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Brad Hershbein
W.E. Upjohn Institute for Employment Research

Bryan A. Stuart
Federal Reserve Bank of Philadelphia Research Department

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The Evolution of Local Labor Markets After Recessions*

Brad Hershbein
W.E. Upjohn Institute for Employment Research
hershbein@upjohn.org

Bryan A. Stuart
Federal Reserve Bank of Philadelphia
bryan.stuart@phil.frb.org

Abstract

This paper studies how U.S. local labor markets respond to employment losses that occur during recessions. Following recessions from 1973 through 2009, we find that areas that lose more jobs during the recession experience persistent relative declines in employment and population. Most importantly these local labor markets also experience persistent decreases in the employment-population ratio, earnings per capita, and earnings per worker. Our results imply that limited population responses result in longer-lasting consequences for local labor markets than previously thought, and that recessions are followed by persistent reallocation of employment across space.

JEL Classification Codes: J21, J61, R23

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1 Introduction

Recessions are a perennial feature of market economies. Since at least 1950, the U.S. unemployment rate has tended to recover gradually after contractions (e.g., Dupraz, Nakamura and Steinsson, 2020; Hall and Kudlyak, 2020), which raises the possibility that recessions have only modest long-run effects on the nationwide labor market. However, as recession severity can vary considerably across geographies, recessions could nonetheless have persistent consequences for *local* labor markets. The importance of understanding whether local areas also recover fully from recessions is underscored by a growing literature showing that local factors shape a range of outcomes—such as intergenerational mobility (Chetty and Hendren, 2018*a*,*b*), health (Finkelstein, Gentzkow and Williams, 2021), and voting (Charles and Stephens, 2013; Autor et al., 2020).

A series of influential studies suggest that local labor markets do recover completely from most recessions. The results in Blanchard and Katz (1992, hereafter BK) imply that, although employment losses persist, state employment-population ratios recover completely within ten years because of rapid population adjustments. Using additional years of data and a different source of identification to estimate the BK model, Dao, Furceri and Loungani (2017) find that population is less responsive in the short run, but their estimates also imply full recovery of the employment-population ratio. Yagan (2019) applies the BK methodology to study recessions and finds rapid recovery following the 1980–1982 and 1990–1991 recessions, but slower recovery from the more severe Great Recession. Monras (2020) uses a different empirical strategy, but also finds lasting effects on local areas after the Great Recession. One interpretation of this evidence is that recessions must be especially severe to generate persistent impacts on local labor markets. The accuracy of this interpretation has broad implications for our understanding of labor markets, economic opportunities available to workers and their children, and appropriate policy responses.

This paper studies the response of U.S. local labor markets to employment losses that emerged during each recession between 1973 and 2009.[1] Specifically, we study how employment, popula-

[1]These recessions took place in 1973–1975, 1980–1982 (we pool the very short recession in 1980 with the longer one in 1981–1982), 1990–1991, 2001, and 2007–2009.

tion, and earnings evolve in local areas (metropolitan areas and commuting zones) where national recessions are more versus less severe. We draw upon multiple data sources, including those from the Bureau of Economic Analysis and Census Bureau, to create annual panels of longitudinally-harmonized geographic areas stretching over five decades. We estimate regression models that relate the evolution of local economic activity to sudden employment changes that arise during recessions, while controlling flexibly for changes in economic conditions at the regional level, as well as pre-recession population trends. This empirical strategy allows us to examine the extent to which local labor markets with larger employment losses during recessions recover relative to areas with smaller employment losses.

We find that declines in employment that emerge during recessions are extremely persistent. Across the five recessions that we study, a 10 percent decrease in metropolitan area employment during the recession, roughly the 90–10 percentile gap across areas for the Great Recession, on average leads to a 11 percent decrease in employment 7–9 years after the recession trough. The sudden decreases in employment that occur during recessions are not driven by differential pre-trends beforehand.

The consequences of these local employment declines depend on the extent of population adjustment. We find that metropolitan areas with larger employment losses experience population declines that begin during recessions and continue to grow for several years after the business cycle trough. The post-recession decrease in population is persistent, but smaller than the decrease in employment. Due to this limited population response, local employment losses are followed by persistently lower employment-population ratios. On average, a 10 percent decrease in employment during a recession leads to a 5.6 percent (3.4 percentage point) decrease in the employment-population ratio. The change in the employment-population ratio accounts for about half of the decline in local area employment 7–9 years after the business cycle trough, with the decline in population explaining the remaining half. Moreover, these relative declines in employment-population ratios persist through at least 2019. Local employment losses during recessions also are followed by lasting decreases in earnings per capita and earnings per worker.

Our findings are consistent with local labor markets that experience larger employment losses during recessions facing a persistent downward shift in labor demand in the presence of a labor supply curve that is less than perfectly elastic but more elastic than population. Additional evidence suggests that our results reflect persistent consequences of labor market shifts that occur primarily during recessions, as opposed to a series of shifts taking place throughout the post-recession period. Consistent with this interpretation, we also show that our findings are not driven by secular changes in local economic activity that are correlated with local areas' pre-recession industrial structure or demographic and labor market characteristics.

To further contextualize our results and corroborate our interpretation, we conduct several supplementary analyses. First, we find that relative declines in local employment are widespread across all sectors. Second, we use IRS data to show that the decline in population after the 2001 and 2007—2009 recessions arises from lower in-migration to local areas that experience larger employment losses. Out-migration actually falls after recessions in negatively affected areas. Third, we use individual-level data from the decennial census and American Community Survey to show that annual earnings declines tend to be more severe at the bottom and middle of the distribution. On average, about three-quarters of the medium-term decline in annual earnings for those who remain employed arises from a reduction in hourly wages. Finally, using two complementary approaches, we present suggestive evidence that a change in the composition of residents due to selective migration does not account for most of the decline in local employment-population ratios or average earnings. Instead, the declines appear to stem mainly from lasting impacts on individuals, consistent with evidence on the effects of job displacement (e.g., Jacobson, LaLonde and Sullivan, 1993; Davis and von Wachter, 2011; Lachowska, Mas and Woodbury, 2020; Schmieder, von Wachter and Heining, 2020).

Why do our results imply less recovery than the literature using vector autoregressions (VARs) (Blanchard and Katz, 1992; Dao, Furceri and Loungani, 2017; Yagan, 2019)? One potential explanation is that studies of local labor markets must rely on relatively short time series, which can lead to finite sample bias in VAR parameters. Using empirically-relevant Monte Carlo simulations, we show that this finite sample bias leads VARs estimated in prior work to incorrectly imply convergence in cases where a decline in employment leads to permanent reductions in the employment-population ratio. The finite sample bias in our simulations would be of first-order importance even if researchers had access to 100 years of data. Moreover, we show that VAR estimates based on different years of state-level data or metro-level data imply complete recovery of the employment-population ratio, while event-study regressions using state-level data are similar to our main results in suggesting more persistent declines. All of this evidence suggests that finite sample bias explains the difference in our results from those based on the BK VAR model.

The key contribution of this paper is evidence over a 50-year period on the response of local labor markets to employment losses that emerged during recessions. Our focus on recessions is motivated by two considerations. First, recessions have attracted substantial attention from researchers, policymakers, and the public. Second, as we show, recessions lead to sudden employment losses that break from pre-existing trends, allowing us to generate transparent evidence on the evolution of local economic activity with flexible regression models. Our results show that local employment losses during recessions are followed by lasting shifts in the spatial distribution of employment and population. The results also show that relative reductions in employment-population ratios and earnings last longer than previously thought. Moreover, post-recession changes in local labor market outcomes are remarkably similar over the past five decades, which underscores the extent to which persistent local labor market disruption is a general feature of the U.S. economy.

Our work complements recent research that uses local labor market variation to understand the consequences of recessions. Yagan (2019) uses tax data to provide evidence that people living in areas severely affected by the Great Recession experienced enduring employment and earnings losses. We differ from Yagan (2019) by focusing on how recessions affect local labor markets, as opposed to individuals, and by examining a larger number of recessions.[2] Monras (2020) pro-

[2]Rinz (2022) shows that the estimated effects in Yagan (2019) of the Great Recession on people's outcomes are smaller in magnitude when examining a broader range of ages, particularly because employment rates of individuals who were born from 1981–1996 recovered more quickly than other groups. Rinz (2022) also shows that the estimated impacts on people are slightly smaller than the impacts on places. Our results are similar to Rinz (2022) in finding that selective migration explains some, but not most, of the decline in local economic outcomes.

vides empirical evidence that reduced in-migration accounts for essentially all of the population decline in areas hit harder by the Great Recession and develops a structural model to rationalize this fact. Our findings on in-migration are qualitatively similar. We differ from Monras (2020) in our empirical strategy and examination of more recessions and more outcomes.

Our work also complements several other studies that examine how local labor demand shifts, such as a change in manufacturing jobs, affect earnings, employment, population, and labor force participation (e.g., Bound and Holzer, 2000; Freedman, 2017; Amior and Manning, 2018; Beaudry, Green and Sand, 2018; Gathmann, Helm and Schönberg, 2020; Notowidigdo, 2020; Cajner, Coglianese and Montes, 2021; Garin and Rothbaum, 2022). We provide new evidence by combining annual data—which directly reveal local labor market dynamics—and a research design that studies local employment shifts over a 50-year period. Additional evidence is particularly valuable because of the disagreement in the literature over whether shifts in local labor demand have persistent effects on wages and employment-population ratios, and how, when, and why these relationships may have changed (Bartik, 1993, 2015; Austin, Glaeser and Summers, 2018).[3]

Amior and Manning (2018) also show that incomplete adjustment of population to local employment shifts can generate persistent gaps in employment-population ratios. We differ in our use of sudden shifts in local employment that arise during recessions and our use of annual data, as compared to their analysis of predicted employment changes based on industrial structure using decadal data. Based on instrumental variable estimates of how employment responds to population and how population responds to employment, the model in Amior and Manning (2018) implies highly persistent labor demand innovations. In our setting, this would imply that areas that experience more severe recessions face additional negative labor demand shocks after recessions. We do not find evidence of such additional labor demand shocks, and our results are robust to controlling for pre-recession local industry shares; both findings suggest that persistent local labor market declines do not arise in our setting because labor demand innovations are strongly correlated over

[3]Greenstone and Looney (2010) and Stuart (2022) provide evidence that recessions are followed by persistent declines in per capita earnings at the county level; our analysis goes considerably further, by examining a larger range of outcomes, other levels of geography, additional recessions, and proximate mechanisms.

time. Instead, our results suggest that the *effects* of specific labor demand disruptions that arise during recessions are persistent.

We emphasize that our finding of persistent local labor market declines is not inconsistent with aggregate economic recovery. The cross-sectional identifying variation we use identifies relative differences in the evolution of local labor market outcomes between areas that experience more or less severe employment losses during recessions.[4] A persistent relative decline does not imply that an area fails to recover in an absolute sense, but rather that a gap remains between that area and one that experienced a less severe recession. These relative differences most directly shed light on the distributional consequences of recessions and the efficiency costs associated with incomplete local labor market adjustments.

2 Conceptual Framework

To guide our empirical analysis, we draw on a simple conceptual framework and previous research to describe how local labor markets might evolve after recessions. This discussion informs our empirical strategy and the interpretation of our results.

Consider a local labor market that experiences a decline in employment during a recession. Over a short horizon of 2–3 years, the most natural catalyst of this fall in employment is a downward shift in labor demand. The fall in demand could stem from many possible sources, such as an increase in interest rates or oil prices or a decline in consumer sentiment. Employment will fall during a recession if labor supply is not perfectly inelastic in the short-run. Wages will fall if labor supply is less than perfectly elastic, and the employment-population ratio also will fall if the labor supply elasticity is larger than the population elasticity.[5]

After the recession, the local labor market could recover to varying degrees. The extent of

[4]Other papers studying local labor markets also identify relative differences (e.g., Blanchard and Katz, 1992; Autor, Dorn and Hanson, 2013; Amior and Manning, 2018).

[5]There are several possible explanations for why the labor supply elasticity could exceed the population elasticity at any horizon. For example, working-age individuals might be more mobile than other individuals (such as retirees). Working-age individuals also could care more about employment opportunities than individuals that are not working. Finally, individuals might adjust their labor supply without moving, possibly by dropping out of the labor force when wages fall below their reservation level.

recovery can be summarized by focusing on two questions.

First, are there lasting declines in employment and population? On the one hand, the local labor market could exhibit complete recovery in terms of these variables if the downward shift in labor demand is temporary and there is no shift in labor supply. For example, this pattern would arise if firms temporarily laid off workers or reduced their hours and there was no change in the non-wage determinants of labor supply and population, such as quality of life. On the other hand, the local labor market could experience a persistent decline in employment or population if the negative shift in labor demand persists and the supply of employment or population is not perfectly inelastic.

Second, are there lasting declines in the employment-population ratio and wages? This question is mainly of interest in the case where there are lasting declines in employment and population. If individuals' labor supply and migration choices are extremely sensitive to local job opportunities, then a combination of labor force exits, higher out-migration, and lower in-migration could re-equilibrate the local labor market near its original employment-population ratio and wage level. In contrast, if the supplies of labor and population to a local area are both relatively inelastic, then there could be lasting declines in wages. If labor supply is more responsive than population, then the employment-population ratio would remain depressed as well.[6]

Existing research tends to find evidence of lasting declines in employment and population in response to shifts in labor demand. One set of papers has found these results by estimating vector autoregressions (VARs) (Blanchard and Katz, 1992; Dao, Furceri and Loungani, 2017; Yagan, 2019).[7] Other papers have studied the consequences of employment changes predicted by the interaction of pre-existing industrial structure and nationwide industrial shifts, often over decadal intervals (Bartik, 1991; Bound and Holzer, 2000; Amior and Manning, 2018; Notowidigdo, 2020).

[6]It is reasonable to expect that the labor supply elasticity is larger than the population elasticity (see footnote 5). However, if the labor supply elasticity is smaller than the population elasticity, then a persistent decline in local labor demand could lead to an increase in the employment-population ratio.

[7]These papers differ in the terms of magnitudes: Blanchard and Katz (1992) estimate that employment recovers by almost 40 percent after the shock; Dao, Furceri and Loungani (2017) estimate recovery between 20–40 percent; and Yagan (2019) estimates even more recovery following the 1980–1982 and 1990–1991 recessions. The evidence in Yagan (2019) comes from estimating the BK VAR using data from 1978–2007 and then calculating averages for states where the VAR-implied recession shock was more or less severe. The presence of pre-trends in this simple model makes it difficult to conclusively say how persistent the employment changes are in these results.

The evidence in Monras (2020) from the Great Recession also indicates a persistent decline in population.

There is less agreement about whether shifts in labor demand are followed by persistent changes in the employment-population ratio and wages. Estimates from VARs generally imply that the employment-population ratio, unemployment rate, labor force participation rate, and wages recover fully within a decade (Blanchard and Katz, 1992; Dao, Furceri and Loungani, 2017; Yagan, 2019).[8] On the other hand, papers that study employment changes predicted by industrial structure tend to find evidence of lasting changes in wages and the employment-population ratio (Bartik, 1991; Bound and Holzer, 2000; Amior and Manning, 2018; Notowidigdo, 2020).[9]

Assessing the extent of declines in the employment-population ratio and wages is particularly important because these measures more directly reflect the economic opportunities available to the average person in an area. In turn, these results inform our understanding of fundamental features of local labor markets and appropriate policy responses to labor demand shifts. We next describe our approach to studying these questions. After presenting our main results, we describe in detail how our findings relate to these cases and past work.

3 Data and Empirical Strategy

3.1 Data

We compile several public-use data sets to measure local economic activity. These data sets are constructed by government agencies using administrative data. Employment is available from the Bureau of Economic Analysis Regional Economic Accounts (BEAR; Bureau of Economic Analysis (1969–2019*b*)), Census County Business Patterns (CBP; Census Bureau (1970–1994, 1995–2017)), and Quarterly Census of Employment and Wages (QCEW; Bureau of Labor Statis-

[8]The estimates in Yagan (2019) imply similarly rapid recovery following the 1980–1982 and 1990–1991 recessions, but slower recovery after the Great Recession.

[9]Monras (2020) also finds evidence of lasting impacts on wages after the Great Recession.

tics (1975–2019*d*)).[10] BEAR and CBP data are available starting in 1969, while QCEW data are available from 1975 onward. BEAR data also contain aggregate earnings.[11] We use the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER; National Cancer Institute (1969–2019)) data for annual population estimates, which are available by sex, race, and age. To measure in- and out-migration, we use the Internal Revenue Service Statistics of Income (SOI; Internal Revenue Service (1993–2019)) data.[12] Finally, we use tabulations and microdata from the decennial census and the American Community Survey (ACS) to examine the earnings distribution and composition changes.[13]

With the exceptions of the decennial census and ACS microdata, all of the data sets are available at the county level. The census and ACS are available at the Public Use Microdata Area (PUMA) level, which we map to other geographies using crosswalks available from the Geocorr program of the Missouri Census Data Center. Consequently, we can examine changes in economic activity for metropolitan areas and commuting zones.[14] Both types of areas are composed of counties, so it is straightforward to map our county-level data into metropolitan areas or commuting zones. A slight complication is that definitions of metropolitan areas and commuting zones change over time; we use Core Based Statistical Areas (CBSAs) as defined by OMB in December 2003 and commuting

[10] Because employment counts are often suppressed for small counties and industries in CBP data, we adopt the imputation procedure of Holmes and Stevens (2002) when necessary. Details are in the Data Appendix. Results from this approach agree closely with WholeData, which uses a linear programming algorithm to recover suppressed employment estimates (Bartik et al., 2019).

[11] More specifically, BEAR data contain earnings by both place of residence and place of work. Since wage and salary employment is available only by place of work, we use earnings by place of work. We define earnings to be wages, salaries, and supplements (benefits), and we adjust it for inflation using the personal consumption expenditures (PCE) deflator in 2019 dollars (Bureau of Economic Analysis, 1969–2019*a*). As discussed below, our results are similar when alternatively measuring earnings by place of residence.

[12] SOI data are available starting in the 1990s. Although they capture moves only for tax filers, SOI data are considered a high-quality source for point-to-point migration flows and have been used in several papers (e.g., Kaplan and Schulhofer-Wohl, 2012, 2017; Wilson, Forthcoming).

[13] We use versions of these tabular and microdata from NHGIS and IPUMS, respectively (Manson et al., 2019; Ruggles et al., 2019). The Data Appendix describes the processing of these data and how we link individuals to our geographies of interest.

[14] Metropolitan statistical areas are defined by the Office of Management and Budget (OMB) as having "at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties" (Office of Management and Budget, 2003). Commuting zones are defined based on commuting patterns and do not have a minimum population threshold or urban requirement (Tolbert and Sizer, 1996). We do not examine counties because these are often too small to constitute local labor markets, our area of focus.

zones as defined by USDA and based on the 2000 census. Although we focus on metropolitan areas because of their greater size and thicker labor markets, we show that our main results are robust to using commuting zones, which unlike metropolitan areas cover the entire United States.[15]

3.2 Empirical Strategy

Our empirical strategy relies on cross-sectional variation in sudden employment changes that occur during nationwide recessions. We use this variation to estimate how the post-recession evolution of local labor market outcomes varies with the severity of recessions.

Our preferred approach is to stack recessions together and estimate the following regression:

$$y_{i,t} - y_{i,p(r)-2} = \sum_{\tau=p(r)-4}^{p(r)+12} s_i^r I_{t=\tau} \delta_\tau + x_i^r \beta_t^r + \varepsilon_{i,t}^r, \tag{1}$$

where $y_{i,t}$ is a measure of local economic activity in location i and year t; s_i^r is the severity of recession r, measured as the log employment change in location i from the nationwide business cycle peak to trough (multiplied by -1); $I_{t=\tau}$ is an indicator for year t being equal to τ, which ranges from 4 years before to 12 years after the nationwide recession start year $p(r)$; x_i^r is a vector of recession-specific, time-invariant control variables; and $\varepsilon_{i,t}^r$ is an error term. The term $y_{i,p(r)-2}$ is the outcome measure in location i two years before the nationwide recession start, so that the left-hand side of equation (1) is the within-location change in the outcome relative to a fixed, pre-recession period.

The key parameter of interest, δ_τ, describes the relationship between the change in employment during the recession and the change in local economic activity as of year τ relative to the nationwide recession start. Because the left-hand side of equation (1) is a within-location change, this approach controls for time-invariant cross-sectional differences. We normalize the δ_τ coefficient to equal zero two years before the recession start (i.e., $\delta_{p(r)-2} = 0$) to facilitate comparisons across recessions. We choose two years before the recession start as the normalization year because the

[15]Metropolitan areas, consistently defined, cover 80–90 percent of people and jobs throughout our sample, with this share growing over time.

exact timing of recessions is uncertain and there is variation in when aggregate economic indicators decline.[16] The δ_τ parameters vary freely across years relative to the recession start, which is useful for identifying empirical patterns without imposing possibly incorrect constraints. Moreover, stacking the five recessions into a single regression in event time allows us to increase precision and focus on central tendencies.[17] This reduced-form approach can capture a wide variety of demand and supply adjustments after the recession.

We measure local recession severity using annual employment data from BEAR. We modify NBER business cycle peak and trough dates to account for our use of annual data. Specifically, we construct s_i^r using the log employment change for each geography between 1973–1975, 1979–1982, 1989–1991, 2000–2002, and 2007–2009.[18] We use wage and salary employment (private and public) to measure recession severity, as coverage of the self-employed is incomplete and varies over time. Variation across areas in employment losses during recessions can arise from differences in industrial specialization (e.g., recessions could decrease demand for automobiles) or even finer differences in the products that are made in an area (e.g., recessions could particularly decrease demand for more expensive trucks and SUVs). Idiosyncratic shocks to a single large firm also could generate local employment losses (c.f., Gabaix, 2011; Salgado, Guvenen and Bloom, 2020).

Estimates of δ_τ can be interpreted as isolating the differential response of local economic outcomes with respect to recession severity if s_i^r is exogenous to changes in residual determinants of local labor market outcomes, $\varepsilon_{i,t}^r$, conditional on the controls in the regression. In addition to controlling for time-invariant differences across local areas, we include several variables in x_i^r to bolster the validity of this interpretation. First, we include Census division fixed effects to flexibly capture broad shifts in local labor demand and supply that are not driven by recessions, such as the rise of the sunbelt (Glaeser and Tobio, 2008). Second, we include *pre*-recession population

[16] Because we show the entire range of estimates of δ_τ, it is straightforward to see how our estimates would change with a different normalization year.

[17] Cengiz et al. (2019) adopt a similar stacked event study approach in their analysis of the minimum wage. We present results for each recession separately in the appendix, as referenced below.

[18] The NBER recession dates are November 1973 to March 1975, January 1980 to July 1980, July 1981 to November 1982, July 1990 to March 1991, March to November 2001, and December 2007 to June 2009.

growth to adjust for secular shifts in local labor supply.[19] The coefficient vector on these controls, β_t^r, varies freely across years and recessions for increased flexibility. In unreported results, we find that estimates are very similar when additionally controlling for pre-recession employment growth with coefficients that vary by year and recession. Estimates of δ_τ for pre-recession years allow us to directly examine the presence of pre-trends, and estimates of δ_τ for post-recession years shed light on whether areas that experience larger employment losses during recessions are differentially exposed to non-recession economic shocks (which would show up as subsequent spikes or jumps in δ_τ). We cluster standard errors at the metro level to allow for arbitrary autocorrelation in the error term $\varepsilon_{i,t}^r$ across years and recessions.

There are several notable aspects to our analysis of how local labor markets evolve after employment changes that occur during recessions. First, recessions feature both general declines in economic conditions and increased dispersion in economic conditions across different areas (e.g., Dao, Furceri and Loungani, 2017). While many metro areas experience absolute job losses during recessions, Appendix Figures 1 and 2 show that several areas also see gains in employment over the 2–3-year recession horizons we examine. Second, as mentioned above, our use of the actual log employment change as the key explanatory variable of interest implies that our regressions partly reflect idiosyncratic shifts in local labor demand. It is not clear a priori whether shifts in employment that include these idiosyncratic factors would lead to more or less persistent changes in local economic conditions than shifts in employment that are predicted by industry shift-share shocks (Bartik, 1991). On the one hand, employment shifts that include idiosyncratic shocks might better capture the consequences of job losses at important establishments or plant closures. On the other hand, shift-share shocks might better reflect structural changes in the economy.[20] Third, the

[19]Controlling for baseline levels or pre-trends of economic outcomes is common (e.g., Autor, Dorn and Hanson, 2013; Dix-Carneiro and Kovak, 2017; Hershbein and Kahn, 2018). Given the challenge of controlling directly for all relevant local labor supply shifters (e.g., due to a wide range of natural and cultural amenities), we opt to control for pre-recession population growth. We control for the log change in population for ages 0–14, 15–39, 40–64, and 65 and above. We construct these population variables using SEER data, which are available starting in 1969. The pre-recession population growth years are 1969–1973 (for the 1973–1975 recession), 1969–1979 (for the 1980–1982 recession), 1979–1989 (for the 1990–1992 recession), 1990–2000 (for the 2001 recession), and 1997–2007 (for the 2007–2009 recession).

[20]That said, shift-share shocks based on the 2–3-year recession horizons we study might be less likely to capture structural changes like the decline in manufacturing than the 10-year horizons that are used in other work (e.g., Bound

consequences of a change in actual employment or a shift-share shock could differ across recessions because of heterogeneity in the macroeconomic shock or the areas that are exposed to the shock (e.g., Adão, Kolesár and Morales, 2019). These considerations motivate our approach of estimating impacts separately for each recession for transparency, estimating stacked regressions to increase precision and focus on central tendencies, and comparing results that rely on variation in the actual employment change in an area to those that rely on variation from the predicted employment change based on a shift-share shock.

