: Predicted log employment decrease from 1978-1982 in		
	All industries All regions (1)	All industries Same region (2)	Manufacturing Same region (3)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979			
0-10	-0.389***	-0.303***	-0.278*
	(0.112)	(0.109)	(0.155)
11-19	-0.191**	-0.159**	-0.159*
	(0.0873)	(0.0801)	(0.0917)
20-28	0.00831	0.0306	0.0423
	(0.0480)	(0.0426)	(0.0477)

Notes: The dependent variable is an indicator for four-year college degree attainment. See notes to Table 2. See equation (2) for definition of instrumental variables.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.21: The Long-Run Effect of the 1980-1982 Recession on Four-Year College Degree Attainment, Robustness to Level of Geography Used to Measure Recession Severity

	Level of geography used to measure recession severity:									
	County		CZ		County		CZ		County	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979										
0-10	-0.303***	-0.0693	-0.0371	0.0126	-0.311***	0.0190	-0.0343	0.0753	-0.283**	-0.0529
	(0.109)	(0.101)	(0.0747)	(0.0869)	(0.115)	(0.114)	(0.0773)	(0.0957)	(0.126)	(0.144)
11-19	-0.159**	-0.0729	0.0137	0.0155	-0.162*	-0.0271	0.0161	0.0438	-0.138	-0.0771
	(0.0801)	(0.0585)	(0.0569)	(0.0674)	(0.0830)	(0.0582)	(0.0577)	(0.0615)	(0.0867)	(0.0813)
20-28	0.0306	0.0297	0.0467	0.0520	0.0280	0.0590	0.0487	0.0726	0.0368	0.0361
	(0.0426)	(0.0453)	(0.0490)	(0.0578)	(0.0427)	(0.0476)	(0.0491)	(0.0550)	(0.0541)	(0.0641)
Interaction between 1978-1992 decrease in log real earnings per capita and age in 1979										
0-10		-0.175***		-0.0755		-0.250***		-0.168***		-0.237***
		(0.0446)		(0.0582)		(0.0477)		(0.0543)		(0.0654)
11-19		-0.0621**		-0.0056		-0.0999***		-0.0491		-0.0657
		(0.0298)		(0.0392)		(0.0289)		(0.0373)		(0.0485)
20-28		0.0031		-0.0094		-0.0202		-0.0405		0.0023
		(0.0209)		(0.0282)		(0.0211)		(0.0302)		(0.0307)
Includes neighboring counties									X	X
Interaction between age in 1979 and change in log median family income from 1970-1980					X	X	X	X		

Notes: The dependent variable is an indicator for four-year college degree attainment. See notes to Table 2. The decrease in log real earnings per capita and the predicted log employment decrease are measured at the same level of geography. In Columns 9 and 10, the measure of the recession and instrumental variable are the weighted average among counties within 100 miles, as described in the text.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.22: The Effects of the 1980-1982 Recession on Local Government Expenditures, 2SLS Estimates

	Dependent variable: Log expenditure							
		By purpose					By type	
	General direct expenditures (1)	Education (2)	Public safety (3)	Welfare and health (4)	Infra-structure (5)	Other (6)	Current (7)	Capital (8)
Interaction between 1978-1982 decrease in log real earnings per capita and year								
1972	-0.0398	-0.450	-0.0823	-0.270	-0.0145	-0.0320	0.181	-1.158
	(0.275)	(0.519)	(0.575)	(1.425)	(0.558)	(0.568)	(0.273)	(1.219)
1982	0.117	0.200	1.069**	-0.624	0.420	-0.0687	0.0849	-0.363
	(0.226)	(0.239)	(0.435)	(1.410)	(0.635)	(0.441)	(0.189)	(1.240)
1987	-0.245	0.212	0.494	0.0258	-0.709	-0.549	-0.153	-1.770
	(0.245)	(0.227)	(0.552)	(1.461)	(0.830)	(0.564)	(0.199)	(1.341)
1992	-1.123***	-0.145	0.0639	-5.317***	-0.812	-1.751***	-1.021***	-2.299**
	(0.308)	(0.284)	(0.593)	(1.813)	(0.844)	(0.625)	(0.313)	(1.080)
1997	-0.878***	-0.168	0.604	-3.071**	-0.861	-1.887***	-0.812***	-1.484
	(0.318)	(0.325)	(0.511)	(1.416)	(0.793)	(0.661)	(0.296)	(1.184)
Observations	15,270	15,270	15,270	15,270	15,270	15,270	15,270	15,270
Real per capita mean, 1977	$2,444	$1,287	$137	$293	$328	$400	$2,109	$335
Share of total, 1977	1.000	0.527	0.056	0.120	0.134	0.164	0.863	0.137

Notes: The interaction between the 1978-1982 decrease in log real earnings per capita and year 1977 is normalized to equal 0. Regressions are estimated by 2SLS, using the predicted log employment change in all industries from 1978-1982 as an IV. Regressions include county and state-by-year fixed effects, interactions between year and the 1950-1970 change in log median family income, log population, and the share of the population age 0-4, 5-19, and 20-64. I transform dependent variables using the inverse hyperbolic sine instead of the log because a small number of observations equal zero. Sample limited to counties with no more than 5 percent of 1976 employment in the mining sector, and sample excludes 5 counties in New York City. Standard errors in parentheses are clustered by state.

Sources: Census of Governments, BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Table A.23: The Effects of the 1980-1982 Recession on Local Government Revenues, 2SLS Estimates

	Dependent variable: Log revenue							
		By broad source			By selected detailed source			
	General direct revenue (1)	Taxes (2)	Charges (3)	Intergov't transfers (4)	Property taxes (5)	Federal transfers (6)	State transfers (7)	Local transfers (8)
Interaction between 1978-1982 decrease in log real earnings per capita and year								
1972	0.206	0.552	0.766	0.244	0.750*	-3.204	-0.419	-0.0115
	(0.294)	(0.374)	(0.828)	(0.342)	(0.443)	(3.306)	(0.367)	(2.397)
1982	-0.132	-0.581**	0.290	0.167	-0.482	-0.0531	-0.0775	1.683
	(0.225)	(0.276)	(0.589)	(0.280)	(0.295)	(0.921)	(0.236)	(1.593)
1987	-0.304	-1.101**	-0.353	0.499	-0.927*	1.833	-0.450	2.162
	(0.262)	(0.493)	(0.633)	(0.503)	(0.522)	(1.411)	(0.564)	(2.728)
1992	-0.964***	-1.493***	-1.756***	-0.0838	-1.748***	-0.921	-0.994*	0.916
	(0.284)	(0.559)	(0.654)	(0.482)	(0.597)	(2.220)	(0.524)	(2.924)
1997	-0.654**	-0.448	-1.310*	-0.313	-0.467	1.607	-1.281**	-0.764
	(0.290)	(0.477)	(0.782)	(0.490)	(0.419)	(1.737)	(0.612)	(2.489)
Observations	15,270	15,270	15,270	15,270	15,270	15,270	15,270	15,270
Real per capita mean, 1977	$2,566	$943	$437	$1,186	$840	$182	$934	$70
Share of total, 1977	1.000	0.367	0.170	0.462	0.327	0.071	0.364	0.027

Notes: See notes to Appendix Table A.22.

Sources: Census of Governments, BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Table A.24: Aggregate Employment Changes from 1978-1992, by Industry

	Share of total 1978 employment (1)	Log employment change (2)	Employment change (3)
Panel A: Overall and one-digit industries			
All industries	1.000	0.317	25,861,062
Manufacturing	0.289	-0.105	-2,007,089
Mining	0.012	-0.223	-164,018
Agriculture, forestry, and fisheries	0.004	0.878	378,609
Construction	0.058	0.167	732,219
Transportation and public utilities	0.062	0.257	1,258,595
Wholesale trade	0.070	0.262	1,464,533
Finance, insurance, and real estate	0.070	0.379	2,251,947
Retail trade	0.206	0.356	6,115,470
Services	0.221	0.717	16,066,416
Panel B: Two-digit industries with largest employment decrease			
Primary metal (manufacturing)	0.017	-0.507	-439,712
Industrial machinery (manufacturing)	0.033	-0.191	-383,492
Electronic equipment (manufacturing)	0.027	-0.236	-383,070
Apparel and other textile products (manufacturing)	0.019	-0.255	-289,581
Textile mill products (manufacturing)	0.013	-0.321	-235,813
Transportation equipment (manufacturing)	0.025	-0.145	-220,057
Fabricated metal products (manufacturing)	0.024	-0.140	-210,290
Stone, clay, and glass products (manufacturing)	0.010	-0.276	-154,170
Leather (manufacturing)	0.004	-0.827	-134,162
Heavy construction (construction)	0.011	-0.111	-76,597
Panel C: Two-digit industries with largest employment increase			
Durables (wholesale trade)	0.041	0.251	782,035
Miscellaneous retail (retail trade)	0.027	0.378	829,284
Depository institutions (finance)	0.021	0.481	841,251
Membership organizations (services)	0.019	0.526	861,985
Food stores (retail trade)	0.031	0.446	1,146,502
Social services (services)	0.013	0.831	1,147,737
Miscellaneous services (services)	0.011	1.324	2,071,041
Eating and drinking places (retail trade)	0.060	0.534	2,829,410
Business services (services)	0.038	0.771	2,966,886
Health services (services)	0.070	0.752	5,226,976

Notes: I construct this table by aggregating county-level data for the continental United States. Because employment is often suppressed at the county-level, I impute employment using the number of establishments and nationwide information on employment by establishment size, as described in Appendix D.
Source: Census County Business Patterns

Table A.25: The Long-Run Effects of the 1980-1982 Recession on Educational Attainment, Separating the Temporary and Persistent Decline in Log Earnings per Capita

	Dependent variable:					
	HS/GED attainment (1)	Any college attendance (2)	Any college degree attainment (3)	Four-year college degree attainment (4)	Two-year college degree attainment (5)	Years of schooling (6)
Interaction between 1978-1982 decrease in log real earnings per capita and age in 1979						
0-10	-0.0073	0.0806	-0.118	-0.0693	-0.0485	-0.464
	(0.0455)	(0.189)	(0.0744)	(0.101)	(0.0537)	(0.467)
11-19	0.0567	0.110	-0.117**	-0.0729	-0.0443	-0.218
	(0.0363)	(0.194)	(0.0517)	(0.0585)	(0.0457)	(0.286)
20-28	0.0173	0.283	-0.0039	0.0297	-0.0336	0.0688
	(0.0296)	(0.203)	(0.0431)	(0.0453)	(0.0347)	(0.223)
Interaction between 1978-1992 decrease in log real earnings per capita and age in 1979						
0-10	0.0352	-0.0694	-0.0496	-0.175***	0.125***	0.0357
	(0.0223)	(0.102)	(0.0437)	(0.0446)	(0.0308)	(0.266)
11-19	-0.0136	-0.143	-0.0027	-0.0621**	0.0593***	0.103
	(0.0133)	(0.111)	(0.0305)	(0.0298)	(0.0151)	(0.160)
20-28	-0.0003	-0.191	0.0235	0.0031	0.0204**	0.221**
	(0.0123)	(0.117)	(0.0201)	(0.0209)	(0.0089)	(0.0946)

Notes: Table reports estimates of the interaction between the 1978-1982 and 1978-1992 decrease in log real earnings per capita in individuals' birth county and indicators for age in 1979. Regressions are estimated by 2SLS, using the predicted log employment change in all industries from 1978-1982 and 1978-1992 as instrumental variables. See notes to Table 2.

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Table A.26: Characterizing States' Potentially Mitigating Policies

	State transfer generosity		State transfer progressivity	
State	More vs. less generous (1)	Residual (2)	More vs. less progressive (3)	Slope (4)
AL	Less	0.023	Less	-0.645
AZ	Less	-0.398	More	-1.470
AR	More	0.142	More	-1.197
CA	More	0.349	More	-0.902
CO	Less	0.008	Less	-0.713
CT	Less	-0.030	Less	0.148
DE	Less	-0.183	Less	0.633
DC	More	0.159	Less	-0.824
FL	Less	-0.741	Less	-0.563
GA	More	0.126	More	-1.071
ID	Less	-0.012	Less	0.984
IL	Less	-0.063	More	-1.287
IN	Less	-0.522	More	-1.334
IA	Less	-0.046	Less	-0.308
KS	More	0.108	Less	0.002
KY	More	0.395	More	-1.339
LA	More	0.364	More	-1.073
ME	Less	-0.144	More	-1.627
MD	More	0.033	More	-0.838
MA	More	0.046	More	-1.849
MI	More	0.226	Less	-0.647
MN	More	0.292	Less	-0.531
MS	More	0.185	Less	-0.673
MO	More	0.118	More	-1.233
MT	Less	-0.069	Less	-0.650
NE	Less	-0.189	Less	-0.630
NV	Less	0.031	Less	-0.608
NH	Less	-0.476	More	-1.082
NJ	Less	-0.154	More	-0.981
NM	Less	-0.080	More	-1.514
NY	More	0.119	Less	0.034
NC	Less	-0.375	More	-0.957
ND	More	0.134	Less	-0.790
OH	Less	-0.186	More	-0.969
OK	More	0.260	More	-1.693
OR	More	0.050	Less	-0.705

Table A.26: Characterizing States' Potentially Mitigating Policies

	State transfer generosity		State transfer progressivity	
State	More vs. less generous (1)	Residual (2)	More vs. less progressive (3)	Slope (4)
PA	More	0.205	More	-1.482
RI	More	0.384	More	-1.039
SC	Less	-0.225	More	-1.332
SD	Less	-0.247	Less	-0.711
TN	Less	-0.147	More	-1.000
TX	Less	-0.353	More	-1.347
UT	More	0.094	Less	-0.739
VT	More	0.294	Less	-0.560
VA	Less	-0.508	Less	-0.488
WA	More	0.542	Less	-0.216
WV	More	0.304	More	-1.131
WI	More	0.234	More	-1.326
WY	Less	-0.077	Less	-0.098

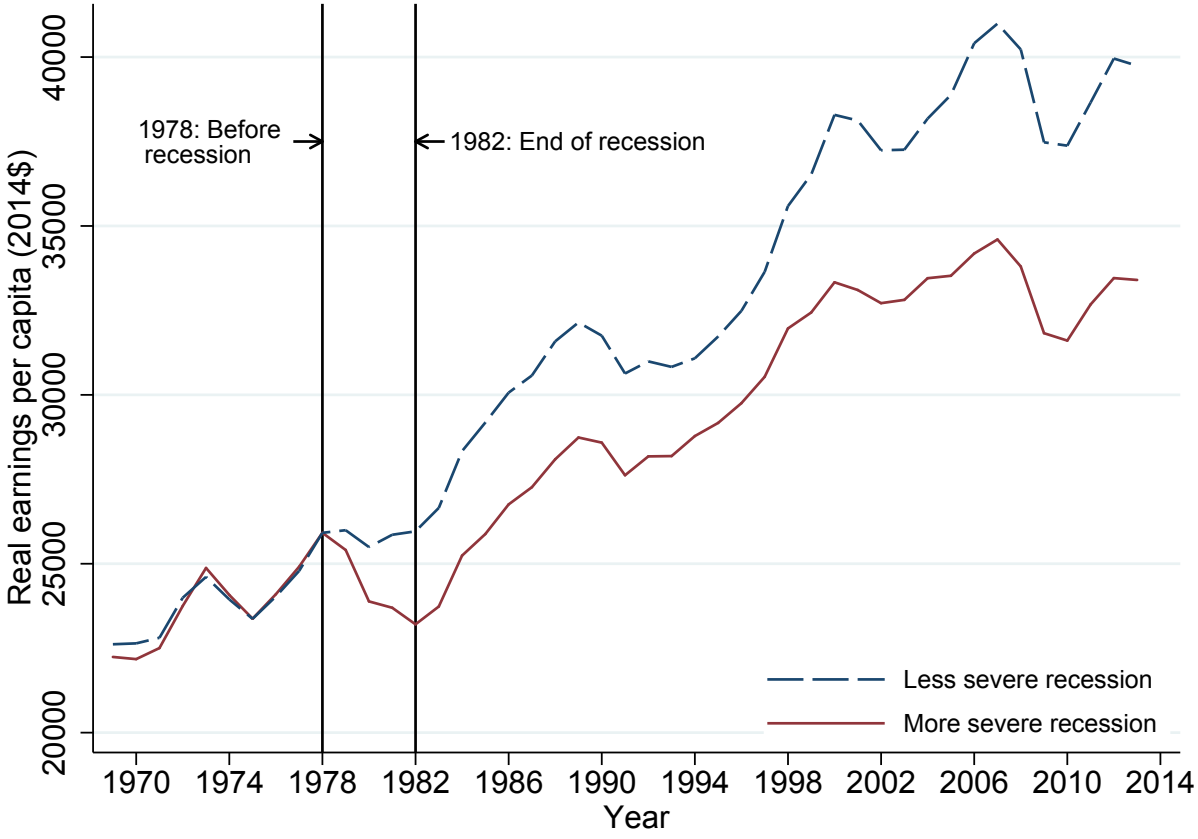
Notes: States with less generous mean transfers are those with below-median transfers per capita in 1970, conditional on demographic and economic covariates. States with a less progressive transfer slope are those with an above-median slope coefficient from a regression of log transfers per capita on log median family income in 1970, conditional on demographic and economic covariates. See text for details. The mean (median) of column 2 is 0 (0.031). The mean (median) of column 4 is -0.824 (-0.838).

Sources: BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Book

Figure A.1: Distribution of County-Level Log Real Earnings per Capita Change, 1978-1982

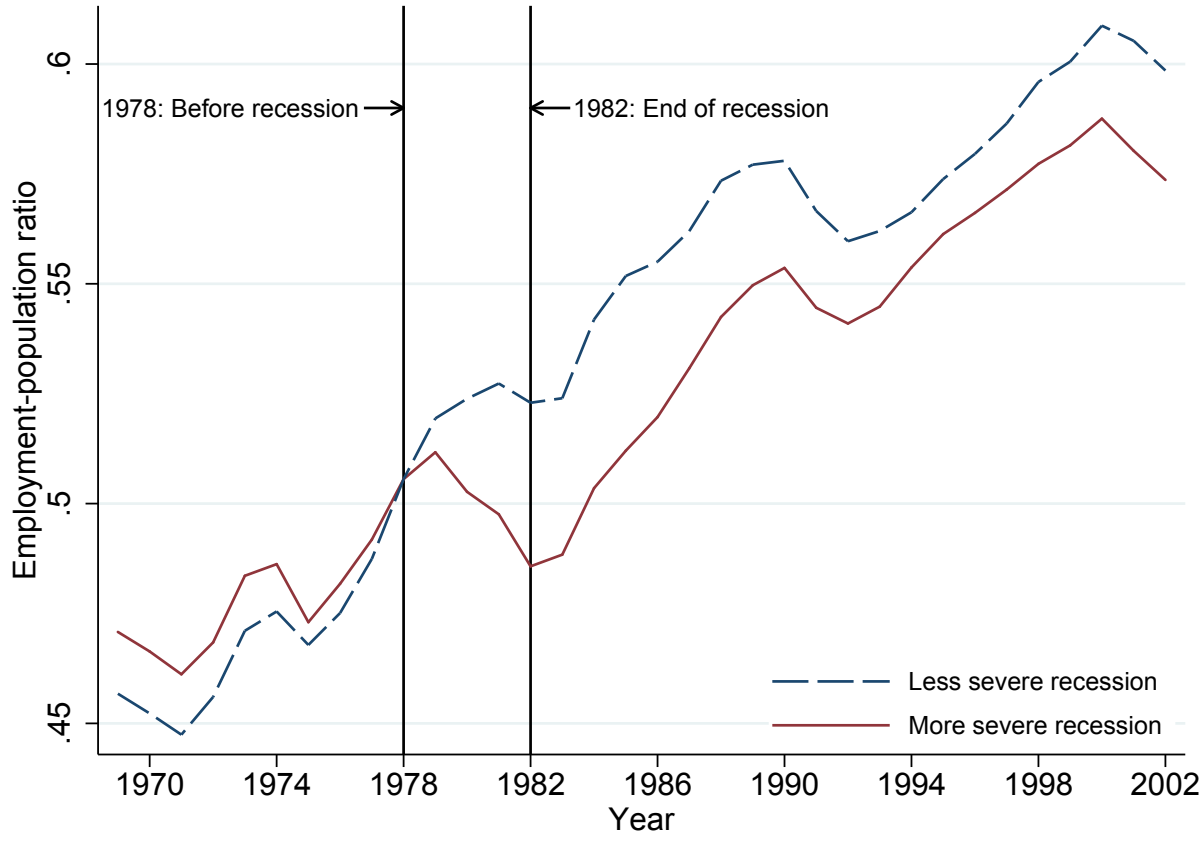
Notes: Sample limited to 3,076 counties in the continental U.S.
Source: BEA Regional Economic Accounts

Figure A.2: Normalized Mean Real Earnings per Capita, by County-Level Severity of the 1980-1982 Recession, 1969-2013