3.3 The Severity of Recessions Across Time and Space

Before moving to estimates of equation (1), we describe the characteristics of the five recessions that are our focus. Figure 1 displays aggregate seasonally adjusted, nonfarm employment from the Current Employment Statistics (Bureau of Labor Statistics, 1969–2019*a*) from 1969 to 2019. Nationwide employment more than doubled over this period. This growth was interrupted by five recessions (combining the two in the early 1980s), as indicated by the vertical shaded bars in the graph. While there is little consensus on the macroeconomic causes of each recession, the drivers almost certainly differ (Temin, 1998). The 1973–1975 and 1980–1982 recessions followed increases in the price of oil and subsequent increases in interest rates by the Federal Reserve. There is less agreement on the causes of the 1990–1991 recession (Temin, 1998). The 2001 recession followed the dot-com bubble, and the 2007–2009 recession followed tumult in housing and financial markets.

Using annual data from BEAR, Table 1 shows the national changes in employment from business cycle peak to trough for each recession, both overall and for major industrial sectors. The recessions vary in overall magnitude, from a 3 percent employment decline during the Great Recession to a 1 percent increase from 1989 to 1991, with the others falling in between. The bottom right panel of the table reports pooled employment changes across recessions. The results show that manufacturing and construction usually experience the largest proportional employment de-

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and Holzer, 2000; Goldsmith-Pinkham, Sorkin and Swift, 2020).

clines. The patterns of employment changes for other industries differ more across recessions.

Figure 2 displays the frequency with which each area experienced a severe recession over the sample horizon. We define a metropolitan area as having a severe recession if it experienced a log employment change worse than the median area for a given recession. The Detroit and Chicago metros, for example, experienced downturns worse than the median for all five recessions, while the Houston metro did so only in 2001. The distribution in severity frequency is roughly symmetric, with a similar number of metros experiencing zero or one severe recessions (112) as those experiencing four or five (105). As a result, there is considerable variation across recessions in whether a given area faces a severe employment loss.[21]

We show the serial correlation in recession severity in Table 2. Panel A shows the raw correlations across metros in log employment changes for each pair of recessions. As suggested by Figure 2, the serial correlation is positive, but moderate. Consistent with the different origins of the recessions as well as temporal changes in industrial mix, the pattern is not monotonic across time. We also show in Panel B the correlations after partialing out fixed effects for the nine Census divisions, and in Panel C the correlations after additionally controlling for pre-recession population growth. These controls tend to slightly reduce the magnitudes of the correlations, but positive serial correlation remains in a few cases. The regression estimates below suggest that serial correlation in recession severity has relatively little impact on our results. We also control for the severity of previous recessions as an additional robustness check and show that these controls do not appreciably change the results.

Table 3 describes the characteristics of metropolitan areas that experience a more versus less severe recession (defined as whether the log employment change is above or below the median). We measure these characteristics using the closest decennial census to the recession start year, except for the 2007–2009 recession, which is measured using the 2005–2009 ACS. The largest consistent difference between areas that experience a more versus less severe recession is the man-

[21] This result is also apparent when examining log employment changes separately for each recession (Appendix Figure 1). Moreover, a substantial share of areas see absolute increases in employment growth during each episode (Appendix Figure 2).

ufacturing employment share, though this difference has decreased considerably over time. The other differences vary across recessions and are generally small.[22] The variables in Table 3 include both sources of recession severity and factors that might influence the response of local areas to decreases in employment. We directly examine changes in some of these variables, while also examining changes in worker composition to better understand related mechanisms.[23]

4 The Post-Recession Evolution of Local Economic Activity

4.1 Employment

We begin with estimates of equation (1) for log employment in metropolitan areas. Panel A of Figure 3 presents estimates from the stacked regression.[24] We include four years before the start of each recession to capture any pre-trends, and we follow areas for 12 years afterwards. Specification 1, shown in red (circles), includes only Census division fixed effects in x_i^r. Our preferred specification 2 (solid blue line) also controls for pre-recession population growth for ages 0–14, 15–39, 40–64, and 65 and above. Specification 3 (green squares) adds the severity of the previous recession, which is possible for all but the 1973–1975 recession. Finally, specification 4 (orange triangles) further includes the severity of *all* previous recessions since 1973. In all cases we allow the coefficient vector β_t^r to vary freely across years and recessions (e.g., we interact division fixed effects with year-by-recession fixed effects).

Overall, there is some weak evidence of negative pre-trends from specification 1, indicating that employment was gradually declining beforehand in areas that experienced a more severe recession. Controlling for pre-recession population growth eliminates these pre-trends. Since pop-

[22]Appendix Table 1 reports p-values of the differences in these characteristics between areas facing more versus less severe recessions. Additionally, Appendix Tables 2 and 3 show descriptive estimates of the relationship between pre-recession metro-area characteristics and, respectively, the metro-level log employment change during recessions (our primary regressor of interest) and the shift-share predicted log employment change. The manufacturing employment share is strongly and consistently predictive of more severe downturns in both cases, but other characteristics are more variable across measures and recessions. As indicated by the R-squareds from the tables, the log employment change during a recession captures more idiosyncratic factors than does the predicted shift-share instrument.

[23]We examined whether post-recession changes in economic activity varied with pre-recession levels of these variables but found little evidence of such heterogeneity.

[24]Recession-specific estimates are in Appendix Figure 3.

ulation growth is calculated over the decade before the recession, it is likely we eliminate secular trends (such as growing migration to certain metros in the South and West).

The results in Panel A of Figure 3 indicate that local employment losses during recessions are extremely persistent. The recession severity variable s_i^r is mechanically correlated with a drop in log employment during the recession. There is no mechanical relationship for the post-recession coefficients, however, which show little to no recovery over the subsequent 10 years. Moreover, the confidence intervals imply that we can reject a return to initial peak employment in every post-recession year. The graph also shows that the persistent decline in employment is not affected by whether we control for the severity of previous recessions, and there is no evidence of subsequent discrete jumps, as might occur from a later shock. We obtain similar results when examining employment from County Business Patterns data, where we also see a persistent decline in the number of establishments (Appendix Figure 4).

Panel B of Figure 3 illustrates how the relative changes identified by equation (1) translate into aggregate outcomes by displaying the implied evolution of mean log employment in metropolitan areas with a more versus less severe recession.[25] The post-recession level of employment is persistently lower in areas where the recession was more severe relative to areas where the recession was less severe. However, employment grows after the business cycle trough in absolute terms in both types of areas.

Panel A of Table 4 summarizes the (preferred) specification 2 results 7–9 years after the business cycle trough.[26] The employment elasticity is -1.1, which indicates that a 10 percent decrease in employment during the recession is followed by 11 percent lower employment 7–9 years later. Because recession severity varies both across recessions and across areas within a given recession (Appendix Figure 2), we also report standardized coefficients. On average, a one-standard

[25]We construct these conditional means using estimates of equation (1), holding all covariates besides recession severity at their mean value, and defining the gap between a more and less severe recession as a log employment change difference of -0.086 (equal to the difference in mean recession severity for areas with a log employment change below or above the median).

[26]We generate the results in this table by pooling the coefficients in equation (1) for post-trough years 7–9. Estimating a pooled coefficient summarizes the medium-term changes while also increasing precision. Appendix Table 6 presents results separately for each recession.

deviation employment decline leads to a 6.6 percent decrease in employment 7–9 years after the trough.

The consequences of these decreases in employment depend on the degree of population response. We examine this next.

4.2 Population

Panel A of Figure 4 presents estimates of equation (1) where the dependent variable is the log of the total working-age population (15+). For brevity, we show only the results from specification 2, although the patterns are robust to specifications 3 and 4. We find that areas with greater job loss experience post-recession decreases in population that double in magnitude over the post-recession period. The summary estimates in Panel A of Table 4 indicate that a 10 percent decrease in employment during the recession is followed by a 5.8 percent decrease in population 7–9 years after the trough. For a one-standard deviation employment decrease, this amounts to a 3.3 percent relative decrease in population.[27]

4.3 Employment-Population Ratio

Population declines by less than employment in areas that experience more severe recessions. This implies that the employment-population ratio falls after recessions in these areas. To examine this pattern more directly, we use the log of the ratio of employment to working-age population as the dependent variable in equation (1).[28]

Panel B of Figure 4 shows that the employment-population ratio falls during recessions and remains below the pre-recession peak, even a decade after a recession's end.[29] Due to the relatively flat employment trajectory and steady population decline, the employment-population ratio shows

[27]Recession-specific estimates are in Appendix Figure 5. Consistent with the previously-documented decline in migration (Molloy, Smith and Wozniak, 2014; Dao, Furceri and Loungani, 2017), post-recession declines in population have become smaller over time.

[28]Our employment-population measure is the ratio of the count of jobs to the number of working-age people; because of multiple job-holding, it is not strictly comparable to official employment-population ratios, which represent the share of the population that is employed.

[29]Recession-specific estimates are in Appendix Figure 6.

a slight recovery over time. As reported in Panel A of Table 4, the average elasticity 7–9 years post trough is about -0.6. Given a mean employment-population ratio of about 60 percent, this elasticity implies that a 10 percent decrease in employment during a recession is followed by a 3.4 percentage point decline in the employment-population ratio. A one-standard deviation employment decline leads to a 3.3 percent (2.0 percentage point) decrease in the employment-population ratio.

The estimates in Table 4 facilitate a simple decomposition of the post-recession decline in employment, namely that the post-recession change in log employment equals the change in log population plus the change in the log employment-population ratio. On average, the decline in the employment-population ratio accounts for about half of the decline in employment 7–9 years after the business cycle trough, with the remaining half explained by the decline in population.

4.4 Earnings per Capita

Local employment losses could be followed by broader changes than a persistent decline in the employment-population ratio. For example, as explained in Section 2, local labor markets could also face declines in wages, and reductions in employment could extend beyond the extensive margin to also affect hours worked. To understand the broader consequences of local employment losses, we examine changes in log earnings per capita. The results in Panel C of Figure 4 show evidence of persistent reductions in earnings per capita following recessions.[30] The medium-term elasticity in Panel A of Table 4 is -0.9, which implies that a one-standard-deviation greater employment decline is followed by a 5.2 percent larger relative decrease in earnings per capita 7–9 years after the trough.[31,32]

[30] Recession-specific estimates are in Appendix Figure 7.

[31] Our preferred earnings measure includes wages, salaries, and supplements (benefits), which are available only by place of work. We show in Appendix Figure 8 that our findings are not sensitive to the place of residence versus place of work distinction.

[32] Recessions also could lower housing prices. Using housing price indices from the Federal Housing Finance Agency (Federal Housing Finance Agency, 1975–2019), we find evidence of a relative decrease in housing prices in areas that experience larger employment losses during a recession (Appendix Figure 9, Panel A). To explore whether these changes in prices offset the decline in earnings per capita, we combine these estimates with the two approaches of constructing local CPI from Moretti (2013). We find that 70–80 percent of the change in log earnings per capita remains after adjusting for local prices, as shown in Panel B of Appendix Figure 9.

4.5 Earnings per Worker

Any reduction in wages and hours following local employment losses during a recession can also be examined through effects on log annual earnings per worker, which encapsulates both the quantity and quality of employment. Panel D of Figure 4 shows evidence of a persistent decline in earnings per worker that is sizable but smaller than the decrease in earnings per capita.[33] The definitions of the outcomes in Panel A of Table 4 facilitate a decomposition of the decline in earnings per capita. In particular, the change in log earnings per capita equals the sum of the change in the log employment-population ratio and the change in log earnings per worker. We find that 63 percent of the post-recession decrease in earnings per capita is explained by the decline in the employment-population ratio, with the remaining 37 percent explained by the decrease in earnings per worker.

4.6 Robustness

Our results are robust to modifying the empirical specification in several different ways. In particular, Appendix B.1 shows that our results are very similar when using private wage and salary employment from BEAR or QCEW data to measure recession severity. Appendix B.2 discusses results that isolate variation in the log employment change during recessions that is predicted by an area's pre-existing industrial specialization (Bartik, 1991). These estimates reveal persistent declines in local economic activity that are similar in magnitude to our main results, which implies that our finding of a persistent post-recession decline in local economic activity is not driven entirely by idiosyncratic shifts in local labor demand. The similarity of these results also suggests that the employment change during recessions is not driven by immediate endogeneous policy responses. Indeed, the event study results are also robust to replacing division-year fixed effects with state-year fixed effects (Appendix Figure 14), which further address potential endogenous policy responses. Finally, Appendix B.3 shows that our results are nearly identical when examining

[33] The numerator of this outcome is the same as in earnings per capita but we change the denominator to the annual employment count rather than the working-age population. Recession-specific estimates are in Appendix Figure 10.

commuting zones instead of metropolitan areas.

5 Discussion

Our results point to a different understanding of local labor market dynamics compared to papers that estimate rapid recovery in response to labor demand shocks (e.g., Blanchard and Katz, 1992; Dao, Furceri and Loungani, 2017). While our finding of persistent declines in employment and population are qualitatively similar to these papers' findings, we provide evidence of persistent declines in the employment-population ratio, earnings per capita, and earnings per worker. This implies that labor demand shocks have much longer-lasting consequences for local areas and that migration plays a smaller role in equilibrating local labor market outcomes. The literature studying the impacts of Bartik shocks over longer horizons also supports this view of the labor market (Bartik, 1991; Bound and Holzer, 2000; Notowidigdo, 2020).

In this section we present additional evidence that supports this interpretation and provides additional context. We demonstrate that our results are not driven by secular changes associated with areas' pre-recession industrial specialization or demographic or labor market characteristics. We also show that all sectors experience a relative decline in employment, while population falls primarily because of lower in-migration. Moreover, the decrease in earnings among individuals who remain employed is explained mainly by a reduction in hourly wages, as opposed to hours of work. Finally, we show that persistent local labor market declines do not simply reflect changes in the composition of residents.

5.1 Supporting Evidence

A possible concern is that our estimates simply reflect the effects of secular changes in the economy, such as the decline in manufacturing. This issue is closely related to the hypothesis of Amior and Manning (2018), who argue that slow regional recoveries are partly due to serially correlated labor demand shocks, which could resemble secular changes in annual data. Several factors point against these interpretations in our setting.

Most importantly, there is little evidence that the persistent decline in local economic activity is driven by subsequent shocks that occur after recessions. If areas faced a severe recession and then a serially correlated shock a few years later, we would expect to see post-recession years with sharp decreases in employment. These sharp changes are not evident in Figure 3. Instead, employment declines rapidly during the recession and then remains relatively flat over the following decade.[34] These results suggest that serially correlated labor demand shocks play a minor role in our setting.

To explore this issue further, we estimate regressions that additionally control for interactions between recession-specific year indicators and pre-recession metro area characteristics. One set of regressions controls for shares of employment in each of ten sectors: agriculture, construction, finance, government, manufacturing, mining, retail trade, services, utilities, and wholesale trade. These controls absorb changes in economic activity that are associated with industrial specialization. For example, areas that specialize in manufacturing might have experienced reductions in employment for the past 50 years, due to either secular change or repeated shocks. Another set of regressions controls for the pre-recession labor market and demographic characteristics examined in Table 3 and Appendix Table 2, which could also correlate with pre-existing trends or future non-recession shocks. The results from both of these specifications, shown in Appendix Figure 16, are similar to our baseline results from Figures 3 and 4. Our estimates of persistent post-recession declines do not simply reflect secular changes determined by industry structure or other labor market characteristics.

5.2 Contextualizing Evidence

5.2.1 Employment Declines across All Sectors

Are the employment losses shown in Figure 3 broad-based or concentrated in certain industries? To explore this question, Figure 5 shows estimates of equation (1), where the dependent variable is log employment in each sector. For simplicity and ease of presentation, we present estimates

[34] As shown in Appendix Figure 3, this pattern generally holds for individual recessions as well.

for specification 2 only and suppress confidence intervals.[35] We find that the relative decline in employment is pervasive across sectors. Construction and manufacturing experience the largest short-term decreases, while government employment generally falls the least. The remaining industries tend to move similarly and lie in between; with the exception of construction, there is little evidence of an upward slope to suggest an eventual recovery in employment.[36]

5.2.2 Population Declines through Lower In-Migration

What explains the decline in population? We use the SOI data to examine this question for the two most recent recessions. In particular, we decompose the net change in population into changes in in-migration, out-migration, and residual net births. This decomposition starts with the identity:

$$\text{pop}_{i,t} = \text{pop}_{i,t-1} + \text{inmig}_{i,t} - \text{outmig}_{i,t} + \text{netbirths}_{i,t}, \tag{2}$$

where $\text{pop}_{i,t}$ is population in location i and year t, $\text{inmig}_{i,t}$ is the number of in-migrants between year $t-1$ and t, $\text{outmig}_{i,t}$ is the number of out-migrants, and $\text{netbirths}_{i,t}$ is the number of births minus deaths. Iterating equation (2) and normalizing by a baseline population level two years before the recession start, we can decompose the proportional change in population from year $p(r)-2$ to year t into components for in-migration, out-migration, and net births as follows:

$$\frac{\text{pop}_{i,t}}{\text{pop}_{i,p(r)-2}} - 1 = \sum_{j=p(r)-1}^{t} \frac{\text{inmig}_{i,j}}{\text{pop}_{i,p(r)-2}} - \sum_{j=p(r)-1}^{t} \frac{\text{outmig}_{i,j}}{\text{pop}_{i,p(r)-2}} + \sum_{j=p(r)-1}^{t} \frac{\text{netbirths}_{i,j}}{\text{pop}_{i,p(r)-2}}. \tag{3}$$

As a starting point, Panel A of Figure 6 shows that using the number of personal exemptions from the SOI data to construct the variable on the left-hand side of equation (3) yields results that are similar to the change in log population shown in Panel A of Figure 4.[37] Panel B of Figure 6

[35] Appendix Figure 17 shows recession-specific estimates.

[36] We exclude agriculture and mining, which are small (especially in metropolitan areas) and highly spatially concentrated.

[37] For this analysis, we stack the 2001 and 2007–2009 recessions and estimate a variant of equation (1) in which the dependent variable is an outcome as of year t and we control for interactions between recession-specific year fixed effects and in-migration, out-migration, and net birth rates in year $p(r)-2$. This approach facilitates an exact decomposition using the regression coefficients, although we omit the effect on net birth rates from the figures for

presents results where the dependent variables are annual migration inflows and outflows divided by the total number of exemptions in year $p(r) - 2$. By business cycle trough, in-migration rates have fallen sharply, with a 10 percent decrease in employment during the recession being followed by a reduction in annual in-migration of about 0.8 percent of pre-recession population. Over the subsequent decade, in-migration rates gradually recover but remain depressed ten years after the business cycle trough. Out-migration shows little response until after the recession has ended. Beginning in the year after the trough, however, out-migration rates steadily *decline* for several years, with similar medium-term magnitudes as for in-migration.

To understand how these components contribute to the change in population, we use the decomposition in equation (3). In particular, we construct cumulative sums of the coefficients in Panel B and divide these sums by the respective estimates in Panel A. When we also multiply the out-migration estimates by -1, the three transformed coefficients—in-migration, out-migration, and net births—sum to 1 and fully decompose the post-recession population change in each period. The results in Panel C reveal that lower in-migration accounts for essentially all of the medium-run decrease in population after recessions.[38] In contrast to a story of individuals moving away from places where recessions are more severe, the decrease in out-migration dampens the population decline.[39] The lack of out-migration is a natural explanation for why the population response is incomplete.

5.2.3 Earnings Decline throughout the Distribution, via Lower Hourly Wages

We use census/ACS data to examine changes in the distribution of prime-age workers' earnings. Specifically, we estimate a variant of equation (1) in which the dependent variable is a pre-post

brevity.

[38]There is a decrease in net births (not shown) that offsets the decline in out-migration in explaining the net population decline.

[39]Monras (2020) also finds this pattern of relative population decline due to falling in-migration for the Great Recession, using variation in recession severity based on pre-recession per capita debt and the share of employment in non-tradable industries (see also Mian, Rao and Sufi, 2013). His calibrated general equilibrium model predicts that migration dissipates about 60 percent of the long-term impact on wages following the Great Recession.

recession change.[40] We examine the mean and the 10th, 50th, and 90th percentiles of the log annual earnings distribution. The first row of Panel B of Table 4 shows that estimates for mean log earnings are similar to those from the BEAR data on log earnings per worker. The percentile estimates in the next three rows indicate that earnings fall throughout the distribution, with larger changes at lower percentiles. These results are consistent with the finding that lower-earning demographic groups are more affected during recessions (Hoynes, Miller and Schaller, 2012).

Does the reduction in earnings stem from a reduction in hours worked, a reduction in earnings per hour, or both? To answer this question, we use the census/ACS data to estimate regressions where the dependent variable is the change in average log annual, weekly, or hourly earnings. If the earnings losses are driven by a reduction in hours, hourly wages could be relatively unaffected several years later. On the other hand, if the recession slows wage growth or displaced workers are less likely to find good employer matches, hourly wage losses may explain more of the annual earnings declines. The results in Panel C of Table 4 indicate that the latter story better fits the data, and accord with Lachowska, Mas and Woodbury (2020), as the estimated decline in log hourly wages explains about three-quarters of the decline in log annual earnings. Decreases in work attachment at the intensive margin therefore explain relatively little of the persistent reduction of annual earnings among individuals who remain employed.[41,42]

5.2.4 The Role of Changes in the Composition of Residents

A remaining explanation for why recessions are followed by persistent declines in the employment-population ratio and earnings per capita is a change in worker composition due to differential

[40] We use the 1970 and 1980 censuses for the 1973–1975 recession, the 1980 and 1990 censuses for the 1980–1982 recession, the 1990 and 2000 censuses for the 1990–1991 recession, the 2000 census and 2005–2007 ACS for the 2001 recession, and the 2005–2007 and 2015–2017 ACS for the 2007–2009 recession. Because the variables used are based on the previous calendar year (census) or preceding 12 months (ACS), these changes straddle the periods when recessions occur.

[41] These results do not conflict with our finding that the reduction in the employment-population ratio explains most of the decline in earnings per capita because our analysis of census/ACS data conditions on earnings being positive.

[42] A potential concern is that the census/ACS results in Panels B and C of Table 4 are difficult to compare to the results using BEA data in Panel A because of differences in when outcomes are measured. This issue is of limited importance in practice, as results that use the BEA data for the census/ACS years are very similar to the baseline BEA results, as indicated in Appendix Table 8.

migration responses. For example, if highly educated workers are more likely to leave an area in response to a decline in employment (Bound and Holzer, 2000; Wozniak, 2010; Notowidigdo, 2020), then average wages might fall because of a change in worker composition. Composition shifts are not a threat to our identification strategy, because our unit of analysis is an area rather than an individual, but they are an interesting mechanism to understand.

To quantify the role of composition shifts, we examine changes in residualized earnings. We regress log annual earnings of prime-age workers from the census and ACS on indicators for education (of which there are 11), age (30), sex (2), and race/ethnicity (4), plus interactions between the education indicators and a quartic in age. We estimate these regressions separately for each year and use metro-area averages and percentiles of the residuals as dependent variables in our regressions. Panel D of Table 4 presents results for composition-adjusted wage and salary earnings. The composition-adjusted results tend to be somewhat smaller in magnitude, which indicates that composition shifts partly contribute to the persistent decline in earnings. However, the composition-adjusted estimates are still at least 80 percent as large as the unadjusted ones. This finding suggests that the persistent post-recession declines in average earnings are not primarily driven by changes in worker characteristics correlated with these variables.

The availability of annual population estimates by age from the SEER data allows us to use a complementary approach to explore the role of shifts in the age distribution of residents in each post-recession year. In particular, we predict the average change in the log employment-population ratio due to changes in the age structure by combining estimates of the post-recession evolution of the share of the population age 0–14, 15–24, 25–34, 35–44, 45–54, 55-64, and over 65 with the cross-sectional, pre-recession relationship between the age structure and the log employment-population ratio.[43] The results in Panel A of Appendix Figure 19 show that changes in the age structure predict a decrease in the log employment-population ratio that is equal to 40 percent of the actual long-run decrease. The results for log earnings per capita, which are constructed analogously and shown in Panel B, are similar. Panel C shows that these results arise from a

[43]We cannot use the same set of observed variables in this annual approach as we use with the long difference for the census/ACS data because the annual SEER data lack population counts by education.

decrease in the share of population below age 45.[44] In line with the results using individual-level data on prime-age workers' earnings from the census and ACS, these findings suggest that shifts in the composition of residents explain some, but not all, of the persistent decline in local labor market outcomes after recessions.

5.2.5 Long-Run Results

Our main results follow local labor markets for a dozen years after recession start. Do local areas eventually recover over a longer horizon? Appendix Figures 20 and 21 show that neither employment nor employment-population ratios had recovered by 2019 for *any* recession.

6 A Comparison to Results from the Blanchard and Katz (1992) Model

Our finding that recessions are followed by persistent declines in the employment-population ratio and earnings per capita differs from the well-known results of Blanchard and Katz (1992)—hereafter BK—which imply that the unemployment rate, the labor force participation rate, the employment-population ratio, and wages return to trend within ten years after state-level employment declines. Our empirical strategy is fundamentally similar to BK, in that we both rely on cross-sectional variation in how local areas respond to employment changes. The key difference is that BK, and the many papers which follow their approach, estimate vector autoregressions (VARs) and then calculate impulse response functions, while we estimate regression models that impose no constraints on how coefficients vary across years relative to the recession start. This section explores why our results differ.