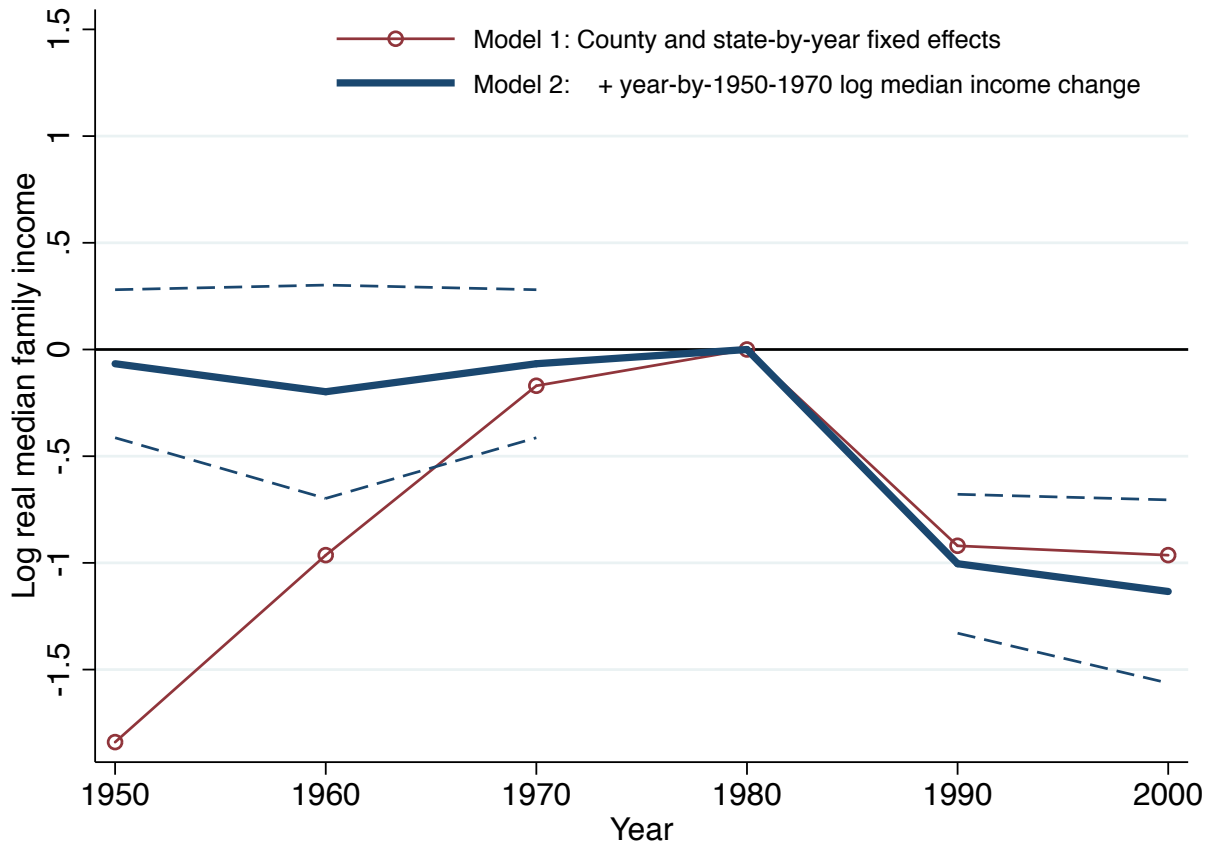
Notes: Figure extends the data in Figure 2 from 2002-2013. See notes to Figure 2.
Source: BEA Regional Economic Accounts

Figure A.3: Normalized Mean Employment-Population Ratio, by County-Level Severity of the 1980-1982 Recession



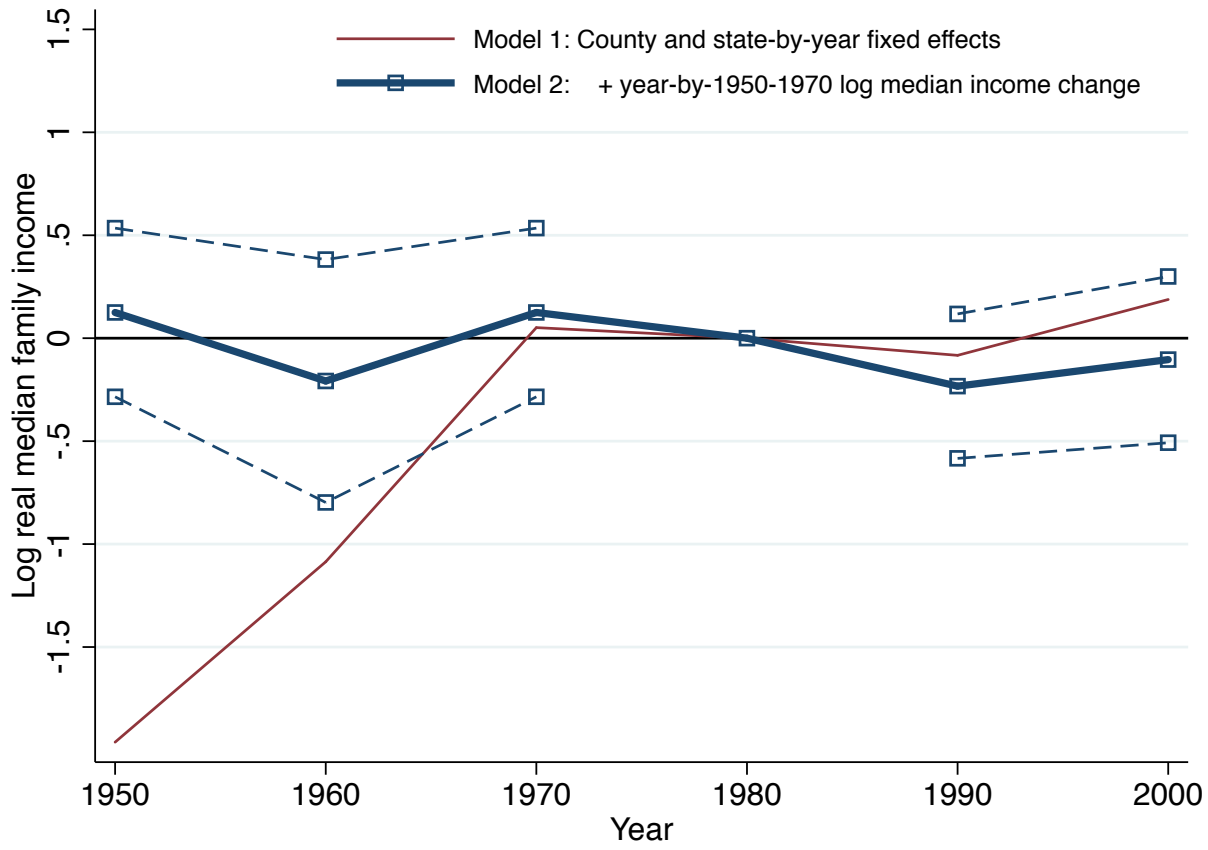
Notes: Figure displays the population-weighted mean employment-population ratio, among counties with a below and above median 1978-1982 decrease in log real earnings per capita. I calculate the median using 1978 population weights. I adjust the less severe recession line to equal the more severe recession line in 1978, which amounts to an upward shift of 0.024. Sample contains 3,076 counties in the continental U.S.
Source: BEA Regional Economic Accounts

Figure A.4: Log Real Median Family Income Before and After the 1980-1982 Recession, 2SLS Estimates



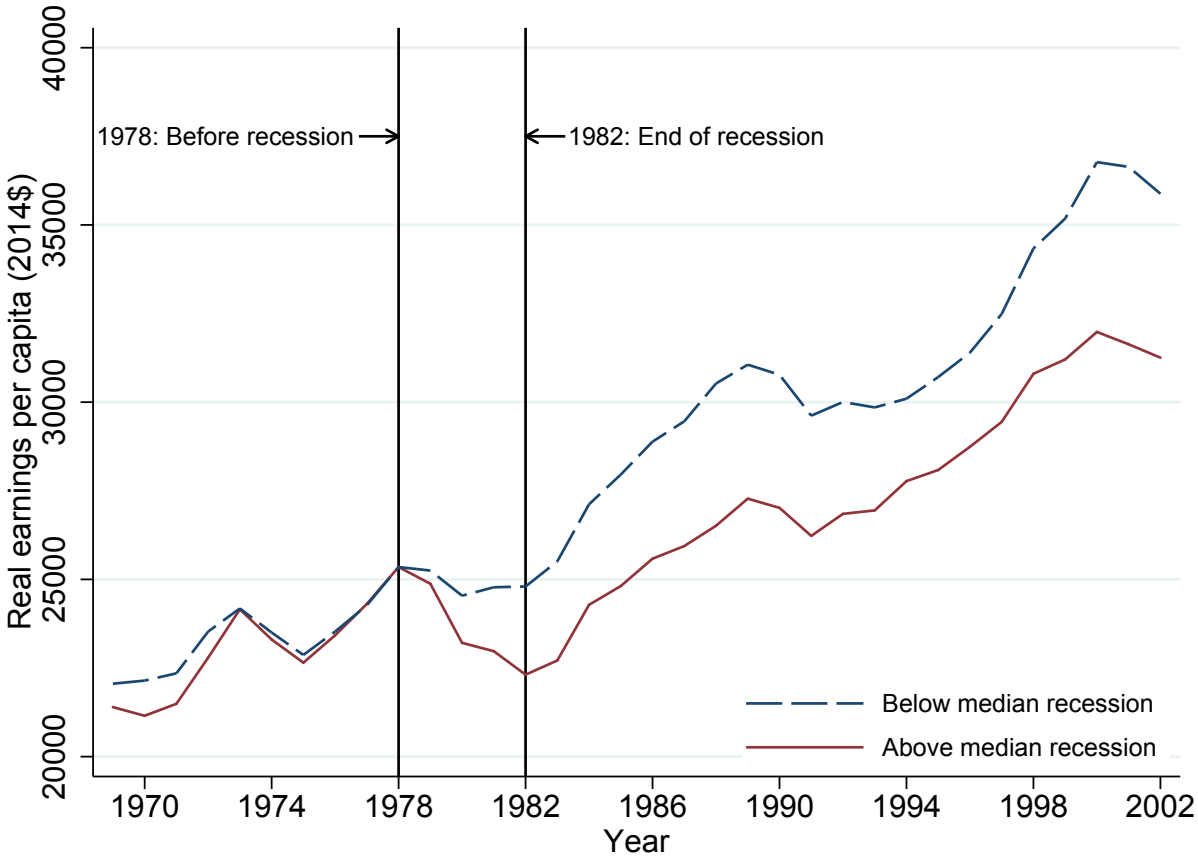
Notes: Figure plots the estimated coefficients on interactions between year and the 1978-1982 decrease in log real earnings per capita, where the coefficient for 1980 is normalized to equal zero. The dependent variable is log real median family income for 1950-1990 and log real median household income for 2000. Regressions are estimated by 2SLS, using the predicted log employment change from 1978-1982 as an instrumental variable. The dashed lines are pointwise 95 percent confidence intervals based on standard errors clustered by state. Sample is limited to the 2,550 counties with less than 5 percent of 1976 employment in the mining sector.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Figure A.5: Log Real Median Family Income Before and After the 1980-1982 Recession, 2SLS Estimates, Including Counties with High Mining Employment Share