To facilitate discussion, we first introduce the BK VAR. The key variables are the annual change in log employment, $\Delta e_{i,t}$, the level of the log employment-labor force ratio, $el_{i,t}$, and the level of the log labor force-working age population ratio, $lp_{i,t}$. BK account for nationwide trends by

[44] Our results are similar to Cajner, Coglianese and Montes (2021) in documenting a decrease in the share of population between ages 25–44 and an increase in the share of population at older ages. There also are some differences: We find a decrease in the share of population ages 15–24, while their results suggest a slight increase. Given the differences in the unit of analysis, methodology, and source of identifying variation, we see the results on the relative responses of different age groups as being quite consistent with each other.

differencing out the same variables for the aggregate U.S. economy. They estimate the following recursive VAR using state-level data from 1976–1990:

$$\Delta e_{i,t} = \alpha_{i10} + \alpha_{11}(L)\Delta e_{i,t-1} + \alpha_{12}(L)el_{i,t-1} + \alpha_{13}(L)lp_{i,t-1} + \epsilon_{i,e,t}, \tag{4}$$

$$el_{i,t} = \alpha_{i20} + \alpha_{21}(L)\Delta e_{i,t} + \alpha_{22}(L)el_{i,t-1} + \alpha_{23}(L)lp_{i,t-1} + \epsilon_{i,el,t}, \tag{5}$$

$$lp_{i,t} = \alpha_{i30} + \alpha_{31}(L)\Delta e_{i,t} + \alpha_{32}(L)el_{i,t-1} + \alpha_{33}(L)lp_{i,t-1} + \epsilon_{i,lp,t}. \tag{6}$$

BK include two lags of each explanatory variable, along with state fixed effects $\alpha_{i10}, \alpha_{i20}$, and α_{i30}. After estimating these equations (which can be done using three separate OLS regressions), BK construct the impulse response functions (IRFs) of each variable with respect to a 1 percent decrease in employment (i.e., a reduction in $\epsilon_{i,e,t}$ of 0.01).[45] Primary interest lies in these IRFs, which are constructed using only the coefficients in equations (4)–(6).

Figure 7 shows IRFs of log employment, the "unemployment rate" (one minus the log employment-labor force ratio), the log participation rate, and log population. We use BLS data from 1976–1990 to generate these results, which are extremely similar to Figure 7 of BK.[46] Notably, the unemployment rate and participation rate completely recover within eight years.

Our preferred unit of geography is a metropolitan area. When using substate areas, reliable data on labor force participation are available for a limited time period at best.[47] Consequently, the most comparable outcome is the employment-population ratio. The IRF of the log employment-population ratio can be constructed as the sum of the IRFs of the log employment-labor force ratio and the log labor force-population ratio. Panel B of Figure 7 shows this IRF from the BK model. As expected given the results in Panel A, the IRF shows complete recovery of the employment-

[45] Because this is a recursive VAR, there is a natural unit of measurement for $\epsilon_{i,e,t}$. In contrast, a structural VAR does not feature this property (see, e.g., Stock and Watson, 2001).

[46] We follow BK in measuring employment using the BLS Current Employment Statistics. We also follow the same approach as BK in using the BLS Local Area Unemployment Statistics (LAUS; Bureau of Labor Statistics (1976–2019*c*)) to measure the number of individuals that are unemployed or not in the labor force, and then constructing population as the sum of employment, unemployment, and not in labor force counts.

[47] The BLS provides county-level labor force estimates from 1990 onward. A separate series contains county-level labor force estimates from 1976–1989, but the BLS stresses that this series is "unofficial" and not comparable to the 1990-forward series. Both data sets rely substantially on extrapolations from statistical models, as household surveys are not large enough to reliably measure unemployment and labor force for most counties.

population ratio.

To facilitate the analysis below, we simplify the BK model in two ways. First, we estimate a two-equation VAR in first differences of log employment and levels of the log employment-population ratio, $ep_{i,t}$. Second, we include only one lag of each variable. The resulting VAR is:

$$\Delta e_{i,t} = \tilde{\alpha}_{i10} + \tilde{\alpha}_{11}\Delta e_{i,t-1} + \tilde{\alpha}_{12} ep_{i,t-1} + \tilde{\epsilon}_{i,e,t}, \tag{7}$$

$$ep_{i,t} = \tilde{\alpha}_{i20} + \tilde{\alpha}_{21}\Delta e_{i,t} + \tilde{\alpha}_{22} ep_{i,t-1} + \tilde{\epsilon}_{i,ep,t}. \tag{8}$$

These simplifying assumptions have little impact on the estimated IRF of the log employment-population ratio, as shown in Panel B of Figure 7.

Equations (7) and (8) permit simpler expressions of the IRF in terms of the underlying parameters. Consider a one-time change in log employment in period t through $\tilde{\epsilon}_{i,e,t}$. The subsequent impacts on the log employment-population ratio in periods t through $t+2$ are:

$$\frac{dep_{i,t}}{d\tilde{\epsilon}_{i,e,t}} = \tilde{\alpha}_{21}, \tag{9}$$

$$\frac{dep_{i,t+1}}{d\tilde{\epsilon}_{i,e,t}} = \tilde{\alpha}_{21}^2\tilde{\alpha}_{12} + \tilde{\alpha}_{21}\tilde{\alpha}_{11} + \tilde{\alpha}_{21}\tilde{\alpha}_{22}, \tag{10}$$

$$\frac{dep_{i,t+2}}{d\tilde{\epsilon}_{i,e,t}} = \tilde{\alpha}_{21}^3\tilde{\alpha}_{12}^2 + 2\tilde{\alpha}_{21}^2\tilde{\alpha}_{11}\tilde{\alpha}_{12} + 2\tilde{\alpha}_{21}^2\tilde{\alpha}_{22}\tilde{\alpha}_{12} + \tilde{\alpha}_{21}\tilde{\alpha}_{11}^2 + \tilde{\alpha}_{21}\tilde{\alpha}_{22}^2 + \tilde{\alpha}_{21}\tilde{\alpha}_{11}\tilde{\alpha}_{22}. \tag{11}$$

Similar expressions exist for the IRF at later horizons, but these first few periods are adequate to highlight some important takeaways. First, bias in the OLS estimates of equations (7) and (8) can generate bias in the IRF, because the IRF is a function of the coefficients in these equations. Second, bias in the IRF can increase in importance over time. For example, if the OLS estimates are attenuated, this bias generates an IRF that can converge towards zero even if the true IRF does not. This arises because the exponents in the IRF and the interactions between parameters increase with time, potentially magnifying bias.[48]

[48]More generally, if $a \in (0, 1)$ is an attenuation factor, then $(ax)^t$ converges to zero faster than x^t.

The potential for finite sample bias in autoregressive models, including VARs, has long been recognized (e.g., Hurwicz, 1950; Shaman and Stine, 1988; Stine and Shaman, 1989; Pope, 1990; Lucas, 1992; Kilian, 1998, 1999; Kilian and Lütkepohl, 2017).[49] This bias arises because residuals are not independent of all regressors in an autoregression, since regressors are lagged dependent variables.[50]

To explore this issue further, we conduct a Monte Carlo study of finite sample bias. We focus on a data generating process (DGP) where a decrease in employment leads to a persistent reduction in the employment-population ratio. We do not argue that this is the true DGP. Instead, this exercise illustrates how the BK VAR can fail to estimate a persistent decline in the employment-population ratio when one is actually present. For the Monte Carlo exercise we assume that log employment is a random walk:

$$e_{i,t} = e_{i,t-1} + \varepsilon_{i,e,t}, \tag{12}$$

and that log population depends on changes in log employment as follows:

$$p_{i,t} = p_{i,t-1} + (1-\phi)\Delta e_{i,t} + \varepsilon_{i,p,t}. \tag{13}$$

This implies that the log employment-population ratio is:

$$ep_{i,t} = ep_{i,t-1} + \phi\Delta e_{i,t} - \varepsilon_{i,p,t}. \tag{14}$$

In terms of equations (7) and (8), this DGP sets $\tilde{\alpha}_{i10} = \tilde{\alpha}_{i20} = 0$ (state fixed effects do not matter), $\tilde{\alpha}_{11} = \tilde{\alpha}_{12} = 0$ (log employment is a random walk), $\tilde{\alpha}_{21} = \phi$, and $\tilde{\alpha}_{22} = 1$. Changes in log

[49]Kilian (1998, 1999) specifically addresses bias in impulse responses. The methods discussed in these papers allow for bias-corrected confidence intervals of impulse responses, but we focus on point estimates here for simplicity. In general, "there is no consensus in the literature that impulse responses should be estimated based on bias-adjusted slope parameters rather than the original [least squares] estimates" (Kilian and Lütkepohl, 2017, p. 37).

[50]In his discussion of BK, Lucas (1992) raises a concern about finite sample bias, but speculates that such bias does not drive BK's conclusions. Amior and Manning (2018) theorize that the limited number of lags in the BK model could explain why BK find faster recovery than Amior and Manning (2018). Bias caused by a limited number of time periods—which we explore here—is distinct from whether the VAR has the appropriate lag structure.

employment have a permanent effect on the log employment-population ratio, with the true IRF equal to ϕ at all horizons.[51]

We calibrate the DGP using state-level LAUS data. We assume that all variables are distributed normally. The first period mean and variance of $e_{i,t}$ and $p_{i,t}$ equal those observed in the 1976 LAUS data, and the variances of $\varepsilon_{i,e,t}$ and $\varepsilon_{i,p,t}$ approximate the variance of log employment and population in subsequent years.[52] We focus on the case where $\phi = 0.75$, with 50 cross-sectional observations and different time-series lengths, T. We study the response to a decrease in $\varepsilon_{i,e,t}$ as in BK.

Panel A of Figure 8 plots the true IRF for the employment-population ratio along with average estimates of the IRF across 499 Monte Carlo simulations. The true IRF reveals a persistent decrease in the employment-population ratio following a one-time decrease in employment. For $T = 15$, which is approximately the number of years available to BK when they wrote their paper, finite sample bias leads to rapid recovery of the employment-population ratio. Ten years after the shock, the IRF estimate is downward-biased (in absolute value) by 89 percent. This bias remains very large for $T = 25$ and $T = 50$. Because previous work on local labor markets uses annual data, the relevant value of T ranges from 15 to 50. For $T = 100$ the bias remains sizable, at 25 percent one decade after the shock. Even for $T = 500$, finite sample bias incorrectly implies a gradual recovery.[53] The bias stems from an insufficient number of time series observations, so instrumental variables, which rely on asymptotic consistency, do not solve this problem in general. Indeed, we find that a sufficiently strong instrumental variable (as has been used in previous work) generates nearly identical results in our DGP (in which an instrument is not needed to obtain consistent estimates).

Finite sample bias also affects the estimated IRFs for other variables in the VAR, as shown in Appendix Figure 25. In the simplified version of the BK VAR, finite sample bias incorrectly

[51]The true IRF for employment is 1, and the true IRF for population is $1 - \phi$.

[52]In particular we set $e_{i,0} \sim \mathcal{N}(13.88, 1.03^2)$, $p_{i,0} \sim \mathcal{N}(14.43, 1.05^2)$, $\varepsilon_{i,e,t} \sim \mathcal{N}(0, 0.015^2)$, and $\varepsilon_{i,p,t} \sim \mathcal{N}(0, 0.015^2)$.

[53]Appendix Table 9 reports the underlying bias in estimates of the parameters of equations (7) and (8) for various values of T. All parameters are biased. While this bias is modest in many cases, it is amplified in the IRF. The IRF bias is of primary interest, because the IRF is used to quantify the extent of recovery.

implies too small of a decline in employment and too large of a decline in population. Finite sample bias for the employment-population ratio is more severe than for employment because the IRF for the employment-population ratio depends on more parameters, each of which suffers from finite sample bias.[54] The opposite sign of the bias for population is a result of the structure of the VAR.[55]

Regressions that mirror our preferred specification in equation (1) do not suffer from finite sample bias due to small T in this setting. To show this, we use the same DGP and estimate the following regression:

$$ep_{i,t} - ep_{i,0} = -1 \times \Delta e_i \delta_t + \beta_t + \varepsilon_{i,t}, \tag{15}$$

where the change in log employment Δe_i occurs between years 0 and 1, we multiply this change by -1 to mirror our analysis elsewhere, and β_t is a year fixed effect. To be consistent with the VAR IRFs, we normalize the coefficient $\delta_0 = 0$. This is the direct analog of equation (1). Under this DGP, we have $\delta_t = -0.75$ for all years $t \geq 1$. Hence, the true values of the coefficient δ_t and the IRF for the employment-population ratio coincide for all years after the measured log employment change. Panel B of Figure 8 shows that there is no systematic bias in estimates of δ_t, regardless of T.[56]

In sum, finite sample bias can lead the BK VAR to find evidence of recovery when there is none. The regressions that we estimate are not subject to this finite sample bias in empirically relevant DGPs. We believe this is the main explanation for why we find widespread evidence of persistent declines in employment-population ratios and earnings per capita, while papers estimating the BK

[54]For example, the IRFs of employment ($e_{i,t}$) and the employment-population ratio ($ep_{i,t}$) in the first period are $de_{i,t}/d\tilde{\epsilon}_{i,e,t} = 1$ and $dep_{i,t}/d\tilde{\epsilon}_{i,e,t} = \tilde{\alpha}_{21}$. There is no bias in the first-period IRF for employment, but there is bias for the employment-population ratio. In the second period, the IRFs for employment and the employment-population ratio are $de_{i,t+1}/d\tilde{\epsilon}_{i,e,t} = 1 + \tilde{\alpha}_{11} + \tilde{\alpha}_{12}\tilde{\alpha}_{21}$ and $dep_{i,t+1}/d\tilde{\epsilon}_{i,e,t} = \tilde{\alpha}_{21}^2\tilde{\alpha}_{12} + \tilde{\alpha}_{21}\tilde{\alpha}_{11} + \tilde{\alpha}_{21}\tilde{\alpha}_{22}$. This pattern holds generally and is the result of employment being the key "shock" variable in the VAR system.

[55]In the BK VAR, the IRF for population is inferred from the response of the other variables. In the simplified version of the BK model, the IRF for population equals the IRF for employment minus the IRF for the employment-population ratio. As a result, the greater bias in the IRF for the employment-population ratio implies that the population IRF is biased in the opposite direction of the employment IRF.

[56]This Monte Carlo exercise does not rule out other potential sources of bias when estimating equation (1), but we prefer to explore those issues using actual data.

VAR generally do not.[57] To be clear, we do not claim that all VARs are incapable of identifying persistent changes. However, finite sample bias is evident in DGPs that are relevant for VARs estimated in previous work on local labor markets.

7 Conclusion

Studying recessions over the course of 50 years, this paper shows that local employment losses that emerge during recessions are followed by long-lasting relative declines in employment, population, employment-population ratios, and earnings per capita. These patterns are consistent with harder-hit areas facing a persistent decline in labor demand relative to other areas, with labor supply being insufficiently responsive to restore pre-recession employment-population ratios and wages. One explanation for why these results have not been shown before is that an influential approach in the literature—estimating vector autoregressions and calculating impulse response functions as in Blanchard and Katz (1992)—can incorrectly find convergence after a persistent decline in local employment because of finite sample bias. In contrast, the regressions that we estimate do not suffer from this bias.

Cross-sectional variation in recession severity allows us to estimate relative changes by comparing local labor markets that experience a more versus less severe recession. This variation, however, does not allow us to identify absolute changes in local economic activity following recessions (e.g., Nakamura and Steinsson, 2014). Nonetheless, the persistent relative changes we find raise the concern that the capabilities of workers in some areas remain underutilized. This "direct effect" could lower aggregate output. At the same time, there could be an offsetting "indirect effect" if recessions reallocate employment to more productive areas. We examine this possibility through simple back-of-the-envelope calculations, described in Appendix B.5, and find no evidence of such productivity-enhancing reallocation. Fully assessing the impacts of persistent local labor market declines on aggregate output requires additional assumptions about the counterfactual

[57] Appendix B.4 describes additional results which show that differences in the sample, time period, and level of geography do not explain why we find a persistent decrease in the employment-population ratio while the prior literature estimating BK VARs finds evidence of complete recovery.

evolution of economic activity in the absence of recessions, which we leave for future work.

Irrespective of the aggregate consequences of local labor market declines following recessions, our findings have important implications for labor market dynamism, the economic opportunities of workers and their children, and optimal policy responses. Our results show that recessions are followed by a sizable reallocation of employment across space. Local areas that experience more severe recessions see a persistent decline in employment across all sectors. At the same time, we find reductions in both in-migration and out-migration after local employment losses, which suggests that individuals are limited in their ability or willingness to move across areas to equilibrate shifts in labor demand. Moreover, the persistent decrease in local economic activity limits the opportunities available to both adults and children in these places. In response to these changes, investments in job creation and skill development could play an important role in boosting local economic activity. Such policies also could forestall the associated reduction in economic mobility for children (Stuart, 2022). Currently, the vast majority of policy responses to recessions focus on short-term conditions. Our results imply that additional consideration should be paid to recessions' long-term consequences.

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Table 1: Aggregate Employment Changes, by Recession

	Share of peak year emp. (1)	Log emp. change (2)	Emp. change (3)	Share of peak year emp. (4)	Log emp. change (5)	Emp. change (6)	Share of peak year emp. (7)	Log emp. change (8)	Emp. change (9)
	1973–1975 Recession			1980–1982 Recession			1990–1991 Recession		
Total	1.000	0.004	421,100	1.000	0.010	1,123,200	1.000	0.011	1,531,000
Manufacturing	0.216	−0.090	−1,758,600	0.196	−0.110	−2,230,100	0.150	−0.049	−962,800
Services	0.203	0.053	1,041,400	0.220	0.103	2,606,900	0.276	0.060	2,264,500
Government	0.177	0.046	792,000	0.168	0.008	149,000	0.156	0.023	493,000
Retail Trade	0.159	0.010	153,300	0.161	0.020	359,600	0.168	0.005	110,800
Finance, Insurance, Real Estate	0.076	0.027	192,700	0.079	0.037	322,200	0.080	−0.014	−146,000
Transportation and Public Utilities	0.054	−0.018	−91,400	0.052	0.003	17,400	0.048	0.034	220,600
Construction	0.054	−0.084	−410,000	0.054	−0.096	−536,900	0.054	−0.065	−451,500
Wholesale Trade	0.048	0.073	341,800	0.052	0.008	44,900	0.050	−0.012	−76,200
Mining	0.008	0.140	114,100	0.011	0.264	350,800	0.008	−0.025	−26,000
Agriculture, Forestry, Fisheries	0.006	0.073	45,800	0.008	0.043	39,400	0.010	0.077	104,600
								Pooled log emp. change	
	2001 Recession			2007–2009 Recession				Mean	Std. Dev.
Total	1.000	−0.000	−62,700	1.000	−0.034	−5,866,000		−0.002	0.017
Manufacturing	0.109	−0.120	−2,004,900	0.082	−0.147	−1,982,600		−0.103	0.033
Services	0.409	0.022	1,504,500	0.432	−0.012	−886,900		0.045	0.038
Government	0.141	0.027	638,000	0.137	0.018	452,000		0.025	0.013
Retail Trade	0.114	−0.015	−268,300	0.107	−0.064	−1,171,600		−0.009	0.030
Finance, Insurance, Real Estate	0.082	0.019	260,100	0.094	0.025	426,900		0.019	0.017
Construction	0.059	0.013	128,500	0.064	−0.190	−1,975,100		−0.084	0.065
Transportation and Public Utilities	0.038	−0.022	−133,000	0.037	−0.061	−385,500		−0.013	0.031
Wholesale Trade	0.039	−0.027	−169,900	0.037	−0.070	−443,300		−0.006	0.047
Mining	0.005	−0.012	−9,000	0.006	0.107	114,300		0.095	0.106
Agriculture, Forestry, Fisheries	0.005	−0.010	−8,700	0.005	−0.017	−14,200		0.033	0.040

Notes: Table reports nationwide wage and salary employment changes during recessions. Employment changes are from 1973–1975, 1979–1982, 1989–1991, 2000–2002, and 2007–2009. The 1973–1991 data are based on SIC industries, and the 2000–2009 data are based on NAICS industries. Industry changes may not sum to total changes due to rounding. The bottom right panel shows means and standard deviations of log employment changes across the five recessions.
Source: Authors' calculations using Bureau of Economic Analysis Regional Economic Accounts (BEAR) data.

Table 2: Correlation of Metropolitan Area Recession Severity

	Change in Log Employment During Recession Years				
	1973–75	1979–82	1989–91	2000–02	2007–09
Panel A: Unadjusted					
1973–75	1.000				
1979–82	0.386	1.000			
1989–91	0.459	0.154	1.000		
2000–02	0.446	0.412	0.281	1.000	
2007–09	0.354	0.210	0.002	0.155	1.000
Panel B: Adjusted for Census division					
1973–75	1.000				
1979–82	0.327	1.000			
1989–91	0.275	0.170	1.000		
2000–02	0.291	0.304	0.234	1.000	
2007–09	0.363	0.071	−0.044	0.091	1.000
Panel C: Adjusted for Census division and pre-recession population growth					
1973–75	1.000				
1979–82	0.258	1.000			
1990–91	0.161	0.018	1.000		
2000–02	0.144	0.084	0.098	1.000	
2007–09	0.400	0.279	0.050	0.212	1.000

Notes: Table reports correlations of log wage and salary employment changes across recessions for 358 metropolitan areas. Panel B reports correlations after partialling out Census division fixed effects, and Panel C partials out Census division fixed effects and pre-recession population growth.
Source: Authors' calculations using BEAR data.

Table 3: Characteristics of Metropolitan Areas with More versus Less Severe Recessions

	Recession					
	1973–75		1980–82		1990–91	
Pre-recession characteristic	Less Severe	More Severe	Less Severe	More Severe	Less Severe	More Severe
Manufacturing emp. share	0.141	0.254	0.140	0.236	0.131	0.179
Mining emp. share	0.013	0.004	0.013	0.005	0.013	0.005
Construction emp. share	0.052	0.051	0.058	0.051	0.055	0.053
Finance, insurance, real estate emp. share	0.062	0.059	0.073	0.063	0.068	0.065
Population (1000s)	333.1	595.4	552.9	430.6	329.8	768.2
Log population growth	0.090	0.066	0.247	0.108	0.137	0.078
Employment-population ratio	0.518	0.537	0.534	0.547	0.546	0.579
Real earnings per capita (1000s)	19.7	21.0	21.5	23.2	23.5	26.4
Share with BA degree or more	0.120	0.096	0.172	0.142	0.195	0.183
Nonwhite share	0.145	0.133	0.209	0.122	0.189	0.188
Foreign-born share	0.029	0.027	0.048	0.028	0.045	0.043

	Recession			
	2001		2007–09	
Pre-recession characteristic	Less Severe	More Severe	Less Severe	More Severe
Manufacturing emp. share	0.096	0.163	0.082	0.110
Mining emp. share	0.008	0.003	0.008	0.002
Construction emp. share	0.059	0.056	0.060	0.067
Finance, insurance, real estate emp. share	0.066	0.064	0.073	0.079
Population (1000s)	531.6	732.4	618.7	744.7
Log population growth	0.162	0.096	0.091	0.117
Employment-population ratio	0.591	0.632	0.612	0.585
Real earnings per capita (1000s)	28.3	32.7	34.1	33.5
Share with BA degree or more	0.229	0.220	0.260	0.240
Nonwhite share	0.257	0.203	0.274	0.277
Foreign-born share	0.081	0.048	0.068	0.081

Notes: Industry employment shares, population, employment-population ratio, and real earnings per capita are measured two years before the recession start year. The last three variables are measured as of the closest decennial census to the recession start year, except for the 2007–2009 recession, which is measured from the 2005–2009 ACS. Population growth is from 1969 to 1973 for the 1973-1975 recession and over the ten years before the recession start for the other episodes. We define an area as experiencing a more severe recession if its log employment change for a given recession is less than the median across the 358 CBSAs for that recession.

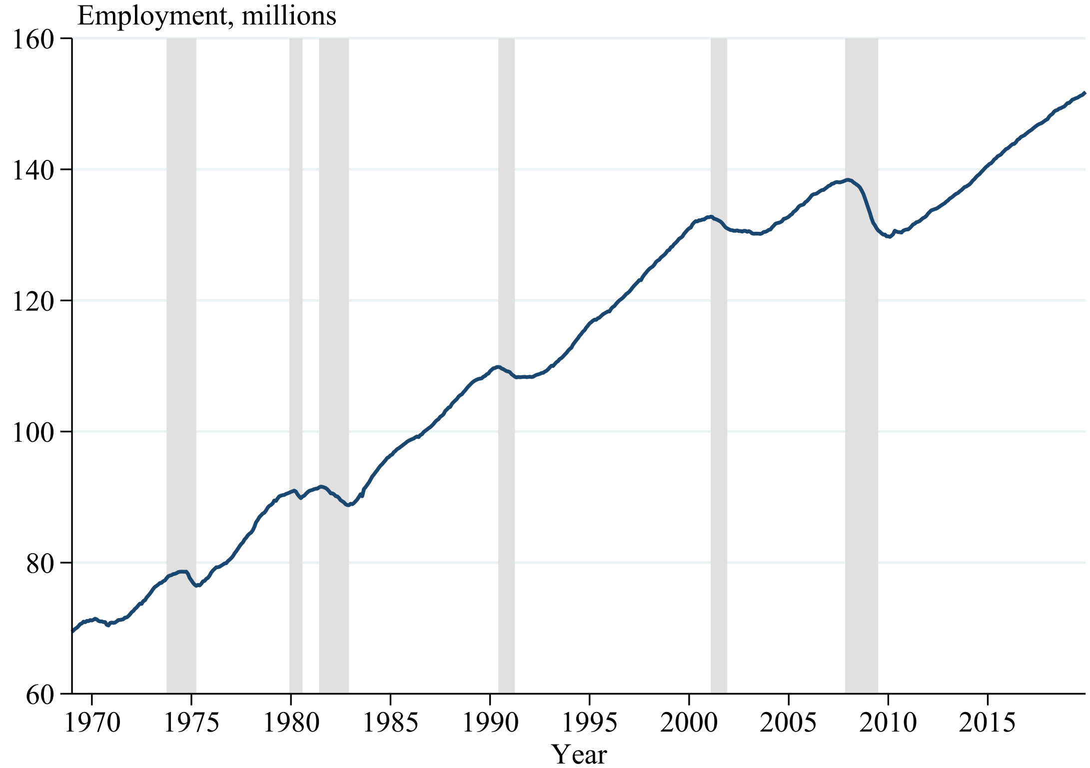
Source: Authors' calculations of data from BEAR, decennial censuses and American Community Surveys (via IPUMS and NHGIS), and Surveillance, Epidemiology, and End Results (SEER).

Table 4: Summary of Changes in Metropolitan Area Economic Activity, 7–9 Years After Business Cycle Trough

Dependent variable	Coefficient on log employment decrease (1)	Implied change from 1 SD decrease in log employment (2)
Panel A: Dependent Variables from BEAR and SEER		
Log employment	−1.141	−0.066
	(0.072)	
Log population age 15+	−0.577	−0.033
	(0.049)	
Log employment-population ratio	−0.564	−0.033
	(0.056)	
Log earnings per capita	−0.893	−0.052
	(0.078)	
Log earnings per worker	−0.329	−0.019
	(0.039)	
Panel B: Log Annual Earnings, Without Composition Adjustment		
Average log earnings	−0.394	−0.023
	(0.055)	
10th percentile, log earnings	−0.637	−0.037
	(0.105)	
50th percentile, log earnings	−0.350	−0.020
	(0.053)	
90th percentile, log earnings	−0.219	−0.013
	(0.040)	
Panel C: Weekly and Hourly Earnings		
Average log weekly earnings	−0.347	−0.020
	(0.046)	
Average log hourly earnings	−0.307	−0.018
	(0.042)	
Panel D: Log Annual Earnings, With Composition Adjustment		
Average log earnings	−0.338	−0.020
	(0.048)	
10th percentile, log earnings	−0.518	−0.030
	(0.101)	
50th percentile, log earnings	−0.301	−0.017
	(0.041)	
90th percentile, log earnings	−0.261	−0.015
	(0.035)	

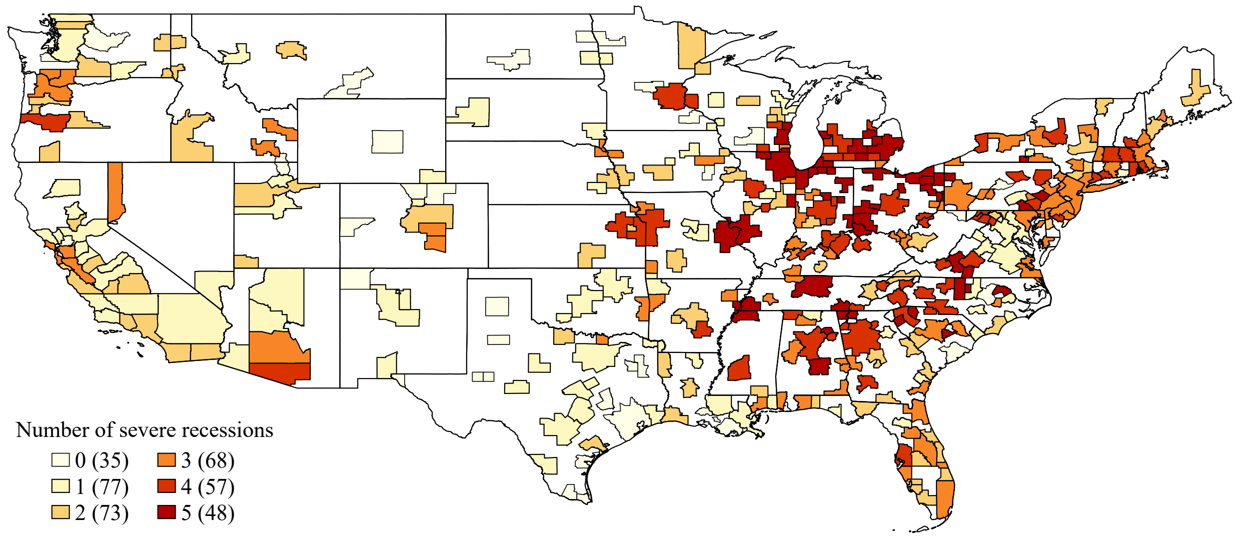
Notes: Table reports estimates of equation (1). Column 1 reports the point estimate and standard error, and column 2 contains the point estimate multiplied by the standard deviation of the log employment change during a recession (0.058). The dependent variable is indicated in the row. In Panel A, the dependent variable is constructed as the change relative to two years before the nationwide business cycle peak, and we report the pooled coefficient for years 7–9 after the business cycle trough. In Panels B–D, the dependent variable is constructed as the change between pre-recession and post-recession years (1970 to 1980, 1980 to 1990, 1990 to 2000, 2000 to 2005–2007, and 2005–2007 to 2015–2017). The underlying sample for Panels B–D is limited to individuals age 25–54 and then collapsed to 358 metropolitan areas. The dependent variables in Panel D are constructed using residuals from regressing log earnings on indicators for education, age, sex, and race/ethnicity (White/Black/Hispanic/other), plus interactions between the education indicators and a quartic in age. The key independent variable is the change in log wage and salary employment during the recession from BEAR data. All regressions control for division-year fixed effects and interactions between pre-recession population growth and year indicators. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area.
Source: Authors' calculations using BEAR, SEER, decennial census, and ACS data.

Figure 1: Aggregate Employment and Recessions, 1969–2019



Notes: Figure shows seasonally adjusted national nonfarm employment. The shading indicates NBER national recession dates.
Source: Authors' calculations using Bureau of Labor Statistics Current Employment Statistics.

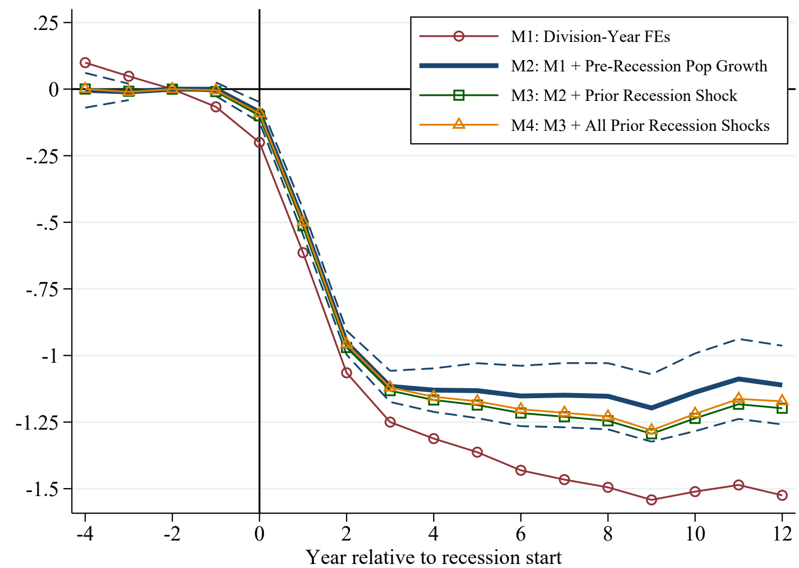
Figure 2: Frequency of Severe Recessions, by Metropolitan Area, from 1973–2009



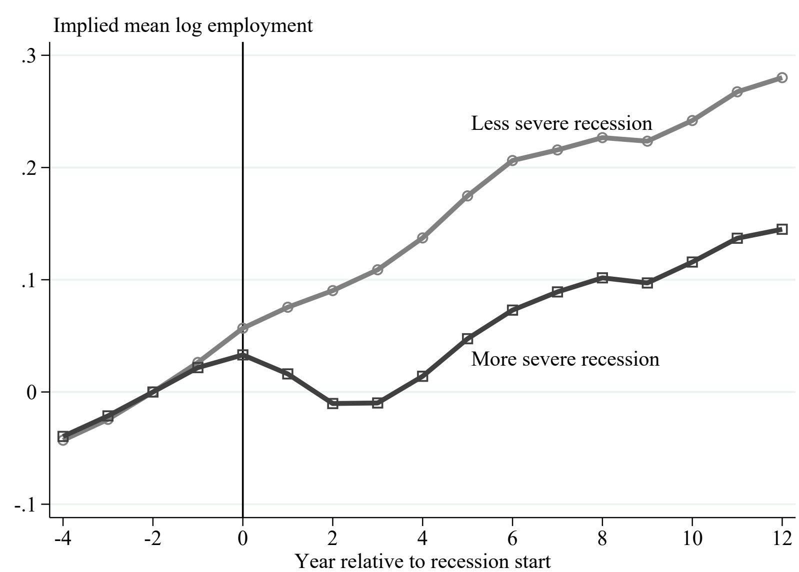
Notes: We define an area as experiencing a severe recession if its log employment change for a given recession is less than the median across the 358 metropolitan areas for that recession.
Source: Authors' calculations from BEAR.

Figure 3: The Evolution of Metropolitan Area Log Employment After Recessions

(a) Event Study Coefficients

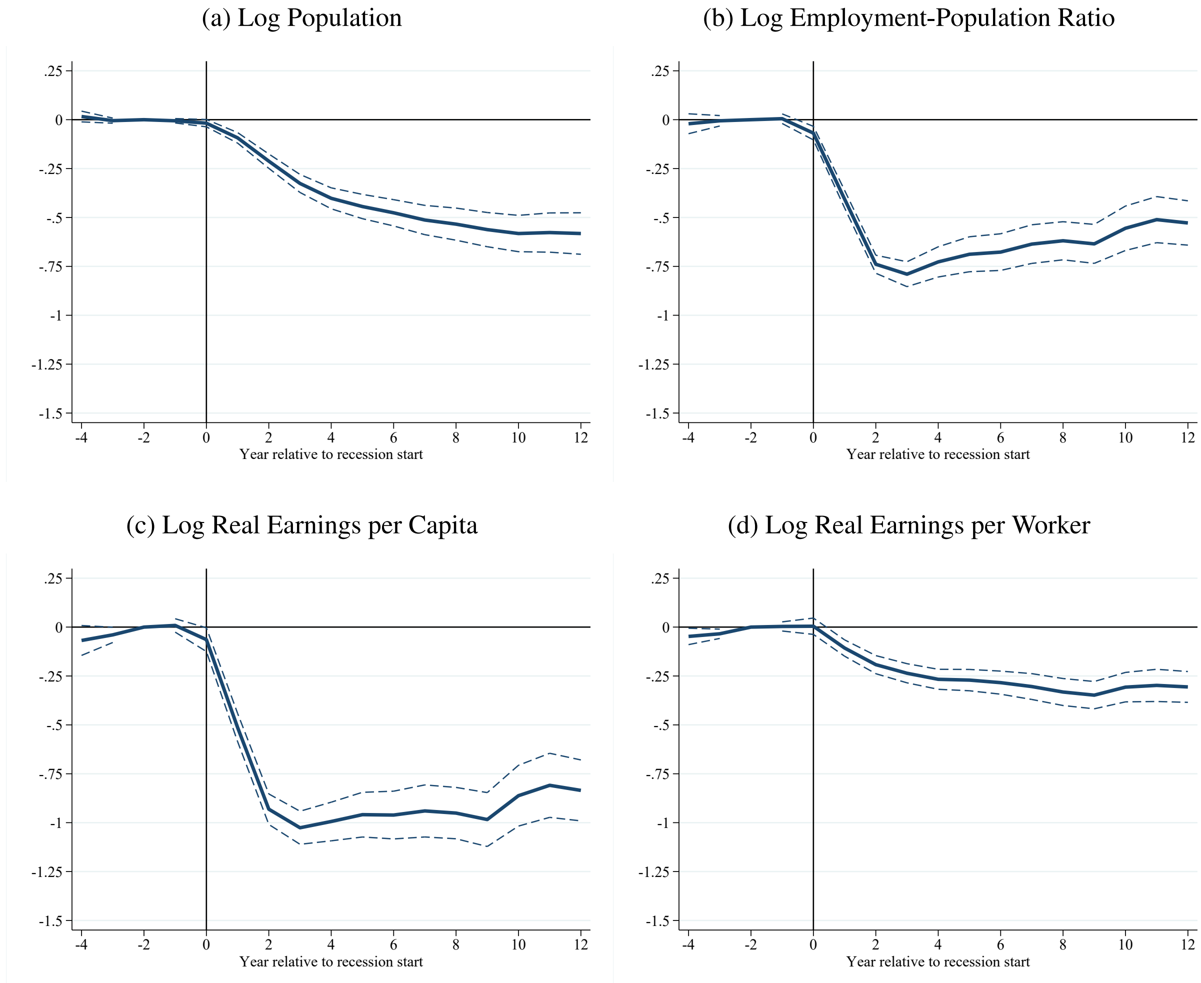


(b) Absolute Changes: Implied Conditional Means



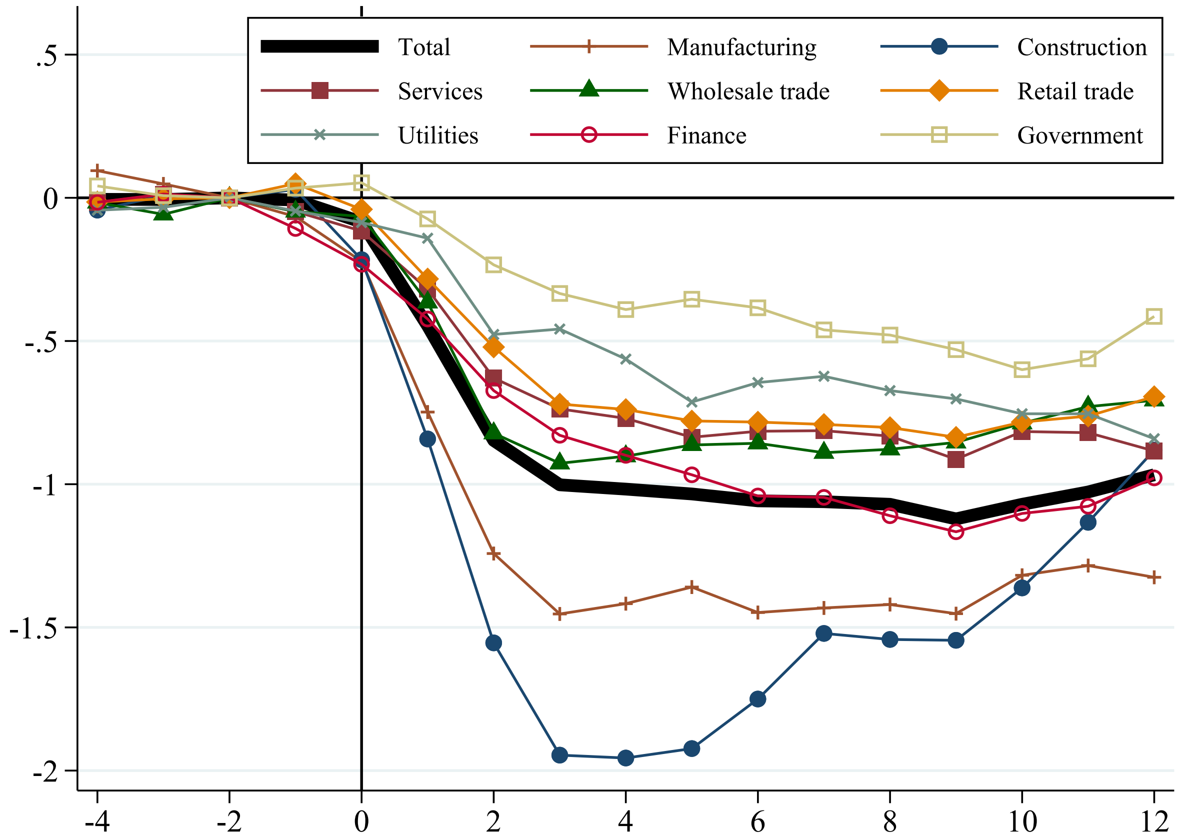
Notes: Panel A reports estimates of equation (1). The dependent variable is log wage and salary employment from BEAR data, and the key independent variable is the change in log wage and salary employment during the recession from BEAR data. Specifications are indicated by the legend. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area. In Panel B, we use estimates of specification 2 to construct mean log employment for metropolitan areas with a more versus less severe recession (based on whether the log employment change is greater than or less than the median log employment change during the recession), holding all other covariates in the regression at their mean value. These conditional means are normalized to equal zero two years before the recession start. The average log employment change during the recession in the less severe recession group is 3.7 percent, and the average change in the more severe recession group is -4.9 percent.
Source: Authors' calculations using BEAR and SEER data.

Figure 4: The Evolution of Metropolitan Area Log Population, Log Employment-Population Ratio, Log Real Earnings per Capita, and Log Real Earnings per Worker After Recessions



Notes: Figure reports estimates of equation (1) for specification 2. The dependent variable is log population age 15 and above in Panel A, the log ratio of wage and salary employment to population age 15 and above in Panel B, log real earnings per capita (age 15+) in Panel C, and log real earnings per worker in Panel D. See notes to Figure 3.
Source: Authors' calculations using BEAR and SEER data.

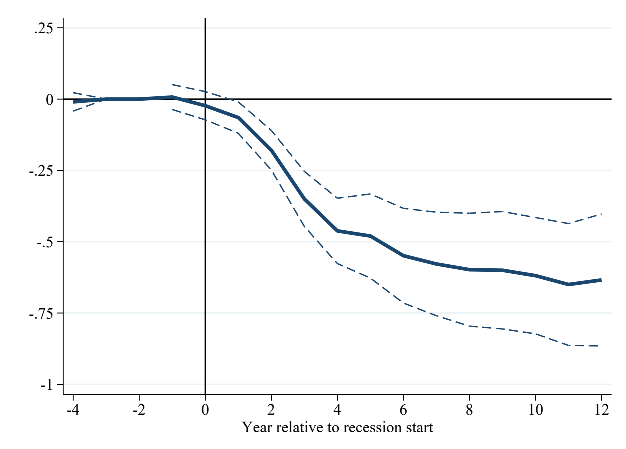
Figure 5: The Evolution of Metropolitan Area Log Employment by Sector After Recessions



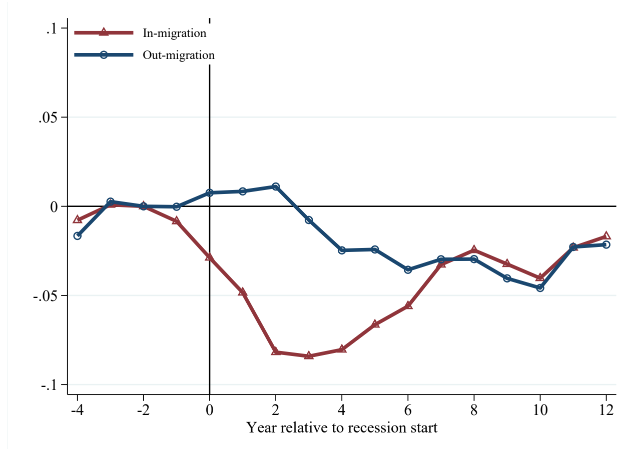
Notes: Figure reports estimates of equation (1) for specification 2. The dependent variable is log employment from the indicated sector. We use BEAR data for the 1973–1975, 1980–1982, 1990–1991, and 2007–2009 recessions. We use QCEW data for the 2001 recession (due to SIC-NAICS industry seaming issues), except for government, which comes from BEAR. See notes to Figure 3.
Source: Authors' calculations using BEAR, SEER, and QCEW data.

Figure 6: The Evolution of Metropolitan Area In-Migration and Out-Migration After Recessions

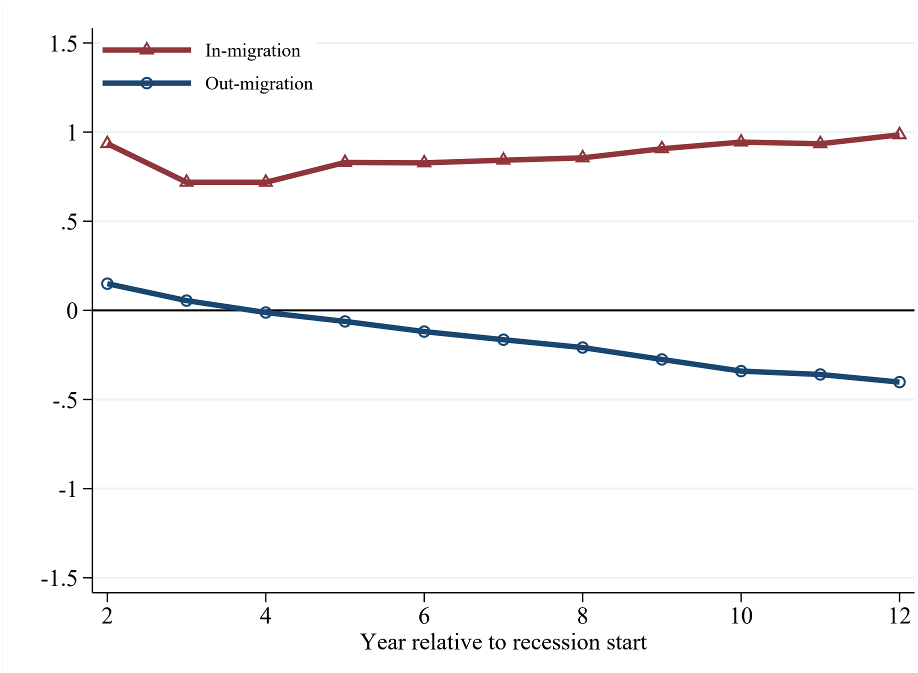
(a) DV: Population



(b) DV: In-Migration and Out-Migration



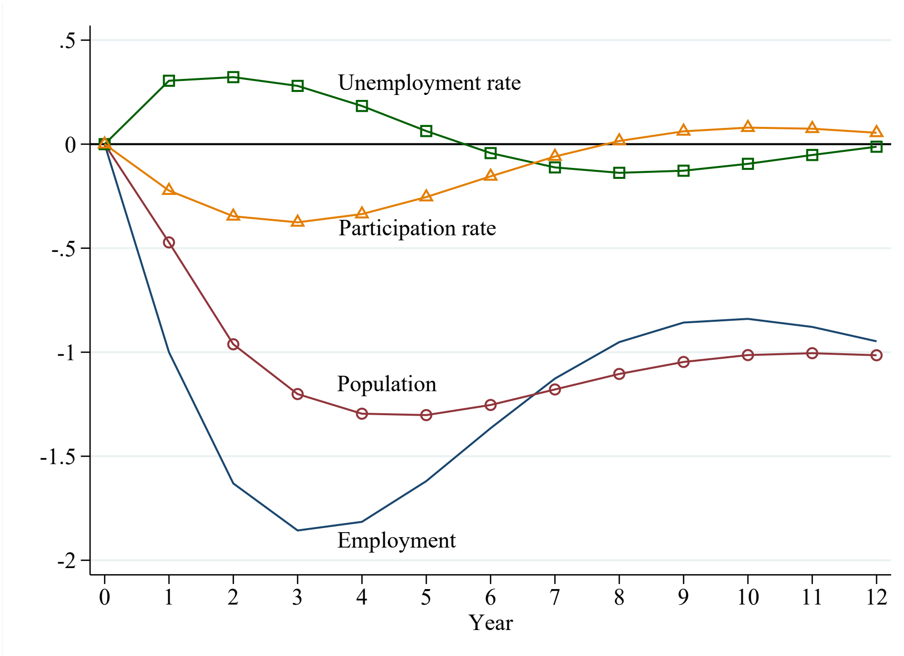
(c) Share of Total Change Due to In-Migration and Out-Migration



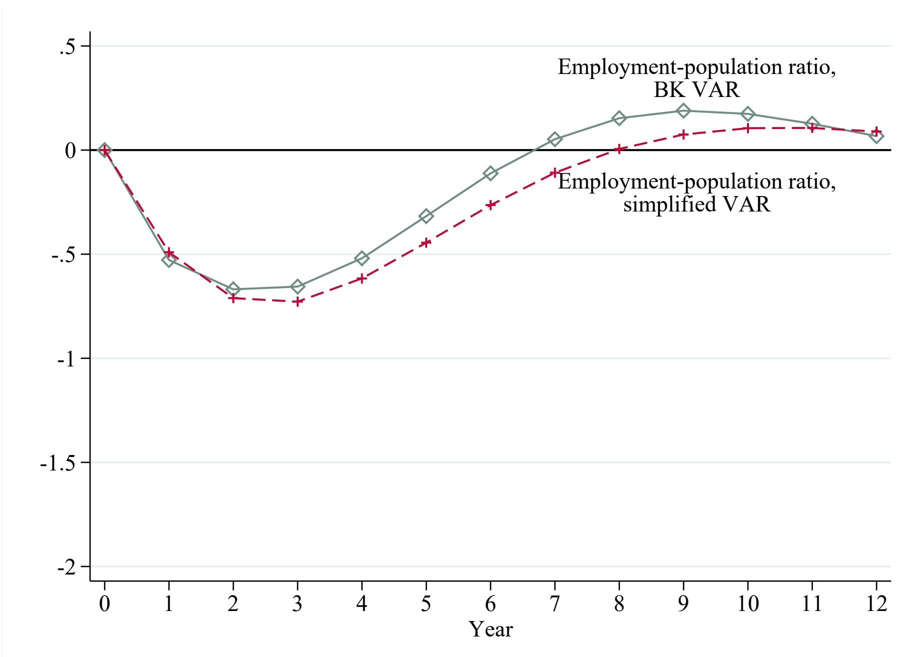
Notes: Figure reports results that stack the 2001 and 2007–2009 recessions and estimate a variant of equation (1) in which the dependent variable is the outcome in year t and we control for interactions between recession-specific year fixed effects and in-migration, out-migration, and net birth rates in year $p(r) - 2$. This approach facilitates an exact decomposition using the regression coefficients (including net births, which we do not show for brevity). In Panel A, the dependent variable is the number of exemptions in year t divided by the same variable in year $p(r) - 2$. In Panel B, the dependent variables are in-migration and out-migration relative to the number of exemptions in year $p(r) - 2$. In Panel C, we divide cumulative sums of the coefficients from Panel B by the coefficients in Panel A; we multiply the out-migration coefficient by -1 so that a positive number indicates that a given population component contributes to the post-recession population decline. Regressions also include specification 2 controls described in the notes to Figure 3.
Source: Authors' calculations using CBP, BEAR, and SOI data.