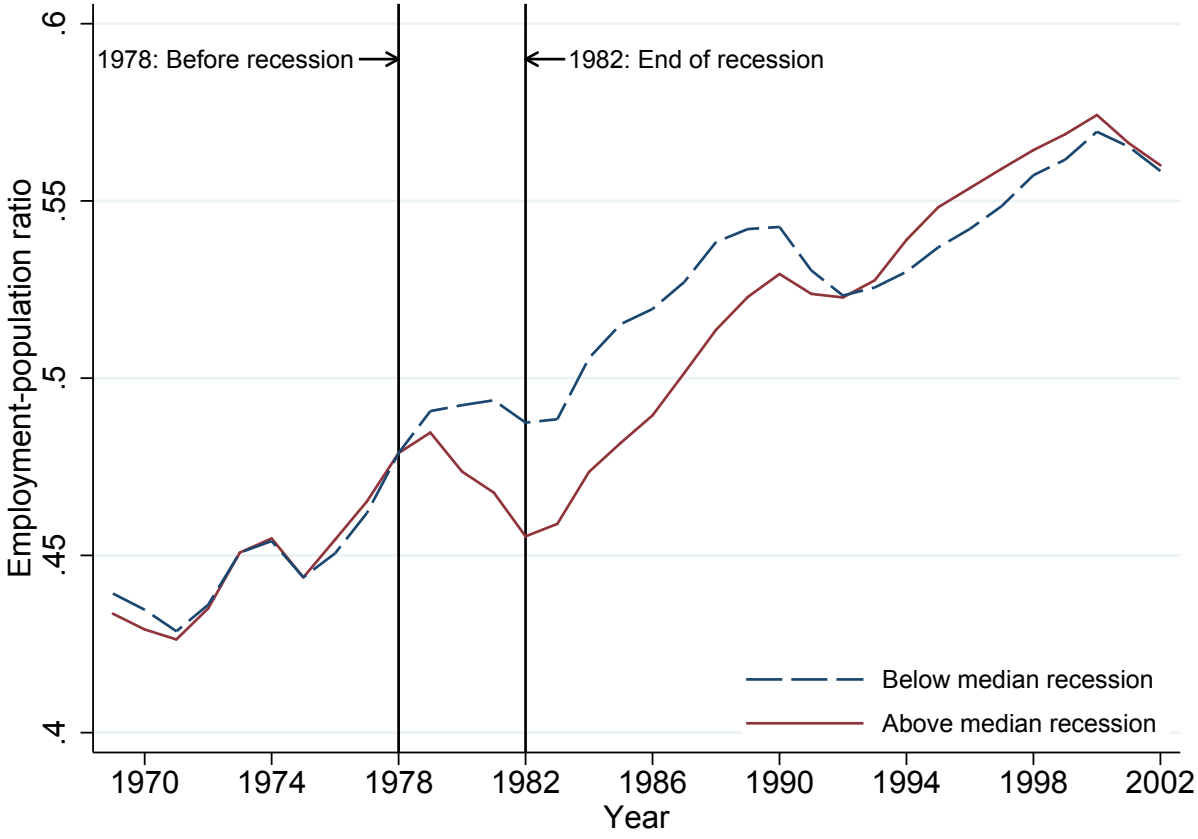
Notes: See notes to Figure A.4. Sample contains 3,076 counties in the continental U.S.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Figure A.6: Normalized Mean Real Earnings per Capita, by Commuting Zone-Level Severity of the 1980-1982 Recession



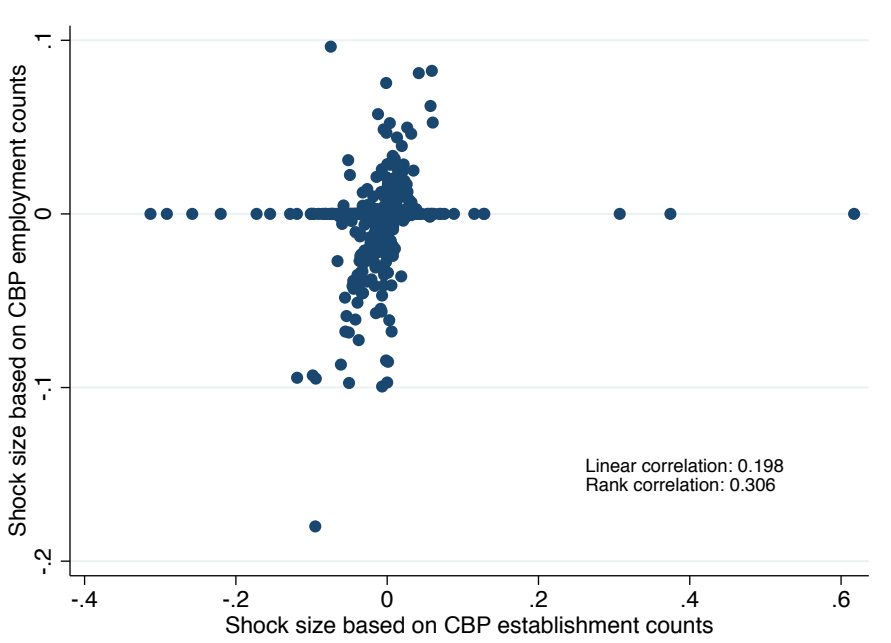
Note: Figure displays population-weighted mean real earnings per capita, among commuting zones with a below and above median 1978-1982 decrease in log real earnings per capita. I calculate the median using 1978 population weights. I adjust the less severe recession line to equal the more severe recession line in 1978, which amounts to a downwards shift of $2,361. Sample contains 722 commuting zones in the continental U.S.
Source: BEA Regional Economic Accounts

Figure A.7: Normalized Mean Employment-Population Ratio, by Commuting-Zone Level Severity of the 1980-1982 Recession

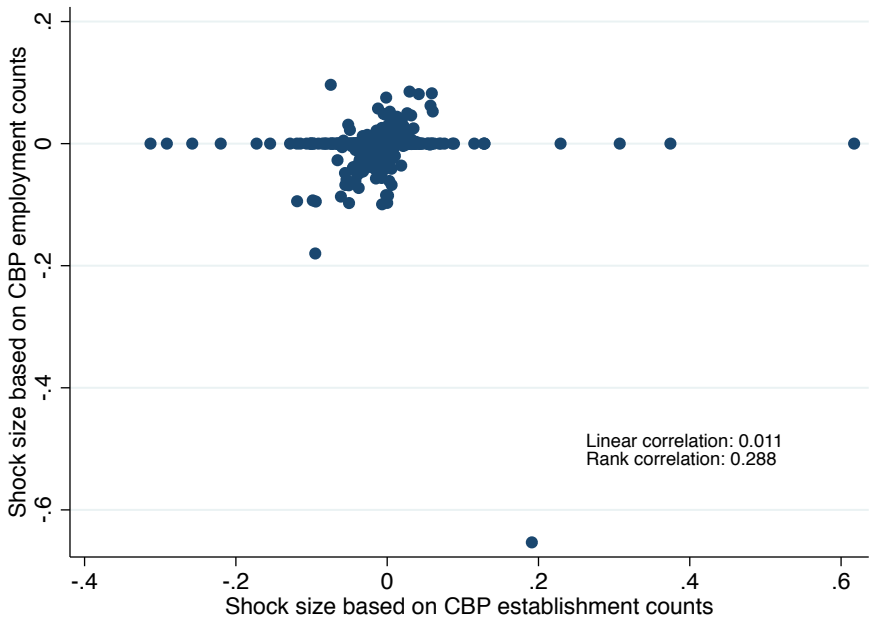


Note: Figure displays the population-weighted mean employment-population ratio, among commuting zones with a below and above median 1978-1982 decrease in log real earnings per capita. I calculate the median using 1978 population weights. I adjust the less severe recession line to equal the more severe recession line in 1978, which amounts to a downwards shift of 0.021. Sample contains 722 commuting zones in the continental U.S.
Source: BEA Regional Economic Accounts

Figure A.8: The Role of County Business Patterns Employment Suppression in Constructing the Shock Size Variable used by Feyrer, Sacerdote and Stern (2007)



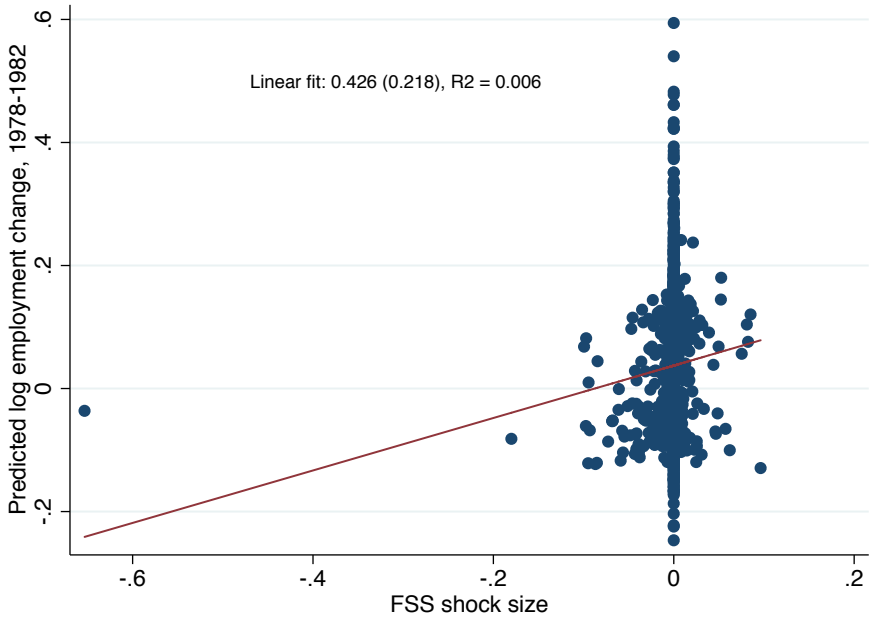
(a) Counties with at least 10,000 residents in 1977 (FSS sample)



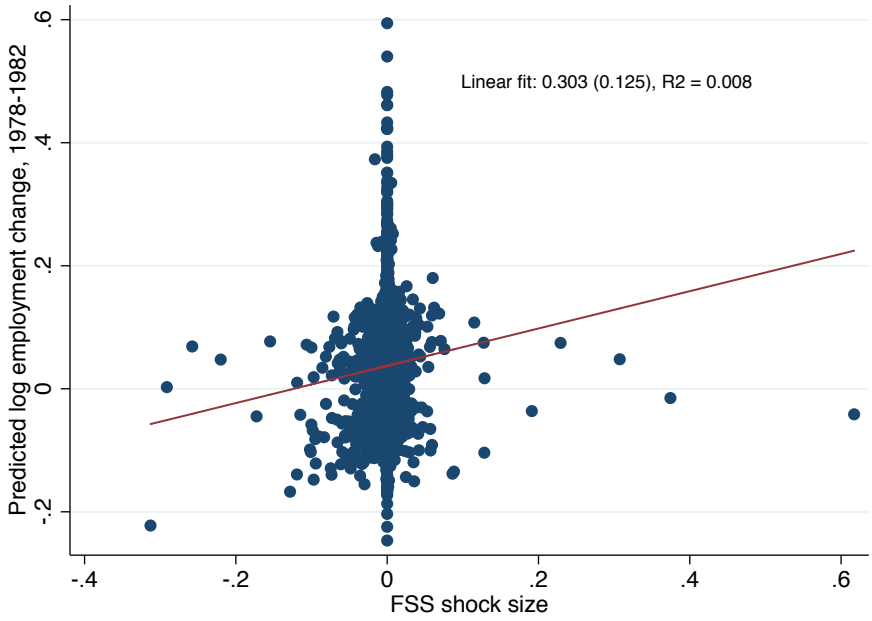
(b) All counties

Notes: Shock size is the 1977-1982 employment change in the auto and steel industries divided by 1977 total employment. FSS construct the shock size based on CBP employment counts, which are frequently suppressed. An alternative approach is to use CBP establishment counts, which are never suppressed. See text for details.
Sources: BLS Local Area Statistics and Census County Business Patterns