Figure 7: Impulse Response Functions to Negative Log Employment Shock from Vector Autoregressions

(a) Results from Blanchard and Katz (1992) Model



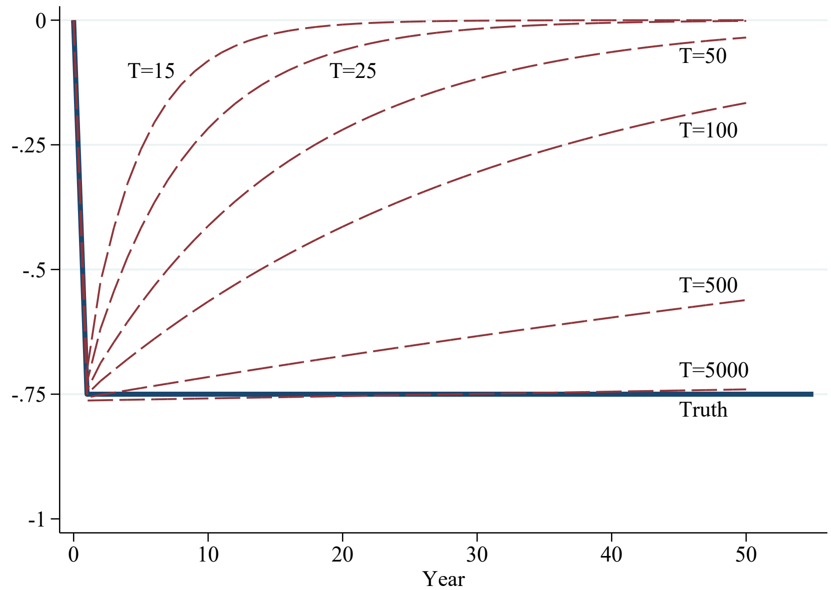
(b) Employment-Population Ratio



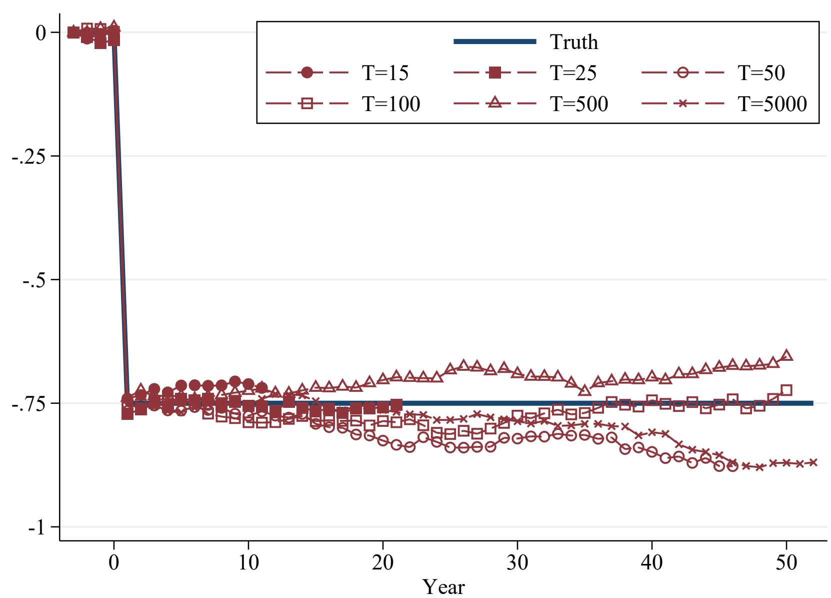
Notes: Figure shows impulse response functions of indicated variables with respect to a negative log employment shock. We construct impulse response functions for the BK VAR using estimates of equations (4)–(6). For the simplified VAR in Panel B, we use equations (7)–(8). Sample contains 50 states and Washington, D.C. from 1976–1990.
Source: Authors' calculations using BLS CES and LAUS data.

Figure 8: Comparison of Finite Sample Bias from Vector Autoregression Impulse Response Functions and Event Study Regressions for the Log Employment-Population Ratio

(a) Vector Autoregression Impulse Response Functions



(b) Event Study Regression Coefficients



Notes: Panel A displays average estimates of impulse response functions of the log employment-population ratio with respect to a negative log employment shock based on estimates of equations (7)–(8). Panel B displays average estimates of δ_t from the regression in equation (15). For both panels, we simulate data following equations (12)–(14). We set $e_{i,0} \sim \mathcal{N}(13.88, 1.03^2)$, $p_{i,0} \sim \mathcal{N}(14.43, 1.05^2)$, $\varepsilon_{i,e,t} \sim \mathcal{N}(0, 0.015^2)$, $\varepsilon_{i,p,t} \sim \mathcal{N}(0, 0.015^2)$, $\phi = -0.75$, and $N = 50$. Results are based on 499 Monte Carlo simulations.

The Evolution of Local Labor Markets After Recessions
Brad Hershbein and Bryan A. Stuart
Online Appendix

A Data Appendix

A.1 Creating Consistent Geography Definitions over Time

We examine the impacts of recessions for different definitions of local areas: metropolitan areas and commuting zones. Each of these geography definitions changes over time. Moreover, each geography is composed of counties, and these, too, change over time.[58] Metropolitan areas are periodically redefined by the Office of Management and Budget (OMB), and commuting zones are redefined decadally by the Department of Agriculture based on commuting questions in the census (in 1990 and 2000) or American Community Survey (2010). For ease of interpretation, we work with temporally-fixed definitions of metropolitan areas and commuting zones throughout our analyses. Specifically, we use Core-Based Statistical Areas (CBSAs) based on OMB definitions from December 2003, and commuting zones based on the 2000 census.[59] Since both of these geographies are composed of counties, it is straightforward to aggregate county-level data using crosswalks released by the Office of Management and Budget (via the Census Bureau) or the Department of Agriculture.

To ensure we work with consistently defined counties, we use the Census Bureau's county change database to recode county and county equivalents in the source data (BEAR, CBP, QCEW, SEER) to consistent definitions.[60] We also restrict our samples of metro areas and commuting zones to the continental United States, excluding Alaska and Hawaii. Finally, we combine the independent cities in Virginia with their surrounding counties.

For analysis using microdata from the decennial census and ACS, counties are generally not observable. Rather, the 1990 census, 2000 census, and ACS identify Public Use Microdata Areas (PUMAs), time-varying areas of at least 100,000 individuals. The 1970 and 1980 censuses instead identify county groups, which are conceptually similar but based on municipal and county units rather than Census tracts. We use population-weighted crosswalks available from the Missouri Census Data Center's Geocorr application to map PUMAs to counties, and we use county group-county crosswalks available from IPUMS to map county groups to CBSAs.[61] As described in the main text, for many of the analyses we first process the microdata and then collapse the relevant measures to our analytic geographies using the crosswalks.

[58]Counties are the most stable, but occasionally change due to state legislative action or boundary disputes.

[59]See `https://www.census.gov/geographies/reference-files/time-series/demo/metro-micro/historical-delineation-files.html` and `https://www.ers.usda.gov/data-products/commuting-zones-and-labor-market-areas/`, respectively.

[60]See `https://www.census.gov/programs-surveys/geography/technical-documentation/county-changes.html`. For counties that change only names or codes, we use the modern versions, and we combine counties that either merge or split.

[61]See `https://usa.ipums.org/usa/volii/t1970maps.shtml` and `https://usa.ipums.org/usa/volii/ctygrp.shtml`.

A.2 Imputing Employment in Quarterly Census of Employment and Wages

For some robustness checks, we use the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW) as an alternative measure to the BEAR data for local area employment. QCEW data are based on unemployment insurance records from each state, are one of the inputs used by BEA to construct its employment data, and constitute the data source used to benchmark the Current Employment Statistics for monthly jobs reports. Data are available starting in 1975 from the BLS website and provide employment and establishment counts, as well as aggregate and average weekly wages, for each county and industry, at annual, quarterly, and (for employment counts) monthly frequencies.[62] However, data suppressions are common, especially earlier in the period. At the county level, data for small or highly concentrated industries (e.g., agriculture and mining) are often suppressed, although very small counties may even have total or total private employment suppressed. When these suppressions occur, *all* data for the county-industry-quarter are suppressed, unlike in County Business Patterns, described below. (For national series, used for constructing the "shifts" in the creation of predicted log employment changes as in Bartik (1991), suppression is not an issue.)

For total and total private (excluding government) employment, we impute missing employment counts at the county level through the following ordered process: 1) If total employment and government employment are reported but private employment is suppressed, we impute private employment as the difference between total and government;[63] 2) If either total *or* private employment is missing in a given quarter, but not for all quarters in the year, we impute the one that is missing based on the average ratio (private share of total) for the year; 3) If either total *or* private employment is missing for an entire year, such that the private share for that year is unavailable, we impute the missing values based on the average share over the rolling window from two years prior to two years after the current year. This process imputes aggregate employment counts for nearly every case from 1978 onward. For the few remaining cases, mostly before 1978, we impute values by running a county-specific regression of the log of the employment measure (either total or total private) on year and quarter dummies from 1978 forward and replacing the missing values (including those from before 1978) with their predicted values from the regression.

A.3 Imputing Employment in County Business Patterns

When constructing the predicted log employment change as in Bartik (1991), we use County Business Patterns (CBP) data to measure local industry employment shares. In the relevant years, 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.

We 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, we impute employment as the number of establishments times average pre-recession

[62] Aggregate employment for each geography is available from 1975; industry-level measures are available under SIC coding from 1975 through 2000 and NAICS coding from 1990 forward.

[63] We follow this rule for 1978 forward, when local and state government reporting was near universal; prior to this year, many jobs in local and state governments were not in the reporting universe, and available counts, when not suppressed, vastly underestimated government employment. See P.L. 94-566.

employment in the establishment size group, where the average comes from nationwide data across all industries. We use 1999 data to construct these imputation adjustments, but the results are very similar when using other years.

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, we 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) and Stuart (2022). We estimate (μ, σ) using the following four moments:

$$p_1 = \Phi\left(\frac{\ln(1499) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(1000) - \mu}{\sigma}\right) \tag{A.1}$$

$$p_2 = \Phi\left(\frac{\ln(2499) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(1500) - \mu}{\sigma}\right) \tag{A.2}$$

$$p_3 = \Phi\left(\frac{\ln(4999) - \mu}{\sigma}\right) - \Phi\left(\frac{\ln(2500) - \mu}{\sigma}\right) \tag{A.3}$$

$$E[y] = \exp(\mu + \sigma^2/2), \tag{A.4}$$

where p_1 is the share of establishments of 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.

We use equations (A.1)–(A.4) to estimate (μ, σ) with GMM, using the identity matrix as the weighting matrix. For years 1978, 1988, 1999, and 2006, the estimates of (μ, σ) are (7.50, 0.67), (7.49, 0.63), (7.50, 0.62), and (7.51, 0.67). We use 1999 parameters throughout for simplicity. Standard facts about the log-normal distribution imply that the imputed means for the four establishment size groups are (1249, 1950, 3373, 6679).[64]

For 1999 and 2006, we can compare the county-industry employment imputations from this procedure (normalized by overall county employment to make industry shares) with those from the Upjohn Institute's WholeData series (Bartik et al., 2019), which provides desuppressed employment counts in the NAICS period. The correlations are very high, in excess of 0.99, suggesting the imputation procedure is quite accurate.

A.4 Local Housing Price Data from the Federal Housing Finance Agency

To measure impacts on local housing prices in supplementary analyses, we draw upon Housing Price Index (HPI) data from the Federal Housing Finance Agency (FHFA; Federal Housing

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

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

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

Finance Agency (1975–2019)).[65] These data use a repeat-sales methodology to show nominal changes in housing prices while controlling for composition. Developmental data are available for most counties at the annual level, with time series going back to the mid 1970s in many cases (Bogin, Doerner and Larson, 2019). No price data in dollars are provided; rather, each index is normalized to a base period that varies with the temporal availability of each geography. We adjust the current county data to our standardized set of counties as in Appendix A.1. To aggregate into metro areas, we would ideally have the number of eligible units in each county and year. Unfortunately, such unit data are not available to our knowledge. Instead we use annual county population weights, from SEER when it is available and from BEA otherwise. In cases where a constituent county is missing HPI data for a given year, we treat it as ignorable, with the resulting metro area average reflecting the remaining constituent counties. Because this happens rarely for metro areas, especially for larger constituent counties, and HPIs are highly correlated in adjacent areas, any resulting bias should be minimal.

B Results Appendix

B.1 Robustness to Different Measures of Log Employment Changes

Our baseline specification uses the change in log total wage and salary employment from BEAR to measure recession severity. We believe this variable is best because the BEA makes considerable efforts to construct data that are consistent over time, although this is more difficult for the self-employed (whose employment can vary over time in response to tax incentives). The two leading alternatives are private wage and salary employment from BEAR and private wage and salary employment from QCEW.[66] Figure 11 shows that the estimated coefficients for employment, population, the employment-population ratio, and earnings per capita are quite similar when using these other measures to define recession severity. The similarity of the results is not surprising, as the public sector accounts for less than 25 percent of wage and salary employment on average, and BEAR data rely on QCEW data as an input. Still, it is reassuring that our results are not sensitive to this choice.

B.2 Results Using Predicted Log Employment Changes

We estimate equation (1) using OLS. A potential concern with this approach is that employment changes in local areas might stem from factors besides recessions, such as changes in labor supply. A common approach in the literature—much of which examines ten-year employment changes rather than business-cycle peak-to-troughs—is to instead use an instrumental variable that measures log employment changes predicted by a location's baseline industrial structure, following

[65] See `https://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index-Datasets.aspx`.

[66] CBP data represent another alternative, although its coverage is not quite as complete as BEAR or QCEW; notably, CBP excludes most public-sector employment, as well as agricultural services, railroads, postal workers, and private households.

Bartik (1991). In our setting, the predicted log employment change for recession r is

$$b_i^r = \sum_j \eta_{i,j}^r(\ln(E_{j,t(r)}) - \ln(E_{j,p(r)})),$$

where $\eta_{i,j}^r$ is the share of employment in local area i in industry j in a base year, and the term in parentheses equals the nationwide log employment change in industry j from business cycle peak to trough. We construct employment shares, $\eta_{i,j}^r$, using CBP data (see Appendix A.3), generally for between 70–90 consistently available industries.[67] We construct the nationwide log employment change, $\ln(E_{j,t(r)}) - \ln(E_{j,p(r)})$, using QCEW data and the same year ranges of peak to trough as we use for the log employment change.[68]

Appendix Table 4 describes the relationship between the actual log employment change and the predicted log employment change. The first column includes no other controls. For every recession besides 1990–1991, the predicted log employment change explains 33–36 percent of the cross-metro variation in the actual log employment change. For 1990–1991, the predicted log employment change explains only 7 percent of the actual variation. Columns 2 and 3 add in division fixed effects and controls for lagged population growth. The coefficients—which are all positive, as expected—are reasonably stable across specifications, especially after 1973–1975 when greater industry-level detail is available. Moreover, the coefficient estimates remain highly statistically significant even with the additional controls.

Appendix Table 5 shows that predicted log employment changes are more highly correlated across time than actual log employment changes. This is not surprising, as the shift-share variable primarily reflects local industry employment shares, which are relatively stable. These high correlations raise the potential concern that the predicted log employment change might not isolate the impact of a recession, which is one reason why this approach is not our preferred one.

Appendix Figure 12 reports results in which we instrument for the actual log employment change in an area with the predicted log employment change, b_i^r. We focus on results that stack the five recessions we study into a single regression to increase precision and focus on central tendencies. The results are quite similar when using the variation in the log employment change that is predicted by the shift-share variable. The short-run impact from the shift-share variable is somewhat smaller (consistent with this variable not capturing some of the idiosyncratic shifts in labor demand that are reflected in the actual log employment change), but the estimates are nearly identical 9–12 years after the recession.[69] We conclude that our finding of a persistent post-

[67]For shares, we average the years 1972–1973, 1978–1979, 1988–1989, 1998–1999, and 2006–2007. The exact number of industries used depends on how many industries are consistently defined in the CBP data during each recession period. For the 1980–1982 and 1990–1991 recessions, we use 71 and 70 SIC industries, respectively. For the 2001 and 2007–2009 recessions, we use 83 and 87 industries, respectively. For the 1973–1975 recession, detailed industries are not available from CBP (or any other source at the county level to our knowledge), and we use the 10 industries provided.

[68]QCEW data have the advantage of being available at a quarterly frequency, which we could (but do not) use in constructing the predicted log employment change; our results are not sensitive to this choice. Because detailed county-by-industry employment counts in the QCEW are commonly suppressed, with less information with which to make imputations, we use the CBP to construct the pre-recession employment share.

[69]To explore whether the shift-share results are influenced by boom-bust dynamics in extractive industries, we estimated instrumental variable regressions that exclude metro areas with the top 5 or 10 percent highest shares of employment in the mining, quarrying, and oil and gas extraction industry. These estimates point to slightly larger declines in the employment-population ratio, but the results are fairly similar.

recession decline in local economic activity is not driven entirely by the idiosyncratic sources of variation included in our measure.[70]

B.3 The Post-Recession Evolution of Economic Activity in Commuting Zones

Our main approach defines local labor markets as metropolitan areas. Another reasonable approach is to use commuting zones, which span the entire (continental) United States, including rural areas. Appendix Figure 15 shows that results are very similar when using commuting zones (specifically, the 2000 definition).

B.4 Additional Results for the Comparison to VAR Models

Figure 7 shows that the BK VAR, estimated using state-level data from 1976–1990, implies complete recovery of the employment-population ratio within a decade of a decrease in local employment. This appendix describes results which show that differences in the sample, time period, and level of geography do not explain why we find a persistent decrease in the employment-population ratio while the prior literature estimating BK VARs finds evidence of complete recovery.

First, we use state-level data to show that the results of the BK VAR are similar when estimated on different years. The results are in Appendix Figure 22. Panel A presents estimates for the original BK years, 1976–1990. In Panel B, we use the same window length (15 years), shifted towards the end of the sample period. The BK sample begins four years before the start of the 1980–1982 recession, and we choose a later sample at a comparable point in the business cycle by selecting years 2003–2017 (i.e., 2003 is four years before the start of the 2007–2009 recession). The results are extremely similar, which indicates that the BK results are not driven by a focus on a specific time period. In Panel C, we use data from 1976–2019 to examine whether additional years of data change the results.[71] The results based on an extended number of years show recovery of the unemployment rate, participation rate, and employment-population ratio that is slower but still complete.[72] This pattern is consistent with the additional years of data reducing the finite sample bias that we document in Section 6.

Second, we show that the results of the BK VAR are similar when estimated using metro areas instead of states as the unit of geography. In particular, we estimate a version of the BK VAR where the dependent variable in the first equation is the change in log employment and the dependent variable in the second equation is the log employment-population ratio. We focus on this two-equation VAR because reliable measures of the number of individuals that are unemployed or in the labor force are not available for metro areas throughout our time period. Otherwise, we use the same lag structure as in the BK VAR.

We generate a comparison between the state and metro area results in several steps because the official LAUS data used by BK are not available for metro areas from 1976–1990. Panel A of Appendix Figure 23 reports results after replacing the Current Employment Statistics establishment-

[70] A limitation of these instrumental variable results is that they display considerably more variability across recessions, as shown for the log employment-population ratio in Appendix Figure 13.

[71] We begin in 1976 because LAUS data are not available before then. We use data up through 2019 in our analysis of recessions.

[72] Dao, Furceri and Loungani (2017) compare results from a version of the BK model estimated on data from 1976–1990 vs. 1976–2013, and they also find that recovery of these variables is slower but ultimately complete when using an extended number of years to estimate the vector autoregression.

level employment estimates used by BK with the analogous employment measure available in BEA data. The results are similar to those shown in Panel A of Figure 7, which demonstrates that changing the source of employment data does not change the conclusions of the model. In Panel B of Appendix Figure 23, we use estimates of the population ages 15 and above from the Census Bureau/SEER in place of BK's approach, which estimates population as the sum of establishment-level employment and survey measures of the number of individuals who are unemployed or not in the labor force. These estimates are similar, and they also imply complete recovery of the employment-population ratio within 7 years. Finally, Panel C uses the same underlying data as Panel B, but for metro areas. Estimates of the BK VAR on metro area data imply complete recovery of the employment-population ratio within 7–8 years. Our event study regressions, which use the same data as Panel C, find clear evidence of a persistent decline in the employment-population ratio. We conclude that the difference between our results and those in BK is not driven by the unit of geography.

Third, we show that event study results are comparable when using metro areas or states as the unit of geography. Appendix Figure 24 reports results from a stacked event study regression where the dependent variable is the log employment-population ratio. The state-level results reveal a persistent decrease in the employment-population ratio, although there is a bit more recovery for states and much less precision in the estimates. Nonetheless, the event study estimates point to much longer-lasting declines in the employment-population ratio than is implied by the BK VAR.

B.5 Back of Envelope Calculations on the Role for Productivity-Enhancing Reallocation

This appendix reports the results of simple calculations that assess whether recessions are likely to increase aggregate earnings per worker by reallocating employment to more productive areas. We refer to these calculations in the conclusion.

The change in aggregate earnings per worker due to recession-induced cross-area reallocation is

$$Y^C_{t+k} - Y_t = \sum_i (\theta^C_{i,t+k} - \theta_{i,t}) Y_{i,t}, \tag{A.5}$$

where Y_t is aggregate earnings per worker in pre-recession year t, and Y^C_{t+k} is the counterfactual level of earnings per worker in year $t+k$ reflecting recession-induced employment reallocation across local labor markets. These aggregate earnings per worker terms are defined as:

$$Y_t \coloneqq \sum_i \theta_{i,t} Y_{i,t} \tag{A.6}$$

$$Y^C_{t+k} \coloneqq \sum_i \theta^C_{i,t+k} Y_{i,t}, \tag{A.7}$$

where $Y_{i,t}$ is earnings per worker in metro i in year t, $\theta_{i,t} \equiv E_{i,t}/E_t$ is the employment share of metro i in year t, and $\theta^C_{i,t+k}$ is the counterfactual employment share in year $t+k$. We construct this counterfactual employment share as

$$\theta^C_{i,t+k} = \frac{E_{i,t} \times \exp(s_i \hat{\delta}_{t+k})}{\sum_j E_{j,t} \times \exp(s_j \hat{\delta}_{t+k})}. \tag{A.8}$$

The numerator of this expression is the pre-recession employment level multiplied by the percent change in employment predicted by recession severity from equation (1). Using only the employment change that is explained by recession severity ensures that we do not attribute secular changes (absorbed by our controls) to the recession.

Column 1 of Appendix Table 10 reports the unweighted standard deviation (SD) of the difference between the counterfactual employment share and the observed pre-recession employment share, $(\theta^C_{i,t+k} - \theta_{i,t})$. We construct this counterfactual 7–9 years after the business cycle trough, using the estimates in Panel A of Appendix Table 6. We set t as the recession start year. Column 2 reports the unweighted SD of the relative employment share difference, $(\theta^C_{i,t+k} - \theta_{i,t})/\theta_{i,t}$. There is a fair amount of reallocation, with the standard deviation ranging from 3.5 to 7.8 percent of baseline employment. Column 3 reports the nationwide average of mean annual earnings per worker in the recession start year, expressed in constant 2019 dollars. Column 4 reports the change in aggregate earnings per worker, $Y^C_{t+k} - Y_t$. In three out of five recessions, cross-area reallocation lowers earnings per worker. However, the aggregate changes are extremely small, ranging from a reduction of \$224 (1990–1991) to an increase of \$23 (1980–1982). This is underscored in column 5, which divides column 4 by column 3 and then multiplies by 100 to express percent changes. The largest change is only 0.3 percent of recession start year earnings per worker.

To shed further light on these results, Appendix Figure 26 displays the cross-metro correlations between the employment share change $(\theta^C_{i,t+k} - \theta_{i,t})$ and earnings per worker in the recession start year $(Y_{i,t})$. The marker symbols are proportional to the start year employment share. High-earning metropolitan areas regularly lose and gain employment. On average, there is no net shift towards higher or lower earning metropolitan areas, as seen in Table 10.

In sum, these calculations suggest that recessions do not meaningfully reallocate employment towards more productive metropolitan areas.