Figure A.9: Comparison of Predicted Log Employment Change to Shock Size Variable used by Feyrer, Sacerdote and Stern (2007)



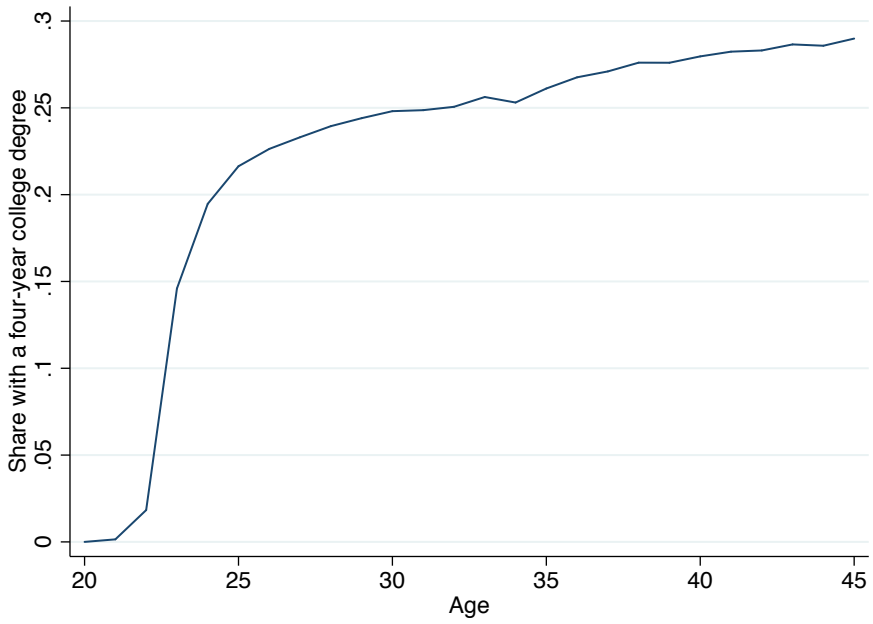
(a) Using CBP Employment Counts to Construct Shock Size



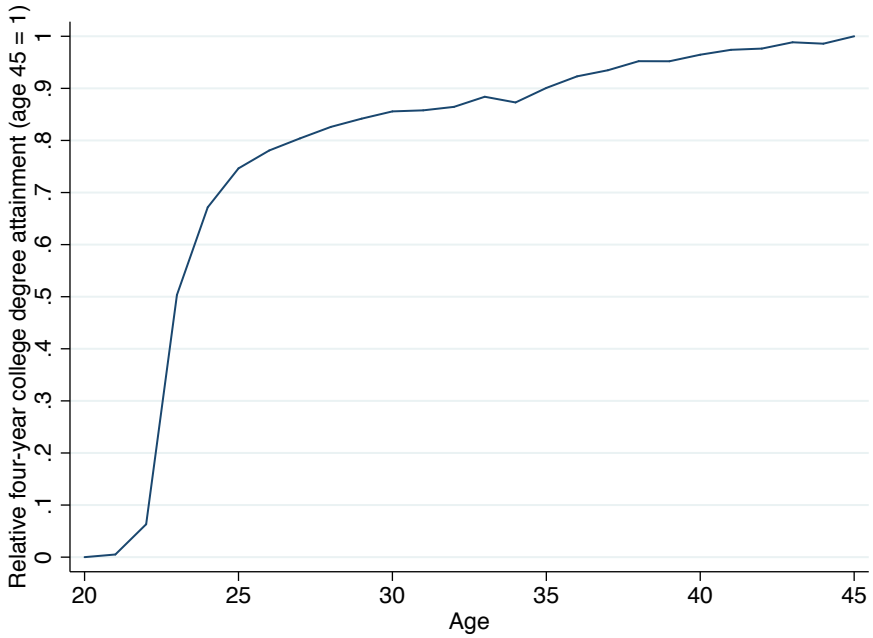
(b) Using CBP Establishment Counts to Construct Shock Size

Notes: Predicted log employment change is based on a county's 1976 industrial structure and aggregate industry-level employment changes, as defined in equation (2). Shock size is the 1977-1982 employment change in the auto and steel industries divided by 1977 total employment. Panel A constructs the shock size variable using CBP employment counts, as in FSS. Panel B uses CBP establishment counts. Standard errors are clustered by state.
Sources: BLS Local Area Statistics and Census County Business Patterns data

Figure A.10: Four-Year College Degree Attainment, by Age



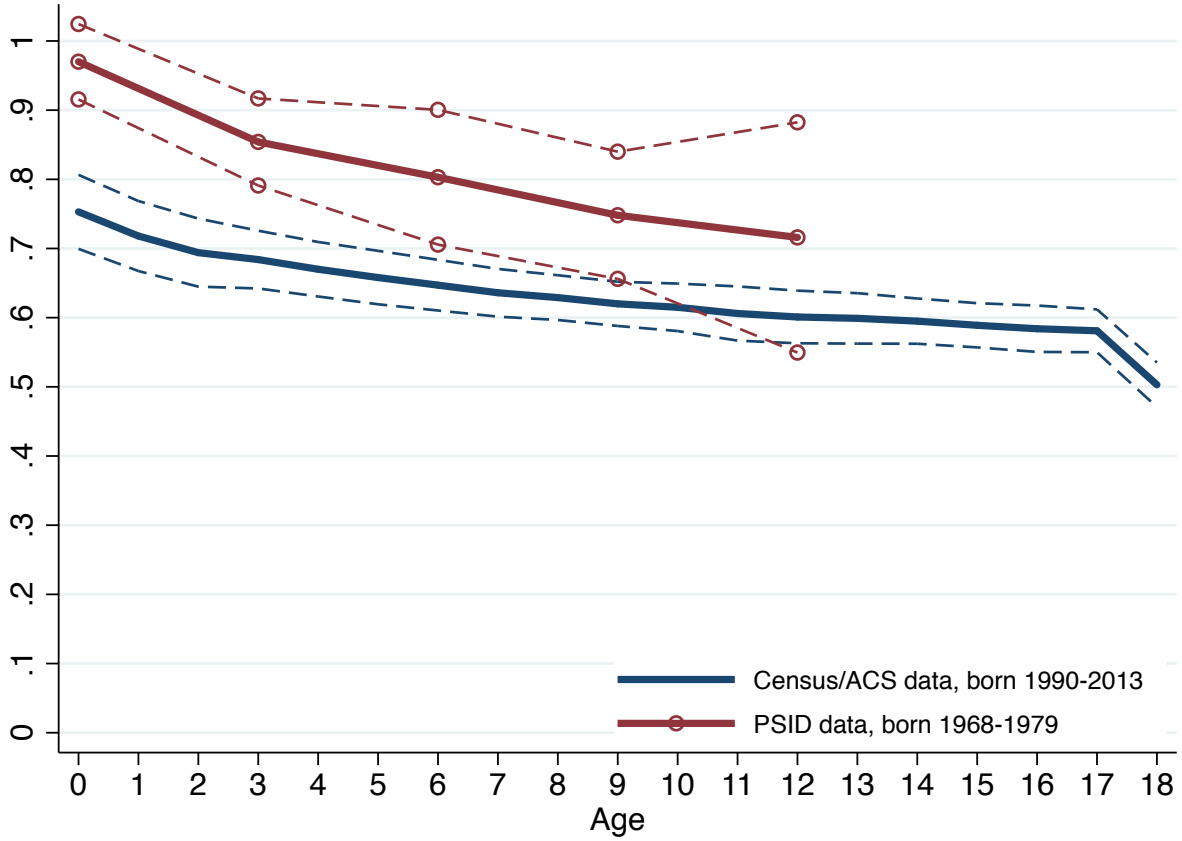
(a) Share with a Four-Year College Degree



(b) Share with a Four-Year College Degree, Relative to Age 45 Attainment

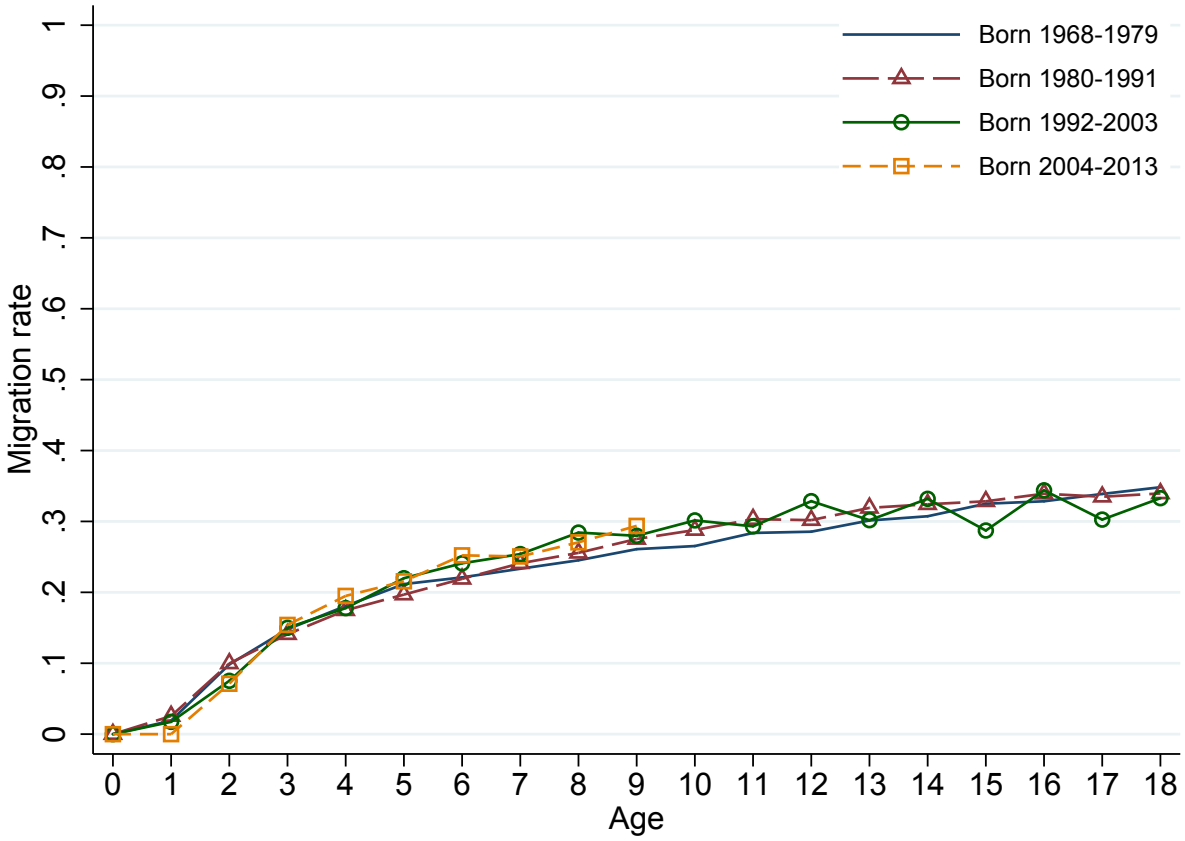
Notes: Panel A displays the share of individuals with a four-year college degree, for a constant sample of individuals born in the U.S. from 1957-1964. Panel B displays the share of attainment divided by attainment at age 45. I use custom weights from the NLS to account for the fact that these tabulations use multiple survey years.
Source: National Longitudinal Survey of Youth 1979 (1979-2010)

Figure A.11: Relationship between Severity of 1980-1982 Recession in County of Residence and County of Birth



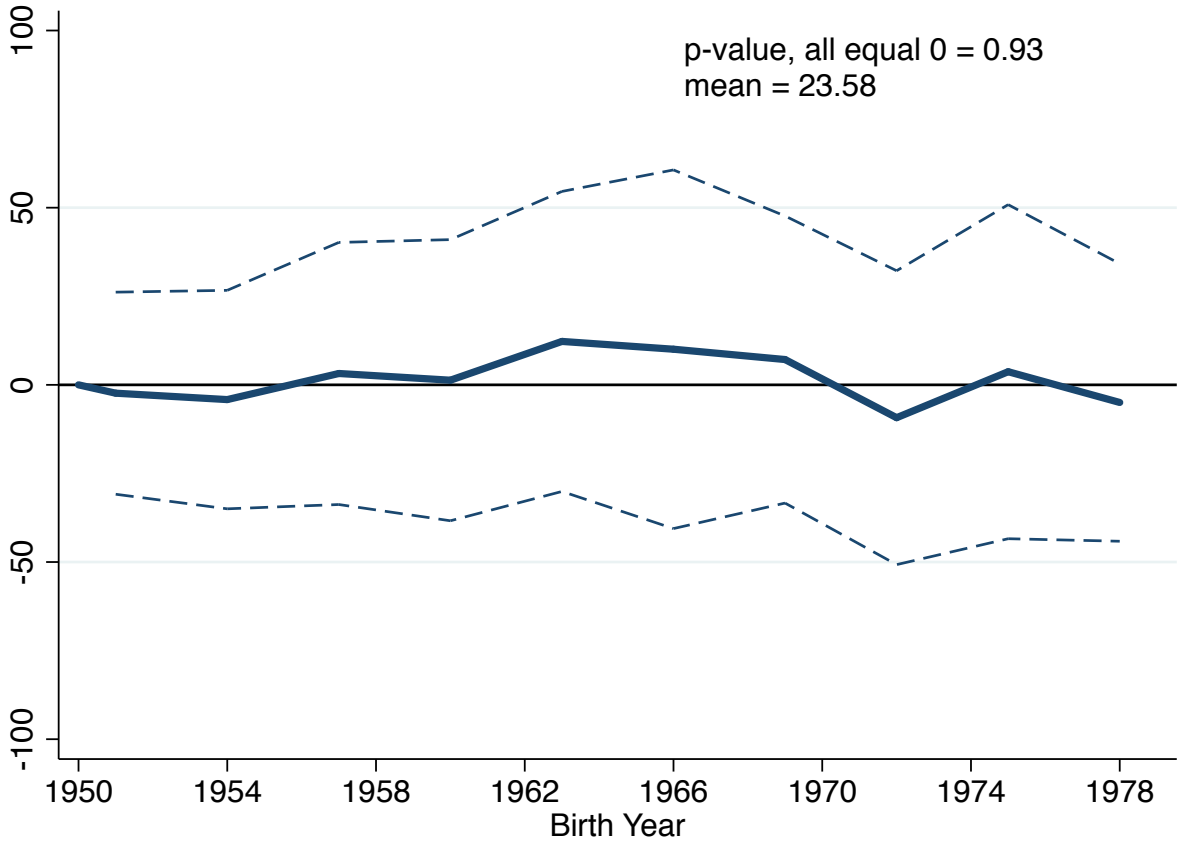
Notes: Figure plots OLS estimates of the interaction between the 1978-1982 decrease in log real earnings per capita in individuals' county of birth and indicators for age. The dependent variable is the 1978-1982 decrease in log real earnings per capita in individuals' county of residence. I estimate this relationship using confidential Census/ACS data for individuals born from 1990-2013 and confidential PSID data for individuals born from 1968-1979. All regressions include fixed effects for race, sex, survey year, and birth year-by-birth state, plus birth-year interacted with the 1950-1970 change in log median family income in individuals' birth county. The dashed lines are pointwise 95 percent confidence intervals based on standard errors clustered by state. The Census/ACS sample contains 11.7 million individuals born in the continental U.S. from 1990-2013 with a unique PIK, unique birth county, and non-imputed variables. The PSID sample contains 3,684 individuals born in the continental U.S. from 1968-1979.
Sources: BEA Regional Economic Accounts, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file, Confidental PSID data

Figure A.12: Comparison of Birth County Out-Migration Rates by Cohort



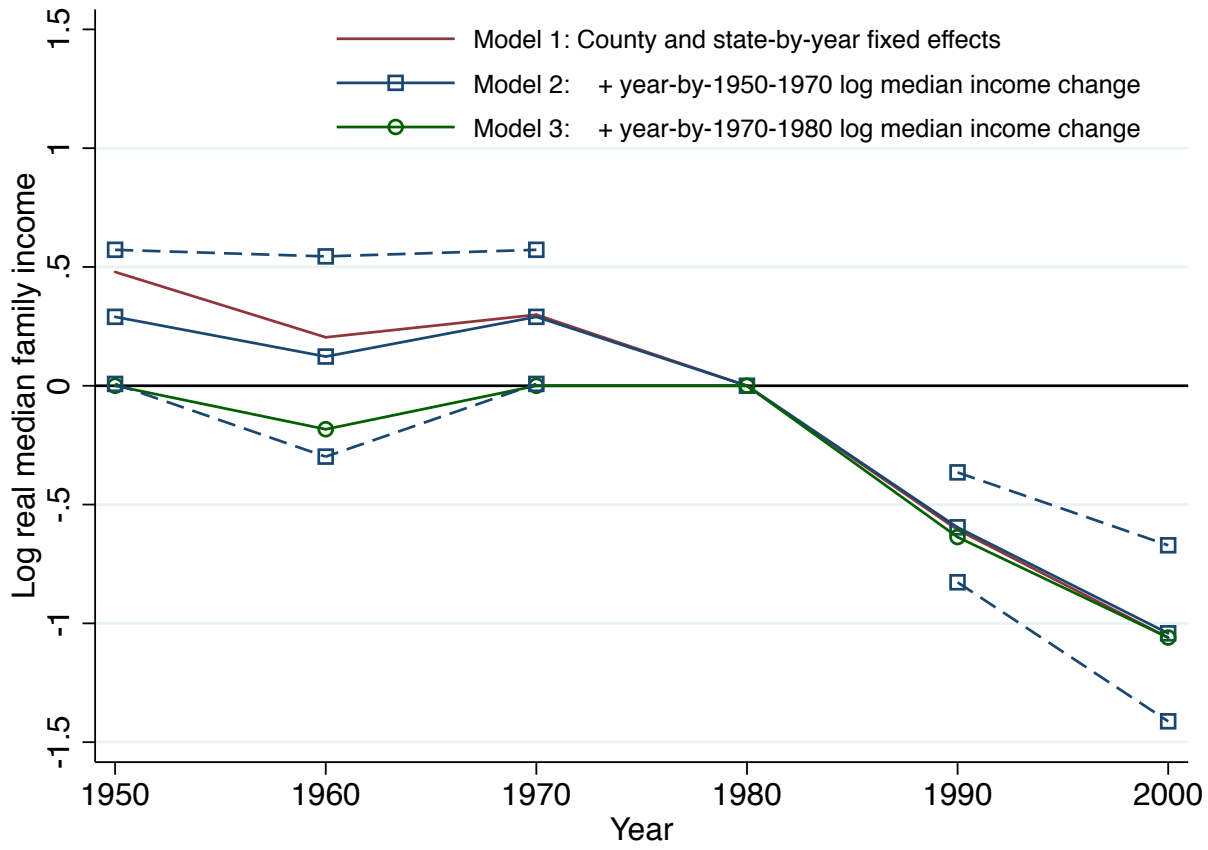
Notes: Figure displays the share of individuals living outside of their birth county for different birth cohorts. The PSID data provide information on county of residence (where the interview took place).
Source: Confidental PSID data

Figure A.13: Infant Mortality Did Not Evolve Differentially Before the 1980-1982 Recession