Appendix Table 1: Characteristics of Metropolitan Areas with More versus Less Severe Recessions, with p-values

	Recession									
	1973–75		1980–82		1990–91		2001		2007–09	
Pre-recession characteristic	Less Severe	More Severe	Less Severe	More Severe	Less Severe	More Severe	Less Severe	More Severe	Less Severe	More Severe
Manufacturing emp. share	0.141	0.254	0.140	0.236	0.131	0.179	0.096	0.163	0.082	0.110
p-value	*0.000*		*0.000*		*0.000*		*0.000*		*0.000*	
Mining emp. share	0.013	0.004	0.013	0.005	0.013	0.005	0.008	0.003	0.008	0.002
p-value	*0.000*		*0.002*		*0.000*		*0.004*		*0.000*	
Construction emp. share	0.052	0.051	0.058	0.051	0.055	0.053	0.059	0.056	0.060	0.067
p-value	*0.552*		*0.000*		*0.271*		*0.026*		*0.001*	
Finance, insurance, real estate emp. share	0.062	0.059	0.073	0.063	0.068	0.065	0.066	0.064	0.073	0.079
p-value	*0.308*		*0.000*		*0.133*		*0.381*		*0.008*	
Population (1000s)	333.1	595.4	552.9	430.6	329.8	768.2	531.6	732.4	618.7	744.7
p-value	*0.044*		*0.348*		*0.002*		*0.194*		*0.441*	
Log population growth	0.090	0.066	0.247	0.108	0.137	0.078	0.162	0.096	0.091	0.117
p-value	*0.002*		*0.000*		*0.000*		*0.000*		*0.012*	
Employment-population ratio	0.518	0.537	0.534	0.547	0.546	0.579	0.591	0.632	0.612	0.585
p-value	*0.008*		*0.063*		*0.000*		*0.000*		*0.002*	
Real earnings per capita (1000s)	19.7	21.0	21.5	23.2	23.5	26.4	28.3	32.7	34.1	33.5
p-value	*0.005*		*0.001*		*0.000*		*0.000*		*0.470*	
Share with BA degree or more	0.120	0.096	0.172	0.142	0.195	0.183	0.229	0.220	0.260	0.240
p-value	*0.000*		*0.000*		*0.065*		*0.203*		*0.012*	
Nonwhite share	0.145	0.133	0.209	0.122	0.189	0.188	0.257	0.203	0.274	0.277
p-value	*0.348*		*0.000*		*0.930*		*0.002*		*0.906*	
Foreign-born share	0.029	0.027	0.048	0.028	0.045	0.043	0.081	0.048	0.068	0.081
p-value	*0.565*		*0.000*		*0.728*		*0.000*		*0.071*	

Notes: See notes to Table 3 for variable definitions and data sources. This table also reports p-values from regression-based t-statistics (accounting for heteroskedasticity) of the difference in a given variable between areas experiencing a more vs. less severe recession.

Appendix Table 2: Metropolitan Area Correlates with Change in Log Employment During Recessions

	DV: Log employment change during indicated recession(s)					
	All	1973–75	1980–82	1990–91	2001	2007–09
	(1)	(2)	(3)	(4)	(5)	(6)
Coefficients for selected pre-recession covariates						
Industry employment shares						
Manufacturing share	−0.298	−0.399	−0.230	−0.276	−0.305	−0.400
	(0.057)	(0.136)	(0.105)	(0.092)	(0.086)	(0.128)
Mining share	0.116	0.136	0.231	0.009	0.113	0.024
	(0.023)	(0.043)	(0.061)	(0.056)	(0.041)	(0.033)
Construction share	−0.021	0.064	−0.002	0.057	−0.041	−0.141
	(0.027)	(0.056)	(0.045)	(0.053)	(0.051)	(0.060)
Finance, insurance, real estate share	−0.052	−0.167	−0.026	−0.061	0.115	−0.196
	(0.038)	(0.056)	(0.053)	(0.057)	(0.063)	(0.082)
Labor market and demographic characteristics						
Log population	0.001	−0.042	0.144	−0.129	−0.018	−0.050
	(0.032)	(0.051)	(0.045)	(0.058)	(0.072)	(0.069)
Employment-population ratio	0.067	−0.101	0.236	−0.116	0.083	−0.004
	(0.053)	(0.089)	(0.075)	(0.102)	(0.112)	(0.162)
Log real earnings per capita	−0.217	0.047	−0.351	−0.114	−0.318	0.064
	(0.064)	(0.111)	(0.091)	(0.123)	(0.150)	(0.171)
Share with BA degree or more	0.108	0.121	0.151	0.114	−0.199	−0.004
	(0.032)	(0.043)	(0.053)	(0.080)	(0.100)	(0.132)
Nonwhite Share	−0.002	0.001	0.090	0.009	−0.162	−0.014
	(0.036)	(0.068)	(0.060)	(0.066)	(0.073)	(0.086)
Foreign-born Share	−0.016	−0.034	0.071	−0.130	0.137	−0.220
	(0.034)	(0.059)	(0.056)	(0.073)	(0.088)	(0.082)
R-squared	0.519	0.610	0.687	0.624	0.579	0.561

Notes: Table reports results of regressing the key independent variable of the main analysis, the log employment change from business cycle peak to trough, on several metro-level characteristics measured prior to the beginning of each recession. Industry shares, log population, the employment-population ratio, and log real earnings per capita are measured two years prior to pre-recession start (1971, 1977, 1987, 1998, and 2005), while education, race, and foreign-born shares are measured as of the previous decennial census or ACS (1970, 1980, 1990, 2000, and 2005-2007). Besides covariates shown, each recession includes remaining industry shares (agriculture, wholesale trade, retail trade, and transportation & utilities), the share of individuals with a high school degree or some college, Census division fixed effects, and age-group-specific log population changes in the period prior to recession start. All covariates and outcomes are studentized for comparability. Estimates in column 1 come from stacking all recessions into a single regression and interacting division fixed effects and pre-recession population change variables with an indicator for each recession to mirror our main analysis. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area in column 1 and robust to heteroskedasticity in columns 2–6.
Source: Authors' calculations using BEAR, SEER, decennial census, and ACS data.

Appendix Table 3: Metropolitan Area Correlates with Change in Bartik Shift-Share Instrument During Recessions

	DV: Predicted log employment change during indicated recession(s)					
	All (1)	1973–75 (2)	1980–82 (3)	1990–91 (4)	2001 (5)	2007–09 (6)
Coefficients for selected pre-recession covariates						
Industry employment shares						
Manufacturing share	−0.892	−1.013	−1.077	−1.034	−0.960	−1.007
	(0.046)	(0.063)	(0.095)	(0.106)	(0.077)	(0.067)
Mining share	0.037	0.238	0.082	−0.174	−0.009	−0.095
	(0.018)	(0.025)	(0.054)	(0.049)	(0.020)	(0.035)
Construction share	−0.063	−0.121	−0.062	−0.139	0.081	−0.199
	(0.025)	(0.025)	(0.045)	(0.066)	(0.037)	(0.052)
Finance, insurance, real estate share	−0.034	0.007	−0.030	−0.038	0.024	−0.245
	(0.024)	(0.031)	(0.041)	(0.039)	(0.039)	(0.056)
Labor market and demographic characteristics						
Log population	−0.034	0.045	0.017	−0.054	−0.115	−0.257
	(0.027)	(0.046)	(0.045)	(0.044)	(0.042)	(0.057)
Employment-population ratio	−0.027	0.095	0.098	−0.198	−0.147	−0.279
	(0.044)	(0.089)	(0.072)	(0.086)	(0.079)	(0.091)
Log real earnings per capita	0.057	0.022	0.085	0.246	0.199	0.241
	(0.053)	(0.104)	(0.096)	(0.097)	(0.085)	(0.108)
Share with BA degree or more	0.059	0.022	0.089	0.065	−0.144	0.097
	(0.028)	(0.023)	(0.045)	(0.072)	(0.089)	(0.107)
Nonwhite Share	−0.010	−0.115	0.004	−0.057	−0.004	0.062
	(0.029)	(0.041)	(0.050)	(0.062)	(0.056)	(0.070)
Foreign-born Share	0.050	0.096	0.067	−0.058	−0.056	−0.089
	(0.028)	(0.028)	(0.044)	(0.054)	(0.052)	(0.058)
R-squared	0.758	0.910	0.788	0.782	0.828	0.766

Notes: Table reports results of regressing the Bartik shift-share instrument on several metro-level characteristics measured prior to the beginning of each recession. Appendix B.2 describes the construction of the shift-share predicted log employment change variable. See notes to Table 2.
Source: Authors' calculations using BEAR, SEER, decennial census, and ACS data.

Appendix Table 4: Cross-Sectional Relationship between Metropolitan Area Log Employment Change and Predicted Log Employment Change

	Dependent variable: Log employment change during recession		
	(1)	(2)	(3)
Panel A: All Recessions			
Predicted log employment change	1.833	1.506	1.414
	(0.104)	(0.092)	(0.098)
R-squared	0.420	0.584	0.643
Panel B: 1973–1975 Recession			
Predicted log employment change	1.869	1.258	1.195
	(0.177)	(0.199)	(0.209)
R-squared	0.355	0.466	0.498
Panel C: 1980–1982 Recession			
Predicted log employment change	1.965	1.778	1.547
	(0.162)	(0.141)	(0.156)
R-squared	0.362	0.593	0.667
Panel D: 1990–1991 Recession			
Predicted log employment change	1.394	0.777	1.090
	(0.234)	(0.228)	(0.231)
R-squared	0.067	0.428	0.493
Panel E: 2001 Recession			
Predicted log employment change	1.533	1.270	1.273
	(0.116)	(0.135)	(0.139)
R-squared	0.346	0.410	0.540
Panel F: 2007–2009 Recession			
Predicted log employment change	1.799	1.537	1.608
	(0.174)	(0.193)	(0.205)
R-squared	0.332	0.456	0.515
Division fixed effects		x	x
Pre-recession population growth			x

Notes: Table reports estimates of regressing the log employment change during recessions against the predicted log employment change during recessions (Bartik, 1991). In Panel A, we interact division fixed effects and age-group-specific pre-recession population growth with indicators for each recession. There are 358 metropolitan areas in the sample. Standard errors in parentheses are clustered by metropolitan area in Panel A and robust to heteroskedasticity in Panel B.
Source: Authors' calculations using BEAR, CBP, QCEW, and SEER data.

Appendix Table 5: Correlation of Metropolitan Area Predicted Log Employment Changes

	Predicted Change in Log Employment During Recession Years				
	1973–75	1979–82	1989–91	2000–02	2007–09
Panel A: Unadjusted					
1973–75	1.000				
1979–82	0.813	1.000			
1990–91	0.722	0.724	1.000		
2001	0.721	0.696	0.809	1.000	
2007–09	0.473	0.525	0.724	0.667	1.000
Panel B: Adjusted for Census division					
1973–75	1.000				
1979–82	0.758	1.000			
1990–91	0.667	0.662	1.000		
2001	0.661	0.629	0.811	1.000	
2007–09	0.496	0.498	0.737	0.686	1.000
Panel C: Adjusted for Census division and pre-recession population growth					
1973–75	1.000				
1979–82	0.740	1.000			
1990–91	0.595	0.577	1.000		
2001	0.556	0.535	0.716	1.000	
2007–09	0.434	0.453	0.673	0.611	1.000

Notes: Table reports correlations of predicted log employment changes (Bartik, 1991) across recessions for 358 metropolitan areas. Panel B reports correlations after partialling out Census division fixed effects, and Panel C partials out Census division fixed effects and pre-recession population growth.
Source: Authors' calculations using BEAR, CBP, and QCEW data.

Appendix Table 6: Summary of Changes in Metropolitan Area Economic Activity, 7–9 Years After Business Cycle Trough, by Recession

	Recession				
	1973–75	1980–82	1990–91	2001	2007–09
Panel A: Dependent Variable: Log Employment					
Coefficient on log emp. decrease	−1.227	−0.935	−1.640	−1.529	−0.780
	(0.185)	(0.137)	(0.151)	(0.130)	(0.130)
Implied change after 1 SD log emp. decrease	−0.069	−0.074	−0.074	−0.053	−0.030
Panel B: Dependent Variable: Log Population Age 15+					
Coefficient on log emp. decrease	−0.642	−0.595	−0.634	−0.537	−0.378
	(0.118)	(0.078)	(0.127)	(0.100)	(0.068)
Implied change after 1 SD log emp. decrease	−0.036	−0.047	−0.029	−0.018	−0.015
Panel C: Dependent Variable: Log Employment-Population Ratio					
Coefficient on log emp. decrease	−0.585	−0.340	−1.006	−0.992	−0.402
	(0.099)	(0.110)	(0.120)	(0.131)	(0.104)
Implied change after 1 SD log emp. decrease	−0.033	−0.027	−0.046	−0.034	−0.016
Panel D: Dependent Variable: Log Earnings per Capita					
Coefficient on log emp. decrease	−0.760	−0.776	−1.060	−1.626	−0.764
	(0.114)	(0.167)	(0.148)	(0.225)	(0.177)
Implied change after 1 SD log emp. decrease	−0.042	−0.061	−0.048	−0.056	−0.030
Panel E: Dependent Variable: Log Earnings per Worker					
Coefficient on log emp. decrease	−0.176	−0.437	−0.054	−0.634	−0.363
	(0.068)	(0.073)	(0.105)	(0.137)	(0.108)
Implied change after 1 SD log emp. decrease	−0.010	−0.035	−0.002	−0.022	−0.014
SD of log employment change	0.056	0.079	0.045	0.034	0.039

Notes: Table reports estimates of equation (1), separately for each recession. The dependent variable is indicated in the panel title and constructed as the change relative to two years before the nationwide recession start. The key independent variable is the change in log wage and salary employment during the recession from BEAR data. We pool estimates for years 7–9 after business cycle trough. All regressions control for division-year fixed effects and interactions between pre-recession population growth and year indicators. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area.

Source: Authors' calculations using BEAR and SEER data.

Appendix Table 7: Post-Recession Changes in Metropolitan Area Wage Earnings from the Census/ACS, by Recession

	Recession				
	1973–75	1980–82	1990–91	2001	2007–09
Panel A: Log Annual Earnings, Without Composition Adjustment					
Average log earnings	−0.345	−0.405	−0.219	−0.628	−0.467
	(0.116)	(0.093)	(0.121)	(0.099)	(0.125)
10th percentile, log earnings	−0.725	−0.521	−0.650	−1.201	−0.398
	(0.220)	(0.167)	(0.264)	(0.232)	(0.268)
50th percentile, log earnings	−0.274	−0.389	−0.093	−0.438	−0.580
	(0.124)	(0.097)	(0.110)	(0.096)	(0.126)
90th percentile, log earnings	−0.067	−0.255	−0.070	−0.404	−0.409
	(0.098)	(0.069)	(0.086)	(0.092)	(0.144)
Panel B: Weekly and Hourly Earnings					
Average log weekly earnings	−0.295	−0.395	−0.132	−0.488	−0.428
	(0.101)	(0.077)	(0.090)	(0.083)	(0.110)
Average log hourly earnings	−0.251	−0.355	−0.159	−0.376	−0.375
	(0.090)	(0.069)	(0.078)	(0.079)	(0.096)
Panel C: Log Annual Earnings, With Composition Adjustment					
Average log earnings	−0.312	−0.302	−0.200	−0.704	−0.379
	(0.100)	(0.079)	(0.102)	(0.082)	(0.118)
10th percentile, log earnings	−0.650	−0.278	−0.613	−1.335	−0.299
	(0.205)	(0.157)	(0.210)	(0.223)	(0.272)
50th percentile, log earnings	−0.270	−0.298	−0.132	−0.541	−0.376
	(0.085)	(0.074)	(0.088)	(0.067)	(0.100)
90th percentile, log earnings	−0.211	−0.245	−0.116	−0.508	−0.373
	(0.090)	(0.062)	(0.063)	(0.076)	(0.136)

Notes: Table reports estimates of separate regressions for each recession. The dependent variable is indicated in the row titles and constructed as the change between pre-recession and post-recession years (1970 to 1980, 1980 to 1990, 1990 to 2000, 2000 to 2005–2007, and 2005–2007 to 2015–2017). The key independent variable is the change in log wage and salary employment during the recession from BEAR data. The underlying sample is limited to individuals age 25–54 and then collapsed to 358 metropolitan areas. All regressions control for division-year fixed effects and pre-recession population growth. The dependent variables in Panel C are constructed using residuals from regressing log earnings on indicators for education, indicators for age, an indicator for sex, and indicators for race/ethnicity (White/Black/Hispanic/other), plus interactions between the education indicators and a quartic in age. Standard errors are robust to heteroskedasticity.
Source: Authors' calculations using BEAR, decennial census, and ACS data.

Appendix Table 8: Changes in Metropolitan Area Economic Activity as Measured 7–9 Years After Business Cycle Trough and Using Census/ACS Years

Dependent variable	Coefficient on log employment decrease (1)	Implied change from 1 SD decrease in log employment (2)
Panel A: Effects on outcomes 7–9 years after trough (baseline approach)		
Log employment	−1.141	−0.066
	(0.072)	
Log population age 15+	−0.577	−0.033
	(0.049)	
Log employment-population ratio	−0.564	−0.033
	(0.056)	
Log earnings per capita	−0.893	−0.052
	(0.078)	
Log earnings per worker	−0.329	−0.019
	(0.039)	
Panel B: Effects on outcomes measured in same years as census/ACS outcomes (robustness check)		
Log employment	−1.010	−0.059
	(0.066)	
Log population age 15+	−0.508	−0.029
	(0.042)	
Log employment-population ratio	−0.501	−0.029
	(0.052)	
Log earnings per capita	−0.823	−0.048
	(0.070)	
Log earnings per worker	−0.322	−0.019
	(0.032)	

Notes: Table reports estimates of equation (1). Column 1 reports the point estimate and standard error, and column 2 contains the point estimate multiplied by the standard deviation of the log employment change during a recession (0.058). The dependent variable is indicated in the row. In Panel A, the dependent variable is constructed as the change relative to two years before the nationwide business cycle peak, and we report the pooled coefficient for years 7–9 after the business cycle trough. In Panel B, the dependent variable is constructed as the change between pre-recession and post-recession years that can be used in our analysis of census/ACS data (1969 to 1979, 1979 to 1989, 1989 to 1999, 1999 to 2004–2006, and 2004–2006 to 2014–2016). The key independent variable is the change in log wage and salary employment during the recession from BEAR data. All regressions control for division-year fixed effects and interactions between pre-recession population growth and year indicators. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area.
Source: Authors' calculations using BEAR, SEER, decennial census, and ACS data.

Appendix Table 9: Bias in Vector Autoregression Parameters

	Parameter			
	$\tilde{\alpha}_{11}$	$\tilde{\alpha}_{12}$	$\tilde{\alpha}_{21}$	$\tilde{\alpha}_{22}$
Truth	0.000	0.000	0.750	1.000
Time series obs. (T)	Average estimate			
15	−0.038	−0.101	0.702	0.855
25	−0.022	−0.060	0.725	0.918
50	−0.010	−0.030	0.742	0.960
100	−0.004	−0.015	0.750	0.980
500	−0.001	−0.003	0.757	0.996
5000	0.000	0.000	0.763	1.000

Notes: Table displays true values and average estimates of parameters in equations (7)–(8) for the indicated number of time series observations (T). We simulate data following equations (12)–(14). We set $e_{i,0} \sim \mathcal{N}(13.88, 1.03^2)$, $p_{i,0} \sim \mathcal{N}(14.43, 1.05^2)$, $\varepsilon_{i,e,t} \sim \mathcal{N}(0, 0.015^2)$, $\varepsilon_{i,p,t} \sim \mathcal{N}(0, 0.015^2)$, $\phi = 0.75$, and $N = 50$. Results are based on 499 Monte Carlo simulations.

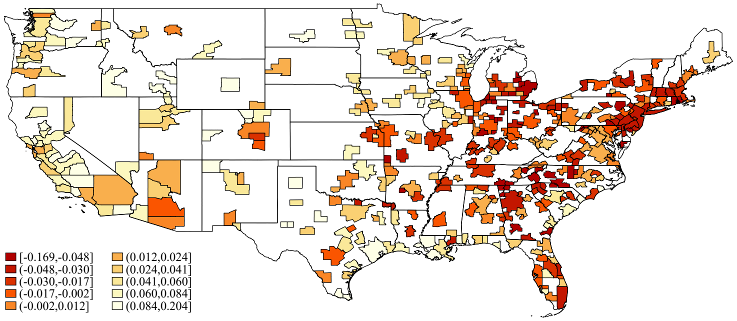
Appendix Table 10: Changes in Earnings per Worker due to Recession-Induced Reallocation

Recession	SD, emp. share change (1)	SD, rel. emp. share change (2)	Mean earnings per worker, peak year (3)	Change in mean earnings per worker (4)	Percent change in mean earnings per worker (× 100) (5)
1973–1975	0.00038	0.073	56,131	−12	−0.021
1980–1982	0.00035	0.078	56,425	23	0.041
1990–1991	0.00050	0.072	65,394	−225	−0.344
2001	0.00020	0.049	79,945	−71	−0.089
2007–2009	0.00017	0.035	88,751	3	0.003

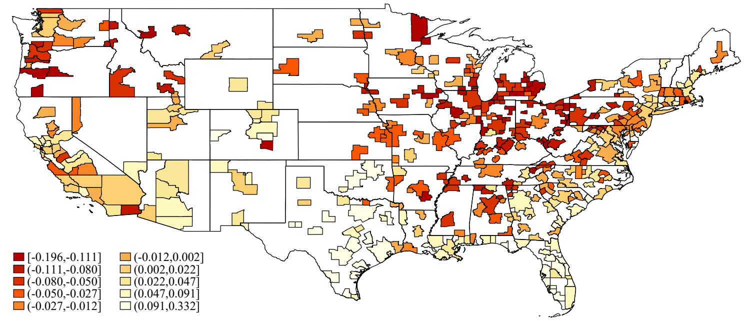
Notes: Column 1 reports the unweighted standard deviation of the difference between the counterfactual employment share (reflecting recession-induced employment reallocation) and the observed pre-recession employment share, $(\theta^C_{i,t+k} - \theta_{i,t})$. We construct this counterfactual 7–9 years after the business cycle trough, using the estimates in Panel A of Table 6. Column 2 reports the unweighted SD of the relative employment share change, $(\theta^C_{i,t+k} - \theta_{i,t})/\theta_{i,t}$. Column 3 reports the mean earnings per worker in the pre-recession business cycle peak year. Column 4 reports the change in aggregate earnings per worker, $Y^C_{t+k} - Y_t = \sum_i (\theta^C_{i,t+k} - \theta_{i,t}) Y_{i,t}$. Column 5 divides column 4 by column 3 and then multiplies by 100 to express percent changes.
Source: Authors' calculations using BEAR, decennial census, and ACS data.

Appendix Figure 1: Log Employment Changes During Recessions in Metropolitan Areas

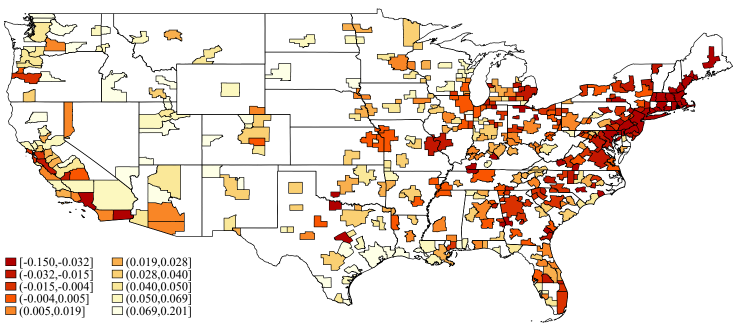
(a) 1973–1975 Recession



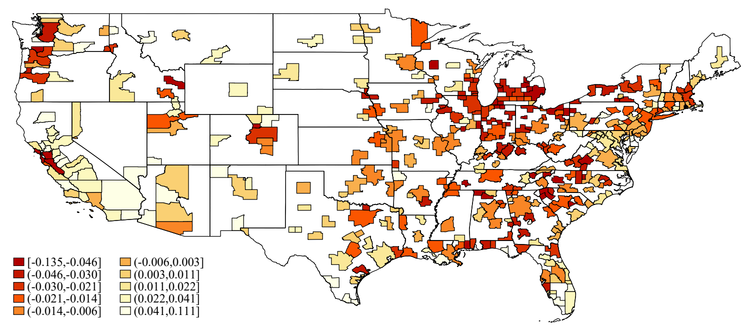
(b) 1980–1982 Recession



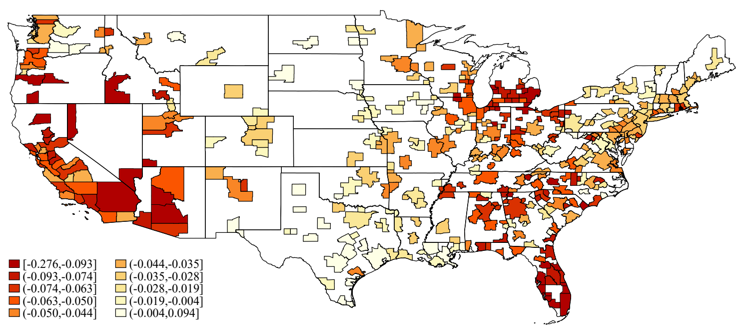
(c) 1990–1991 Recession



(d) 2001 Recession



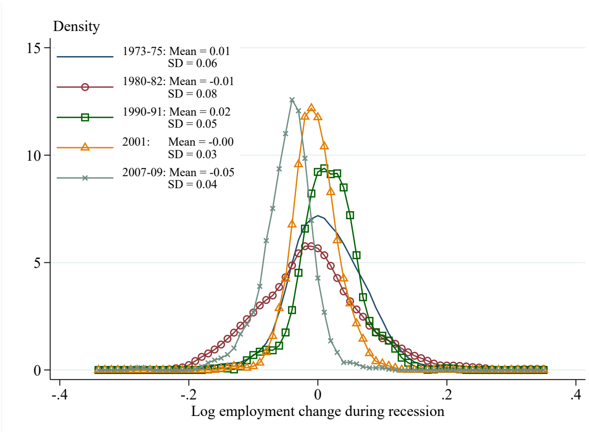
(e) 2007–2009 Recession



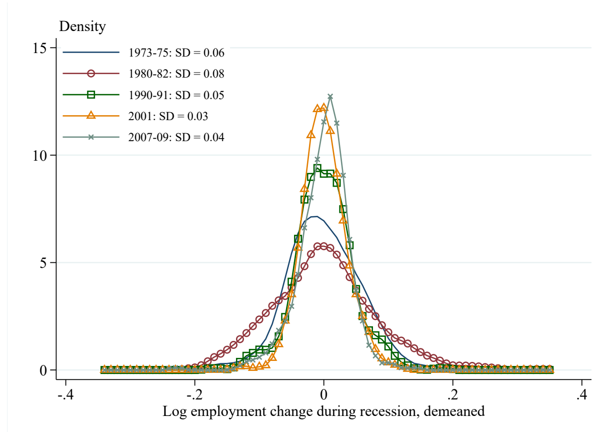
Notes: Each map shows the change in log employment from nationwide business cycle peak to trough for 358 metropolitan areas as described in the text. Each color group represents a decile of the recession-specific log employment change, with darker colors indicating larger employment losses.
Source: Authors' calculations from BEAR.