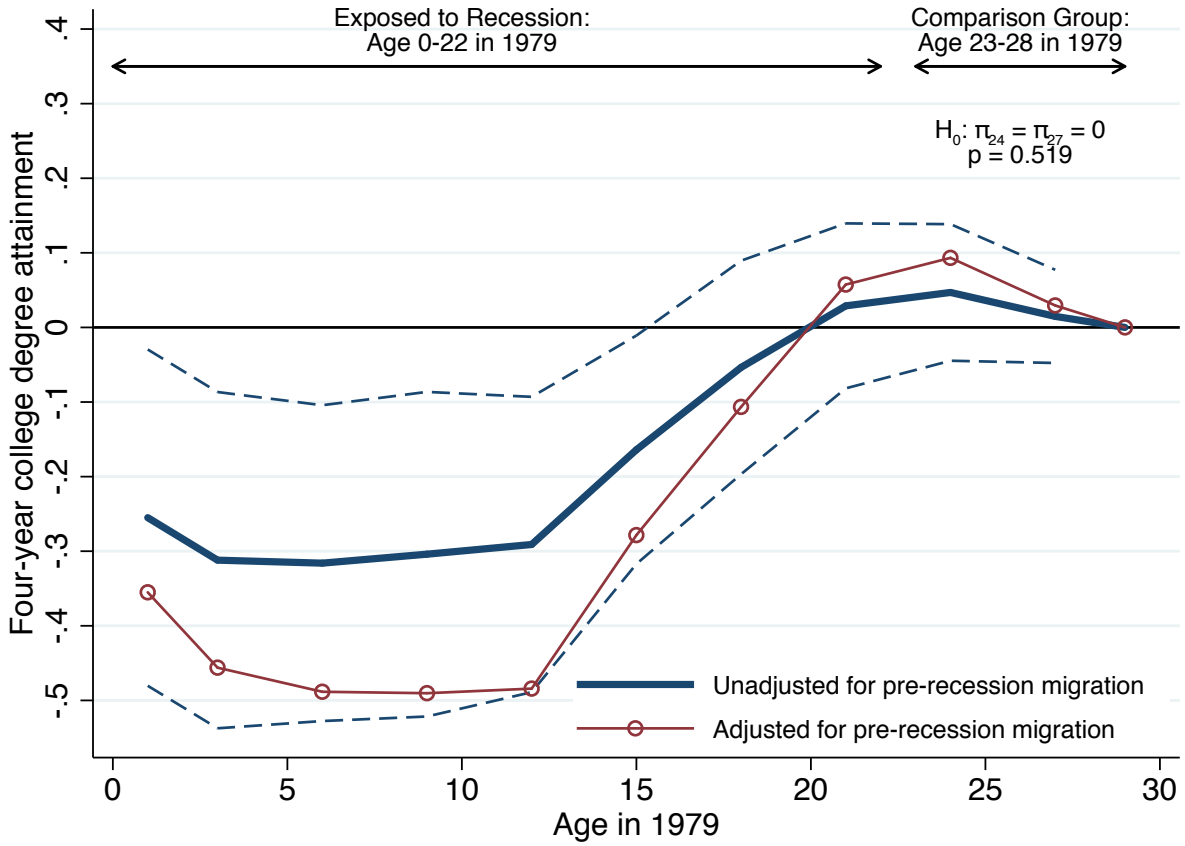
Notes: Figure plots the estimated coefficients on interactions between birth year and the 1978-1982 decrease in log real earnings per capita, where the coefficient for 1950 is normalized to equal zero. The dependent variable is the infant mortality rate (deaths pers 1,000 births). The regression is estimated by 2SLS, using the predicted log employment change from 1978-1982 as an IV. The regression includes fixed effects for birth county and birth year-by-birth state, plus interactions between birth year and the 1950-1970 change in log median family income. The dashed lines are pointwise 95 percent confidence intervals based on standard errors clustered at the birth state level. Sample is limited to the 2,550 counties with less than 5 percent of 1976 employment in the mining sector.
Sources: Bailey et al. (2016), BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Figure A.14: Log Real Median Family Income Before and After the 1980-1982 Recession, 2SLS Estimates, Measuring Recession Severity at Commuting Zone Level



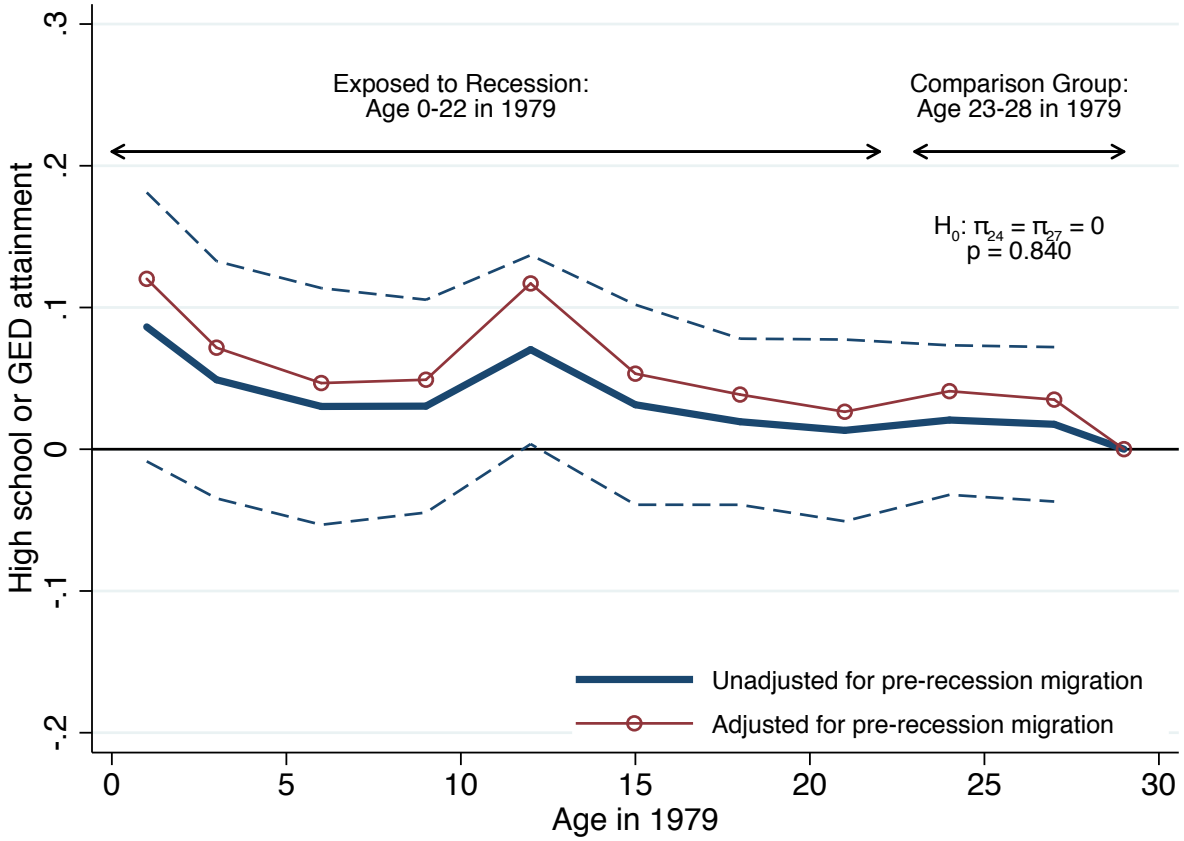
Notes: Figure plots the estimated coefficients on interactions between year and the 1978-1982 decrease in log real earnings per capita, where the coefficient for 1980 is normalized to equal zero. The dependent variable is log real median family income for 1950-1990 and log real median household income for 2000. Regressions are estimated by 2SLS, using the predicted log employment change from 1978-1982 as an instrumental variable. The change in log earnings per capita and the predicted employment change are measured at the commuting zone level. The dashed lines are pointwise 95 percent confidence intervals based on standard errors clustered by state. Sample is limited to the 2,550 counties with less than 5 percent of 1976 employment in the mining sector.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Census County Data Books, Minnesota Population Center (2011)

Figure A.15: The Long-Run Effects of the 1980-1982 Recession on Four-Year College Degree Attainment, Adjusted for Measurement Error



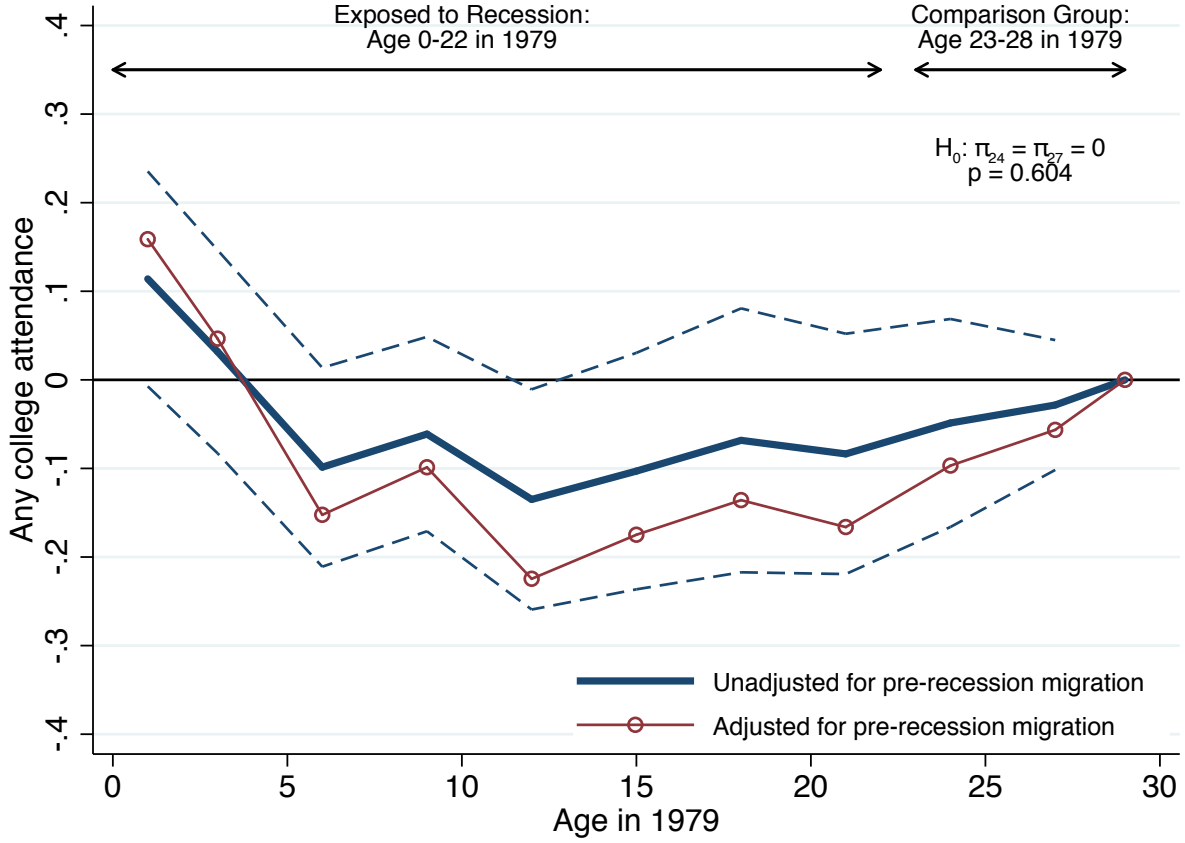
Notes: See notes to Figure 3. The dependent variable is an indicator for four-year college degree attainment. The line that adjusts for pre-recession migration divides the unadjusted estimates by the coefficient from regressing the 1978-1982 decrease in log real earnings per capita in county of residence on the 1978-1982 decrease in log real earnings per capita in county of birth, using individuals born from 1990-2013. See Appendix E for details.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Figure A.16: The Long-Run Effects of the 1980-1982 Recession on High School or GED Attainment



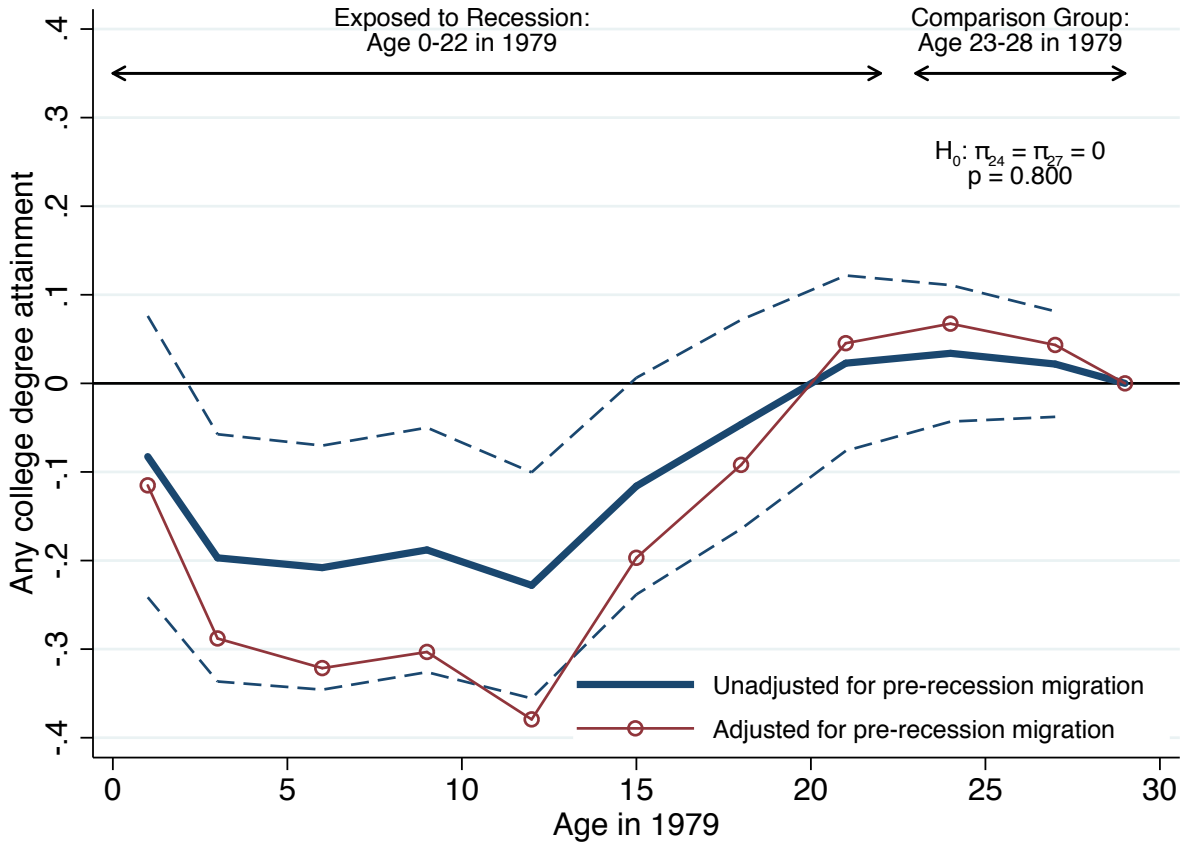
Notes: See notes to Figures 3 and A.15. The dependent variable is an indicator for high school or GED attainment.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Figure A.17: The Long-Run Effects of the 1980-1982 Recession on Any College Attendance



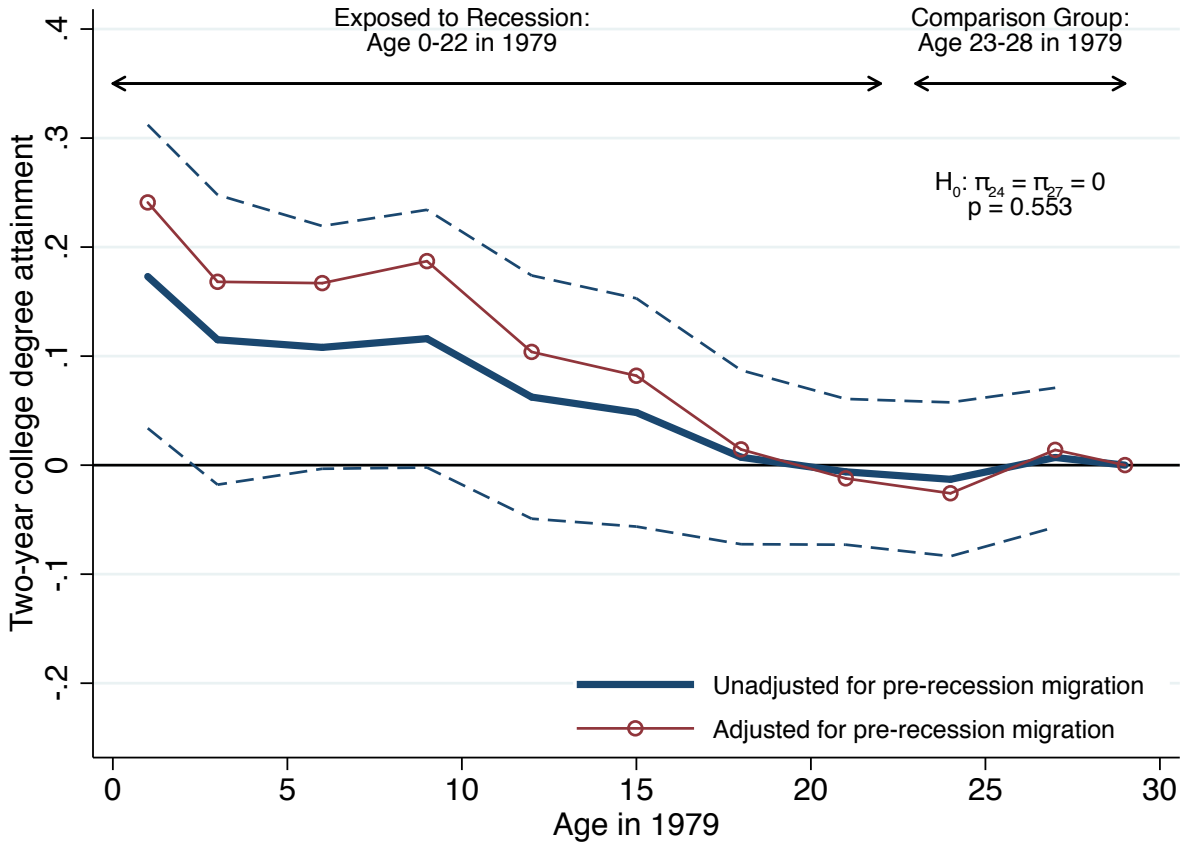
Notes: See notes to Figures 3 and A.15. The dependent variable is an indicator for any college attendance.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Figure A.18: The Long-Run Effects of the 1980-1982 Recession on Any College Degree Attainment



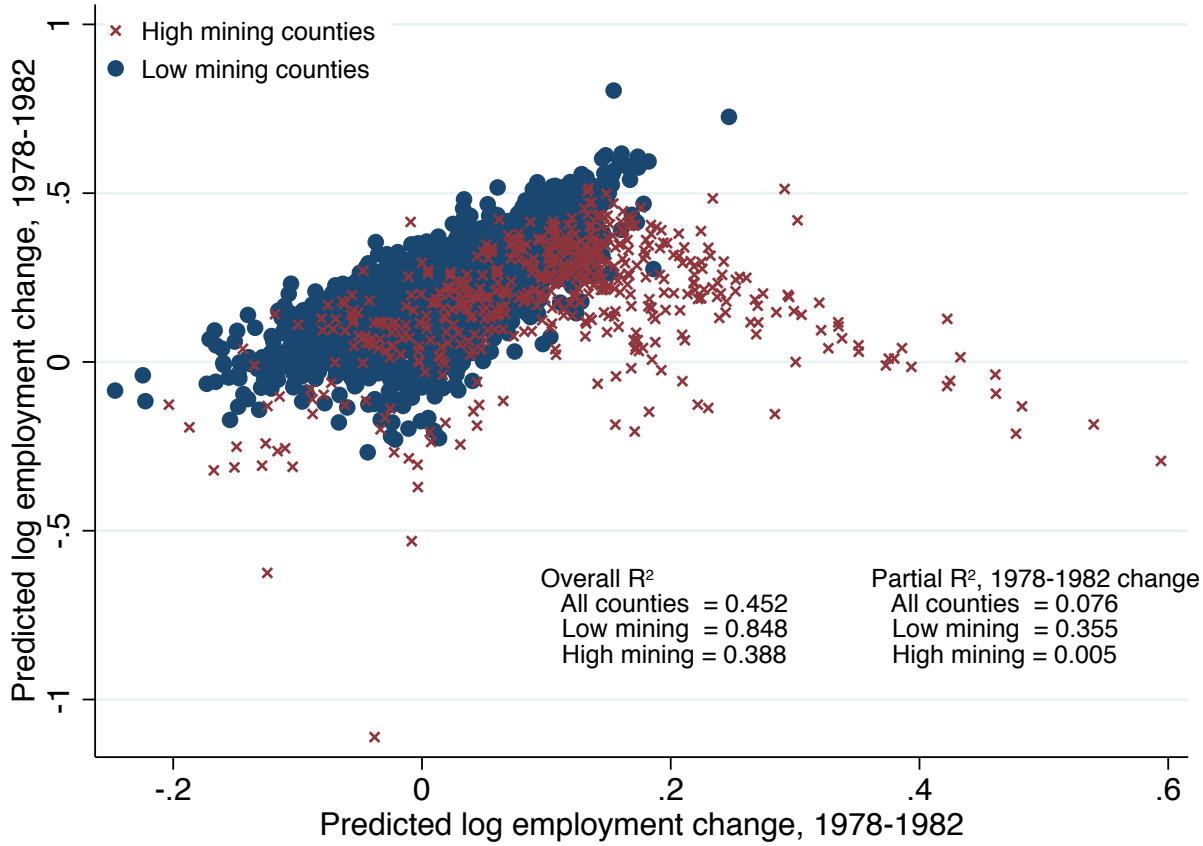
Notes: See notes to Figures 3 and A.15. The dependent variable is an indicator for any college degree attainment.
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Figure A.19: The Long-Run Effects of the 1980-1982 Recession on Two-Year College Degree Attainment



Notes: See notes to Figures 3 and A.15. The dependent variable is an indicator for two-year college degree attainment (exactly).
Sources: BEA Regional Economic Accounts, Census County Business Patterns, Confidential 2000-2013 Census/ACS data linked to the SSA NUMIDENT file

Figure A.20: Predicted Log Employment Change, 1978-1992 and Predicted Log Employment Change, 1978-1982



Notes: Predicted log employment change from 1978-1992 and 1978-1982 are constructed using a county's 1976 industrial structure and the change in industry-level employment from 1978-1992 and 1978-1982 in other states within the same region, as defined in equation (2). The overall R^2 includes the variation explained by state fixed effects. Overall sample contains 3,076 counties in the continental U.S. Low mining counties are the 2,550 counties with less than 5 percent of 1976 employment in the mining sector.
Source: Census County Business Patterns