Appendix Figure 2: Density of Log Employment Changes and Predicted Log Employment Changes During Recessions Across Metropolitan Areas

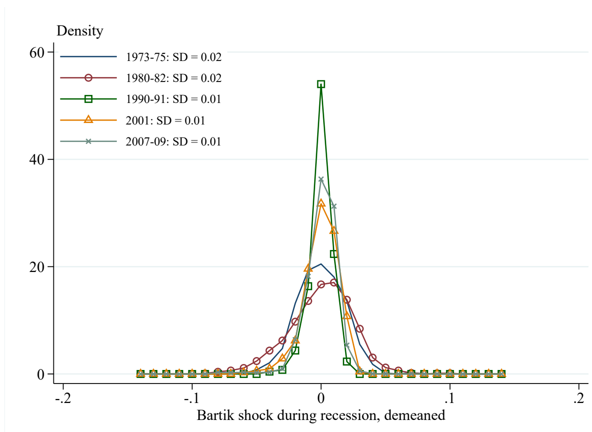
(a) Log Employment Change



(b) Log Employment Change, Demeaned



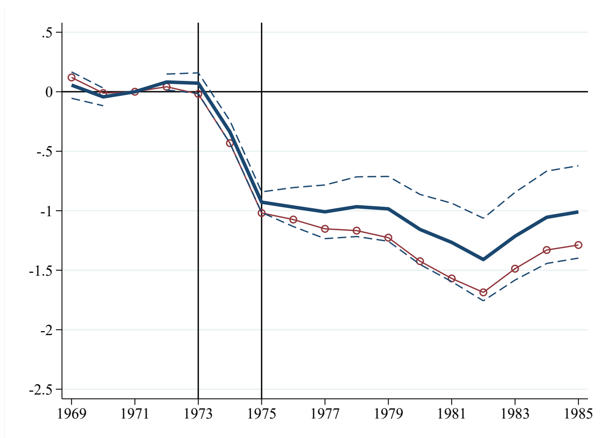
(c) Predicted Log Employment Change, Demeaned



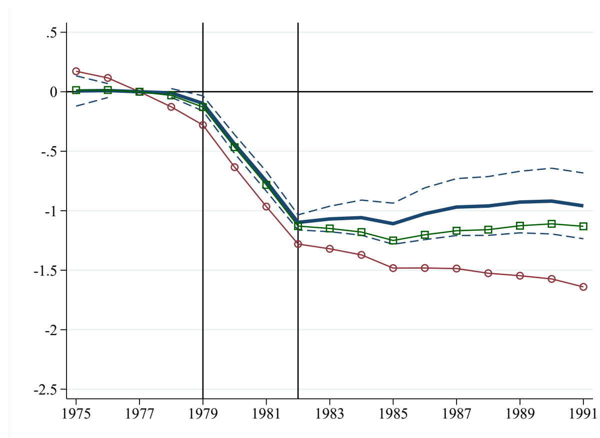
Notes: Figure shows estimated kernel densities of the log wage and salary employment change (Panels A and B) and predicted log employment change based on pre-recession industrial structure (as in Bartik (1991); Panel C) across metros for each of the five recessions between 1973–1975 and 2007–2009. In Panels B and C, log employment changes are demeaned for each recession using the unweighted average across metros. There are 358 metropolitan areas in the sample.
Source: Authors' calculations from BEAR, CBP, and QCEW data.

Appendix Figure 3: The Evolution of Metropolitan Area Log Employment, by Recession

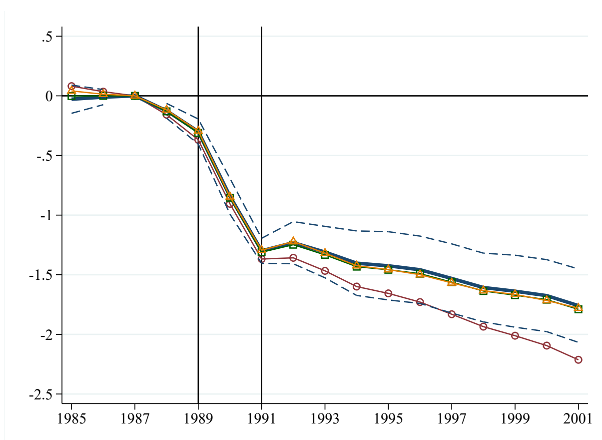
(a) 1973–1975 Recession



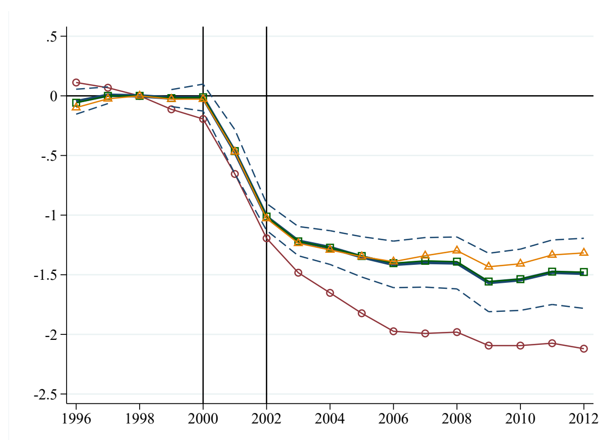
(b) 1980–1982 Recession



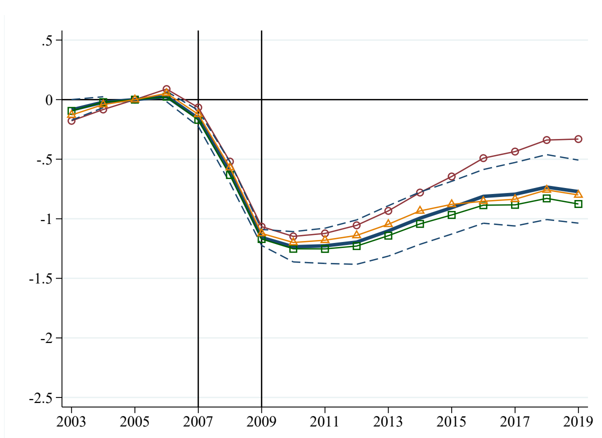
(c) 1990–1991 Recession

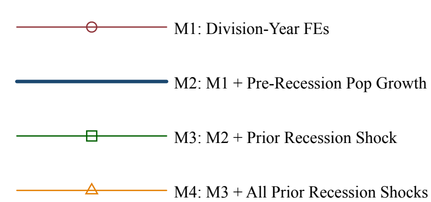


(d) 2001 Recession



(e) 2007–2009 Recession

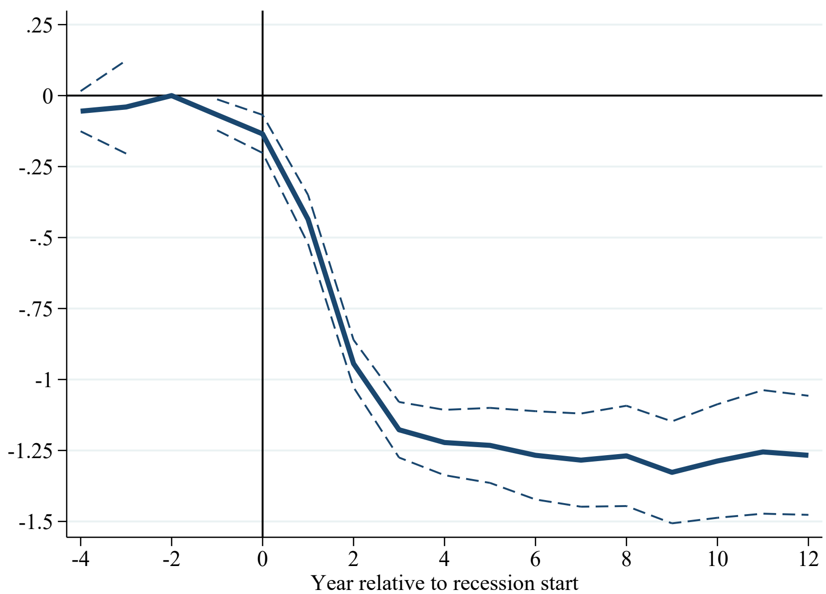




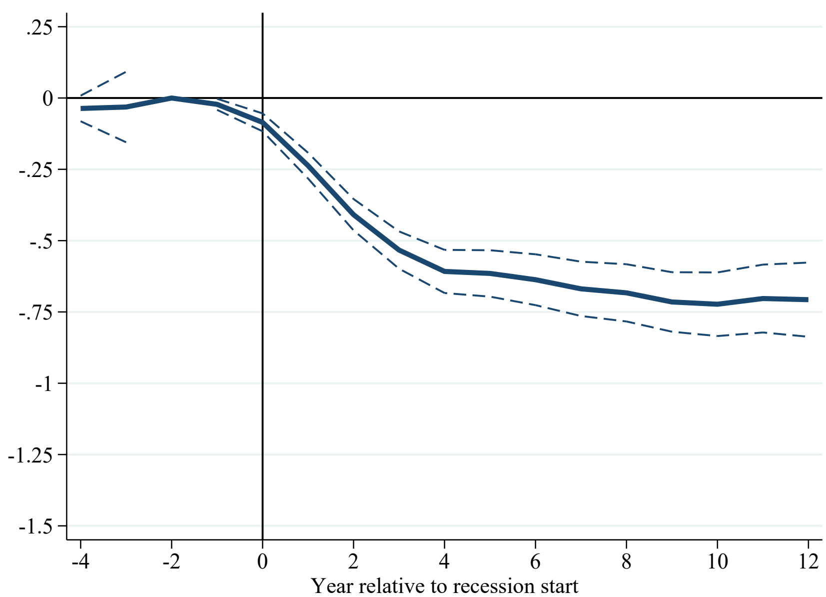
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is log wage and salary employment from BEAR data, and the key independent variable is the change in log wage and salary employment during the recession from BEAR data. Specifications are indicated by the legend. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 4: The Evolution of Metropolitan Area Log Employment and Establishments from County Business Patterns, by Recession

(a) Log Employment



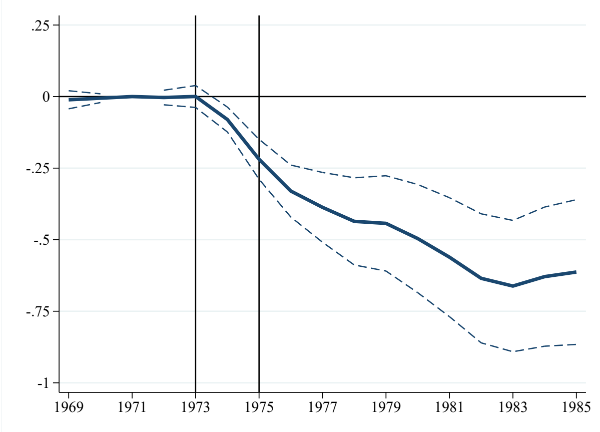
(b) Log Establishments



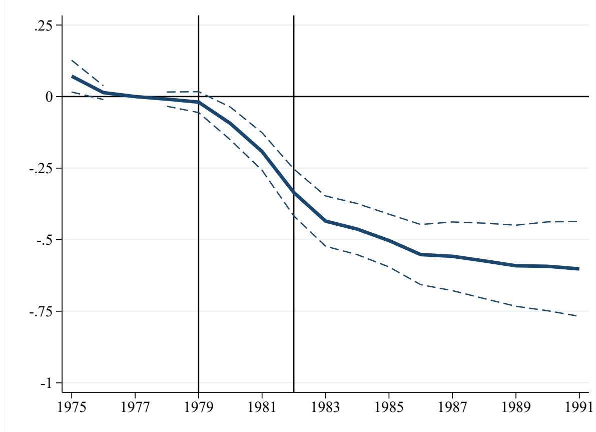
Notes: Figure reports estimates of equation (1). The dependent variable in Panel A is log employment, and the dependent variable in Panel B is the log number of establishments. Both come from CBP data. See notes to Figure 3. Source: Authors' calculations using CBP, BEAR, and SEER data.

Appendix Figure 5: The Evolution of Metropolitan Area Log Population, by Recession

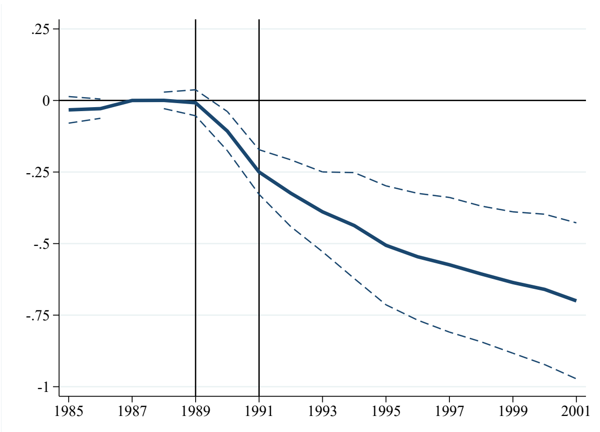
(a) 1973–1975 Recession



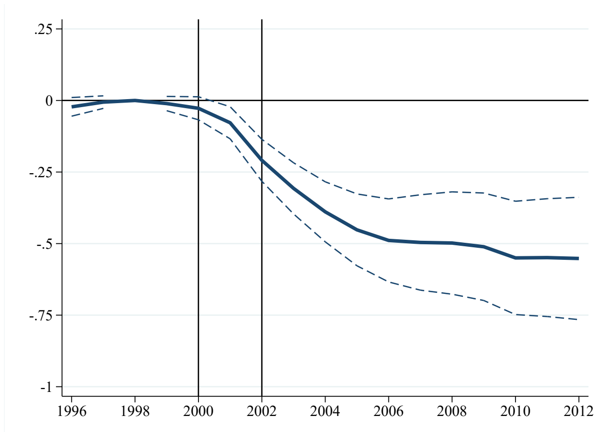
(b) 1980–1982 Recession



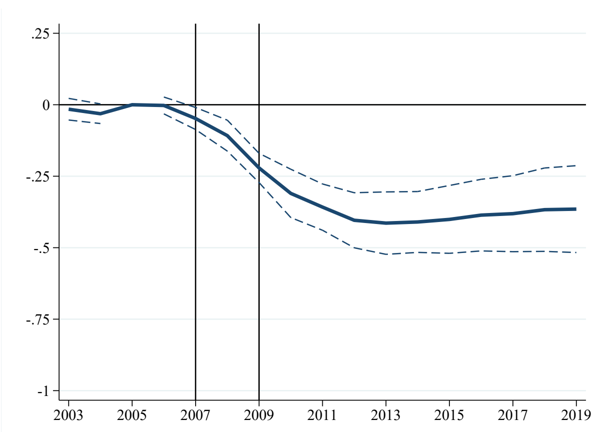
(c) 1990–1991 Recession



(d) 2001 Recession



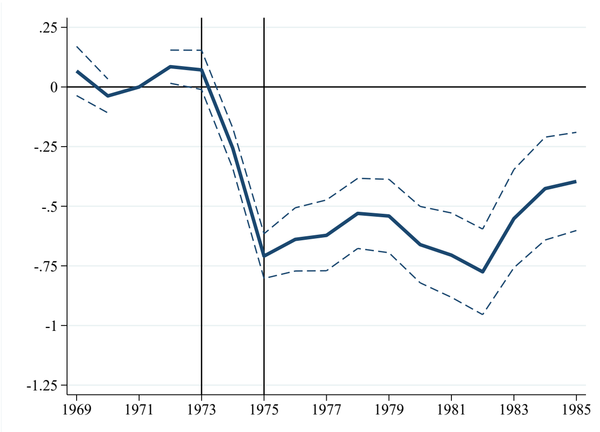
(e) 2007–2009 Recession



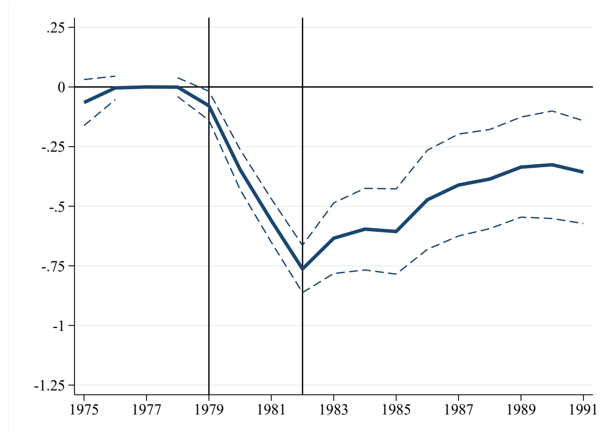
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is log population age 15 and above. See notes to Figure 3.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 6: The Evolution of the Metropolitan Area Log Employment-Population Ratio, by Recession

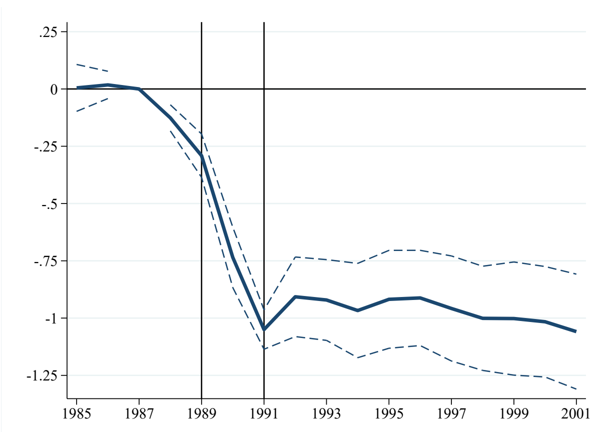
(a) 1973–1975 Recession



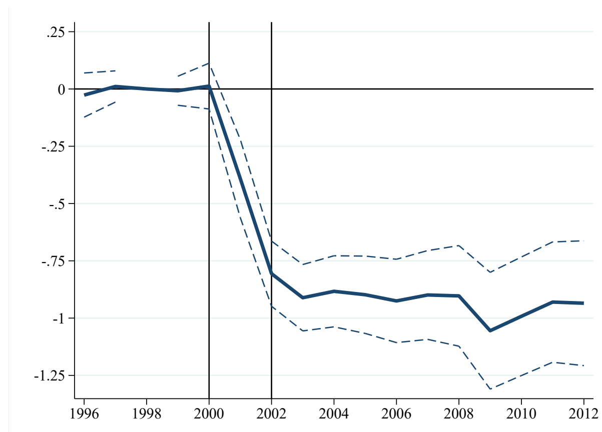
(b) 1980–1982 Recession



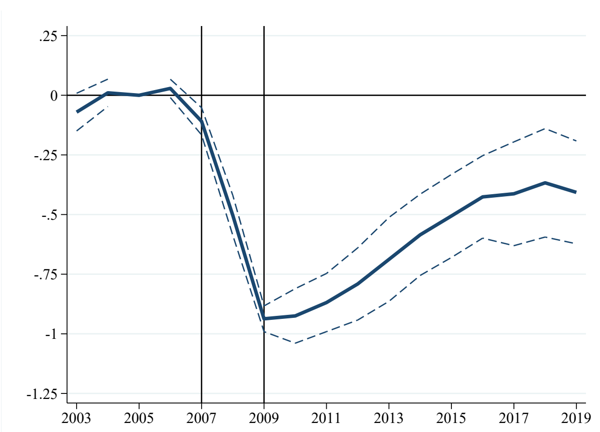
(c) 1990–1991 Recession



(d) 2001 Recession



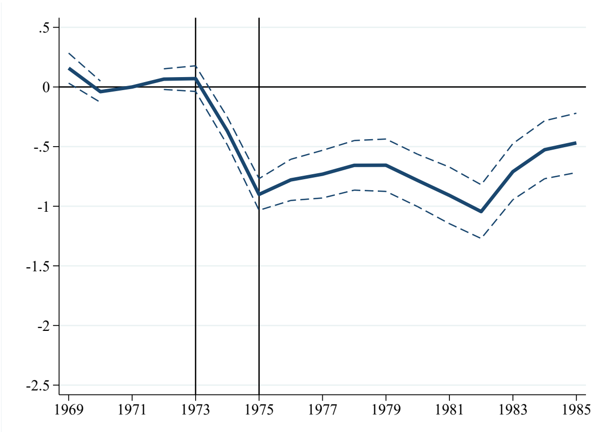
(e) 2007–2009 Recession



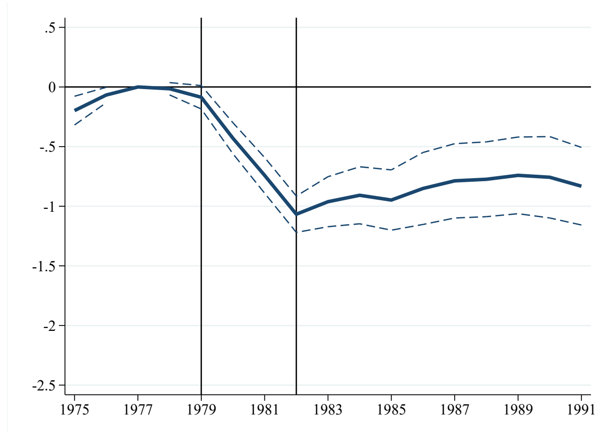
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is the log ratio of wage and salary employment to population age 15 and above. See notes to Figure 3.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 7: The Evolution of Metropolitan Area Log Real Earnings per Capita, by Recession

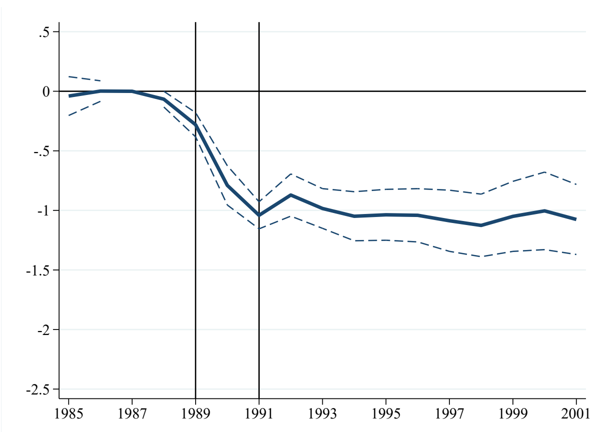
(a) 1973–1975 Recession



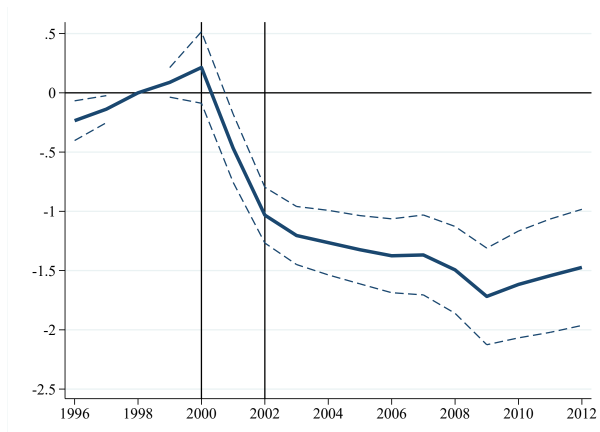
(b) 1980–1982 Recession



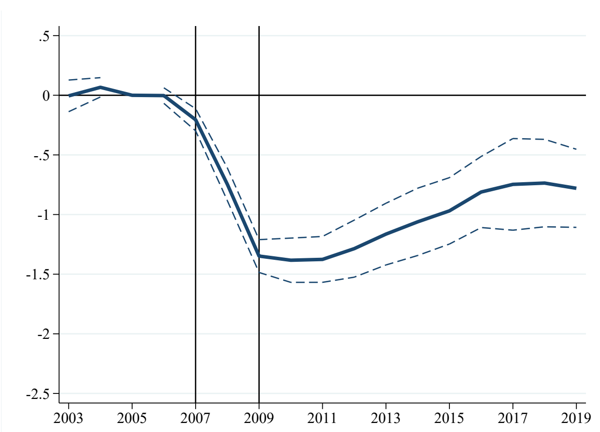
(c) 1990–1991 Recession



(d) 2001 Recession

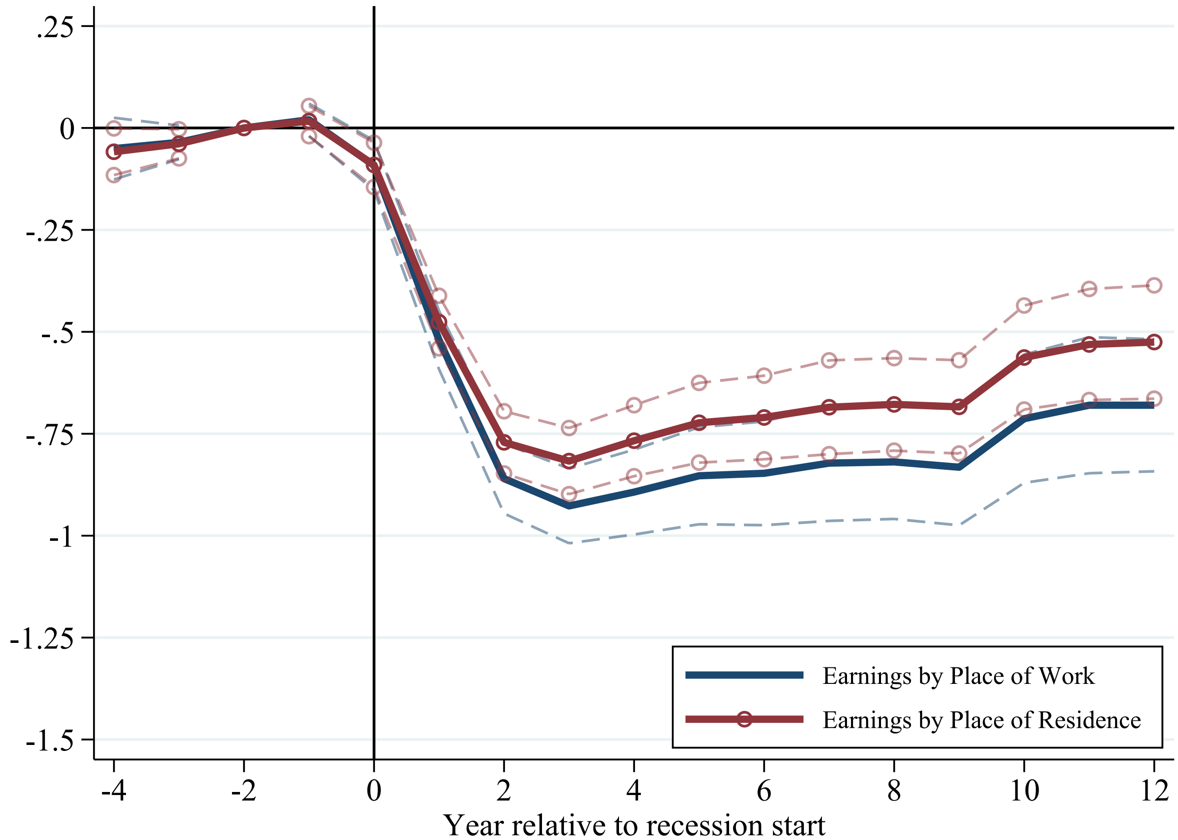


(e) 2007–2009 Recession



Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is log real earnings per capita (age 15+). See notes to Figure 3.
Source: Authors' calculations using BEAR and SEER data.

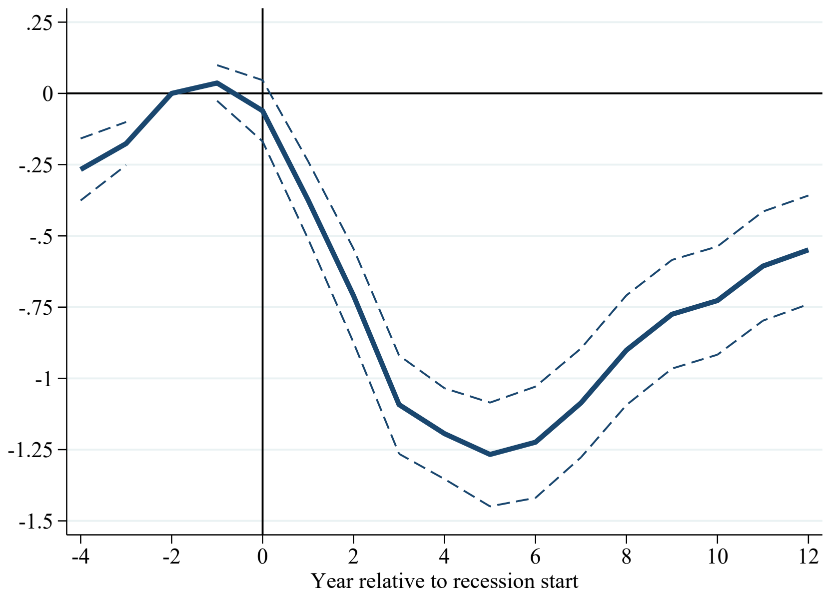
Appendix Figure 8: The Evolution of Metropolitan Area Log Real Earnings Per Capita, Robustness to Different Earnings Measures



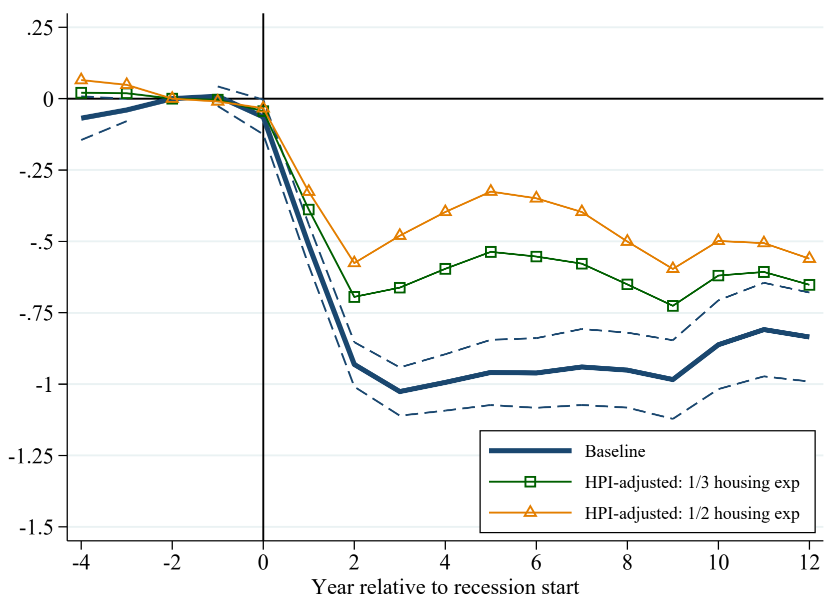
Notes: Figure reports estimates of equation (1). The dependent variables are log real earnings per capita (age 15+), either by place of work or place of residence, as indicated in the legend. The denominator of population is the same, but the numerator is different. Because proprietors' income cannot be separated from earnings by place of residence, both earnings measures include proprietors' income; this is distinct from the earnings measure in Panel C of Figure 4, which excludes proprietors' income. There are 358 metropolitan areas in the sample.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 9: The Evolution of Metropolitan Area Log Housing Prices and Price-Adjusted Log Earnings per Capita After Recessions

(a) Log Housing Price Index

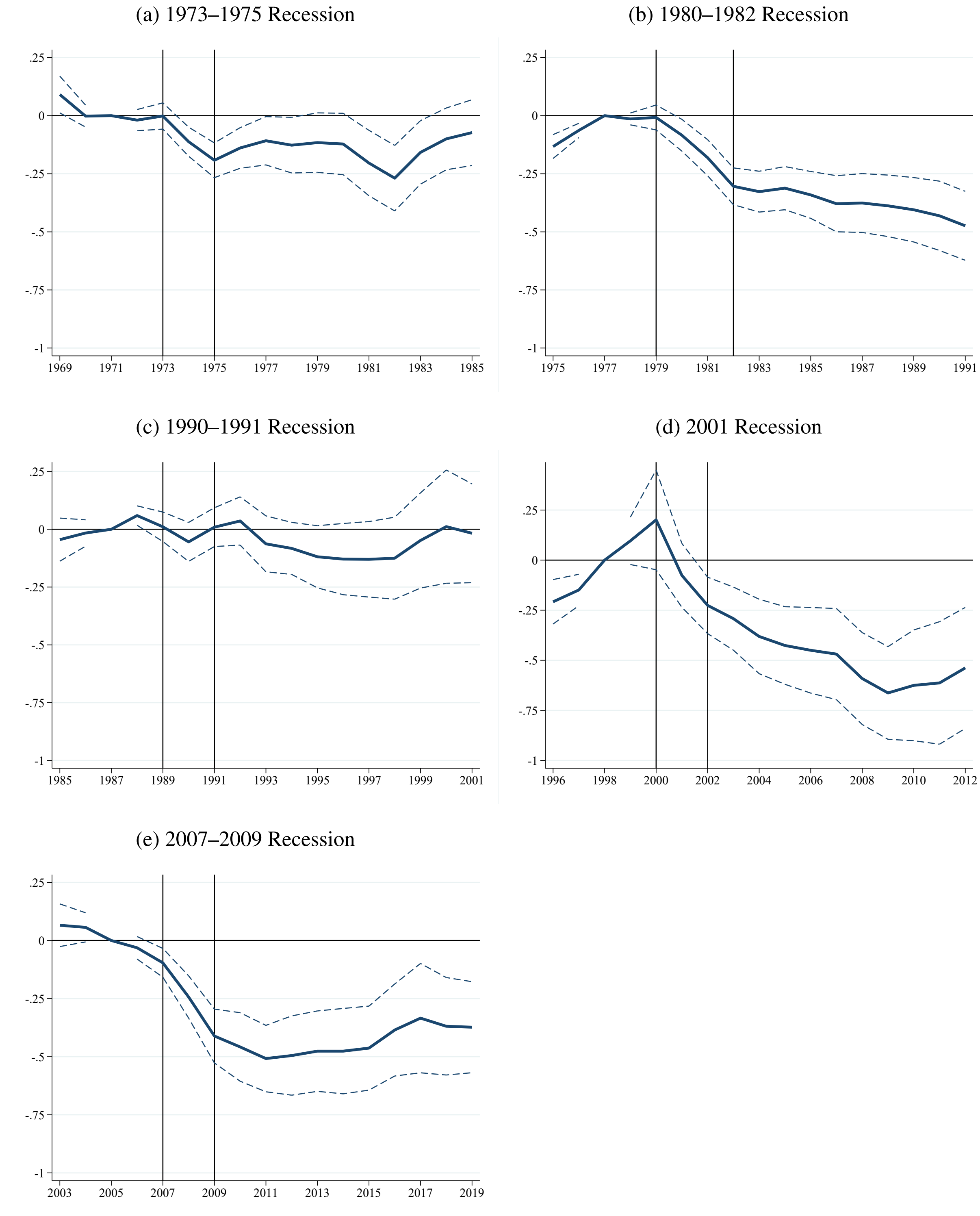


(b) Log Earnings per Capita, Without and With Price Adjustments



Notes: Figure reports estimates of equation (1). The dependent variable in Panel A is the log of the Federal Housing Finance Agency Housing Price Index. Panel B repeats the baseline estimates of log earnings per capita as in Panel C of Figure 4 alongside estimates adjusted for the price changes from panel A under two scenarios: housing representing one-third of expenditures and housing representing one-half of expenditures.
Source: Authors' calculations using FHFA, BEAR, and SEER data.

Appendix Figure 10: The Evolution of Metropolitan Area Log Real Earnings per Worker, by Recession



(a) 1973–1975 Recession

(b) 1980–1982 Recession

(c) 1990–1991 Recession

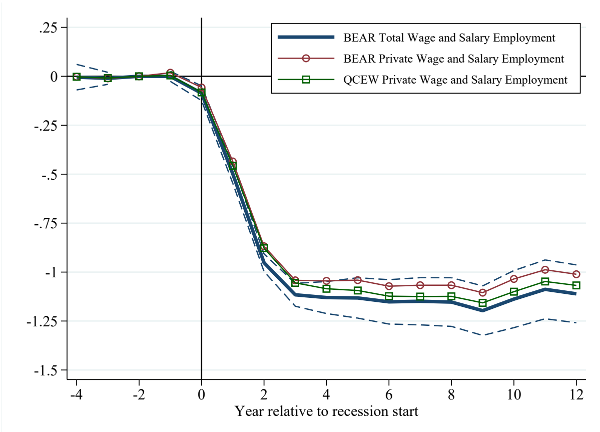
(d) 2001 Recession

(e) 2007–2009 Recession

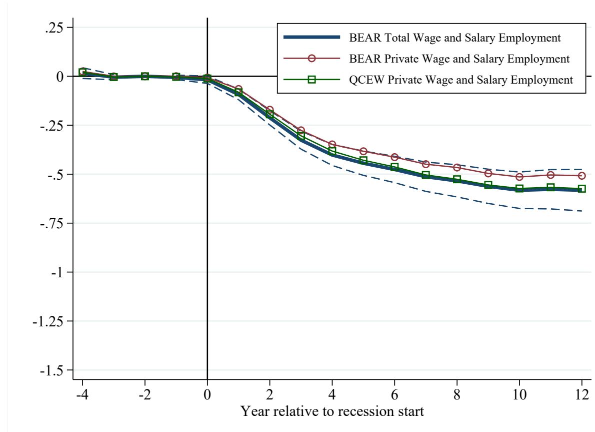
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is log real earnings per wage and salary worker. See notes to Figure 3.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 11: The Evolution of Metropolitan Area Labor Market Outcomes After Recessions, Robustness to Different Log Employment Change Measures

(a) Log Employment



(b) Log Population



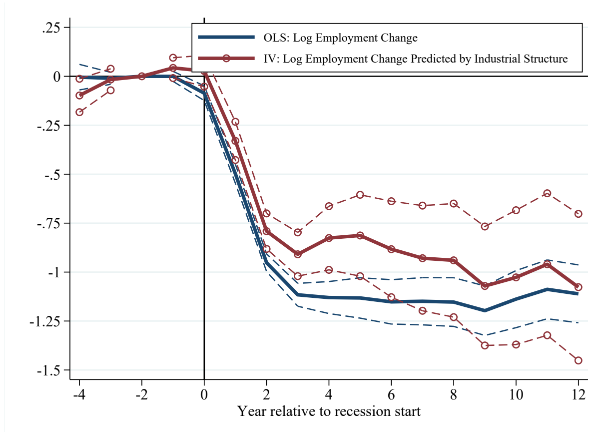
(c) Log Employment-Population Ratio

(d) Log Real Per Capita Earnings

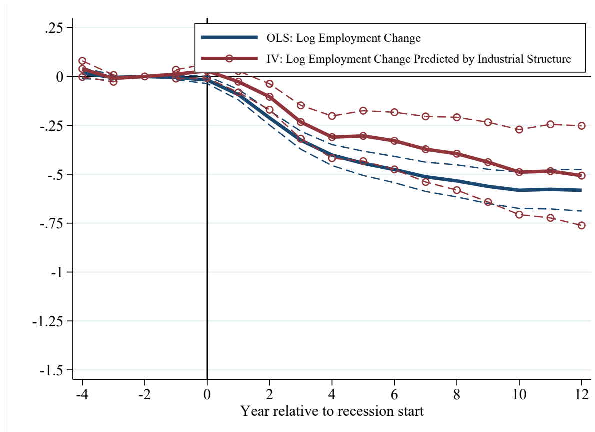
Notes: Figure reports estimates of equation (1). The dependent variable is log wage and salary employment in Panel A, log population age 15 and above in Panel B, the log ratio of wage and salary employment to population age 15 and above in Panel C, and log real earnings per capita (age 15+) in Panel D. The key independent variable is indicated in the legend. For independent variables besides BEA total wage/salary employment, we normalize the coefficients by multiplying point estimates by the ratio of the standard deviation of the independent variable to the standard deviation of the BEA wage/salary log employment change. The QCEW log employment change is not available for the 1973–1975 recession, and we use the BEA total wage/salary log employment change as the key explanatory variable for this recession to ensure that all estimates are based on all recessions. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area. See notes to Figure 4.
Source: Authors' calculations using BEAR, QCEW, and SEER data.

Appendix Figure 12: The Evolution of Metropolitan Area Labor Market Outcomes After Recessions, Robustness to Using Instrumental Variable Based on Pre-Existing Industrial Structure

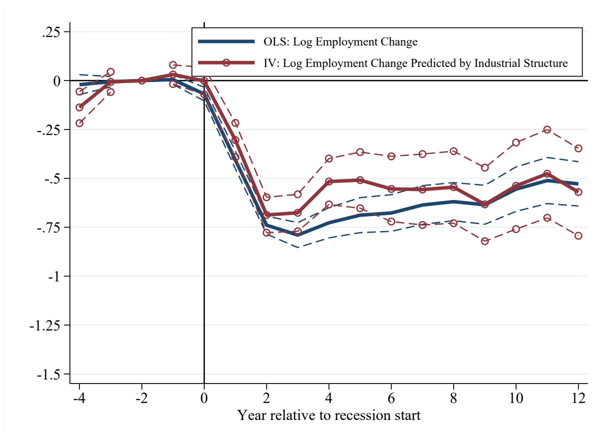
(a) Log Employment



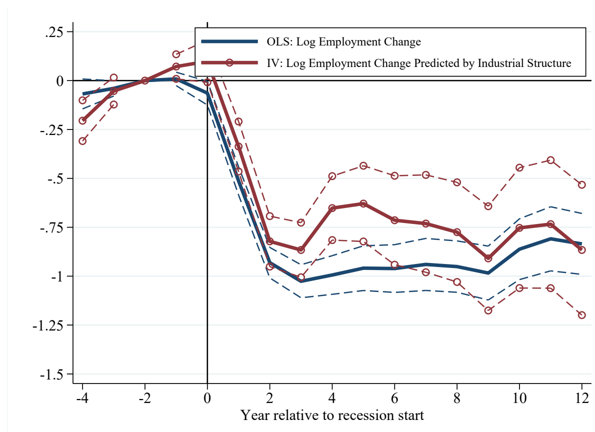
(b) Log Population



(c) Log Employment-Population Ratio

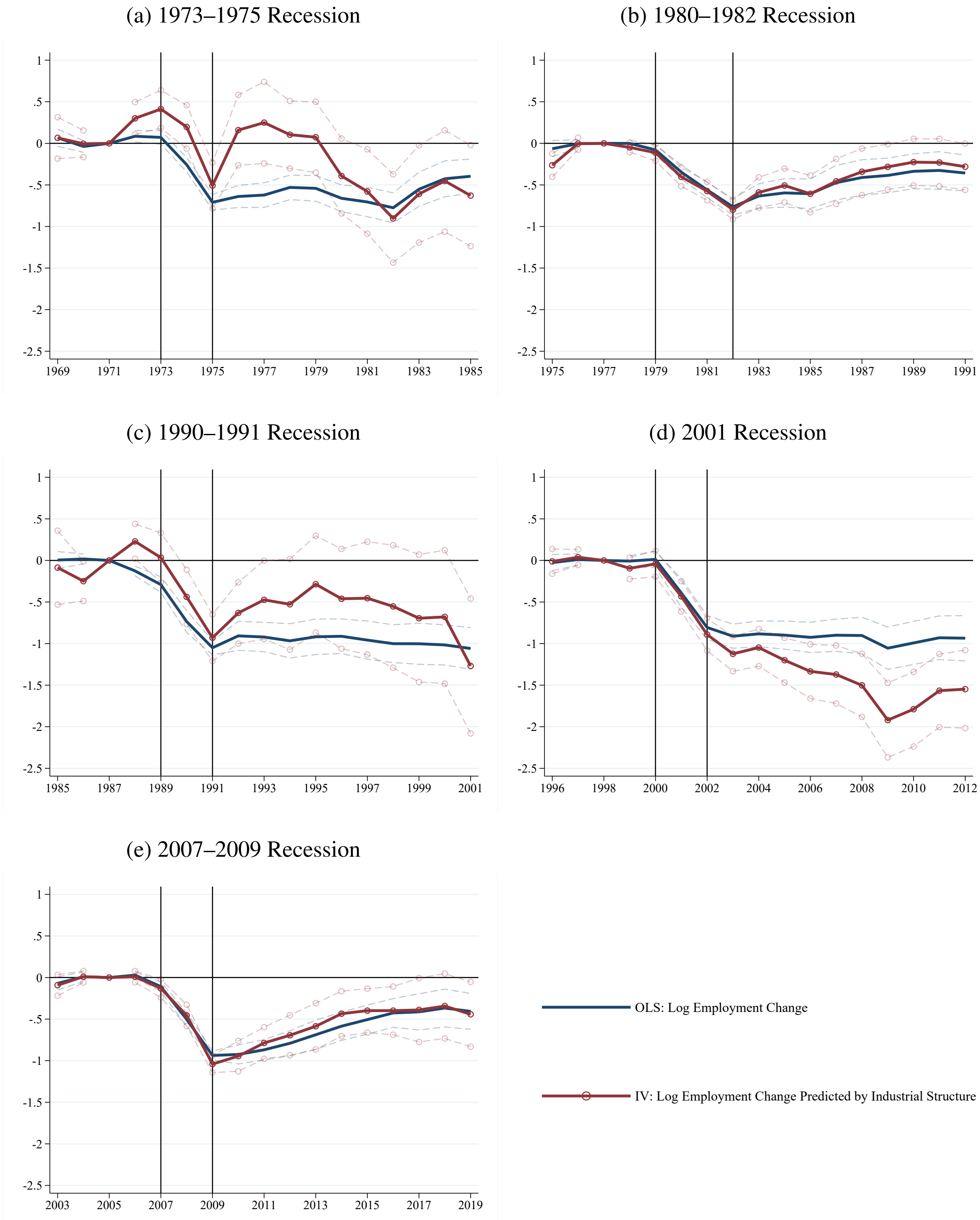


(d) Log Real Per Capita Earnings



Notes: Figure reports estimates of equation (1). The dependent variable is log wage and salary employment in Panel A, log population age 15 and above in Panel B, the log ratio of wage and salary employment to population age 15 and above in Panel C, and log real earnings per capita (age 15+) in Panel D. The key independent variable is the change in log wage and salary employment during the recession from BEAR data. The estimates in red circles are based on using the log employment change during the recession predicted by pre-existing industrial employment shares and nationwide log employment changes during the recession (Bartik, 1991) as an instrumental variable. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area. See notes to Figure 4.
Source: Authors' calculations using BEAR and SEER data.

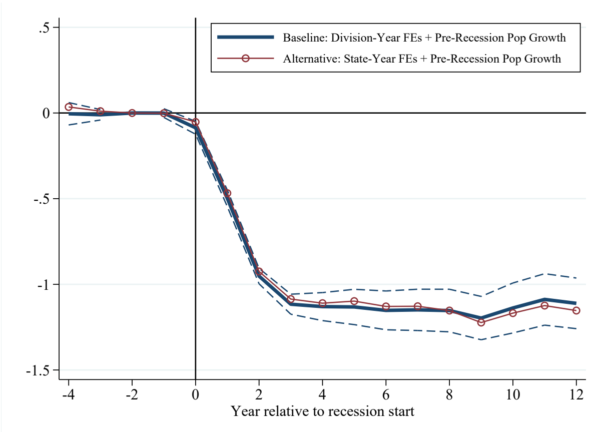
Appendix Figure 13: The Evolution of the Metropolitan Area Log Employment-Population Ratio After Recessions, Robustness to Using Instrumental Variable Based on Pre-Existing Industrial Structure, by Recession



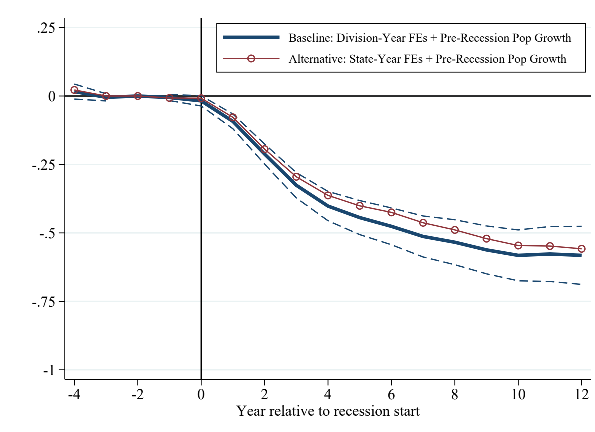
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is log wage and salary employment in Panel A, log population age 15 and above in Panel B, the log ratio of wage and salary employment to population age 15 and above in Panel C, and log real earnings per capita (age 15+) in Panel D. The key independent variable is the change in log wage and salary employment during the recession from BEAR data. The estimates in red circles are based on using the log employment change during the recession predicted by pre-existing industrial employment shares and nationwide log employment changes during the recession (Bartik, 1991) as an instrumental variable. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area. See notes to Figure 4.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 14: The Evolution of Metropolitan Area Labor Market Outcomes After Recessions, Robustness to Controlling for State-Year Fixed Effects

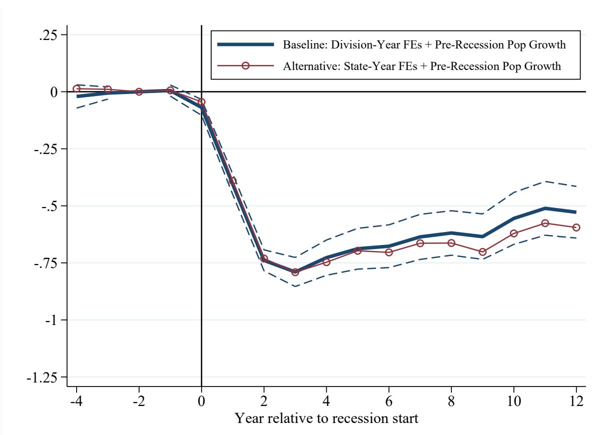
(a) Log Employment



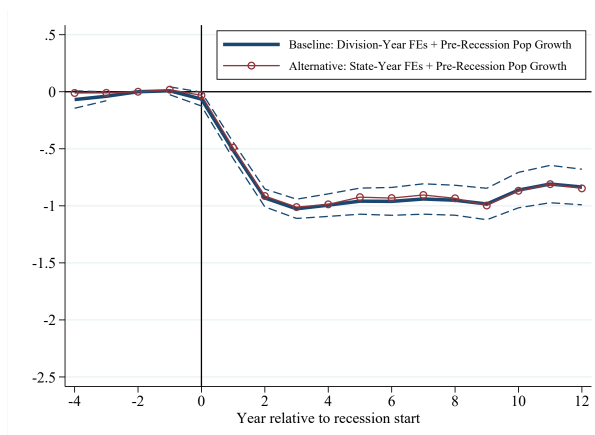
(b) Log Population



(c) Log Employment-Population Ratio

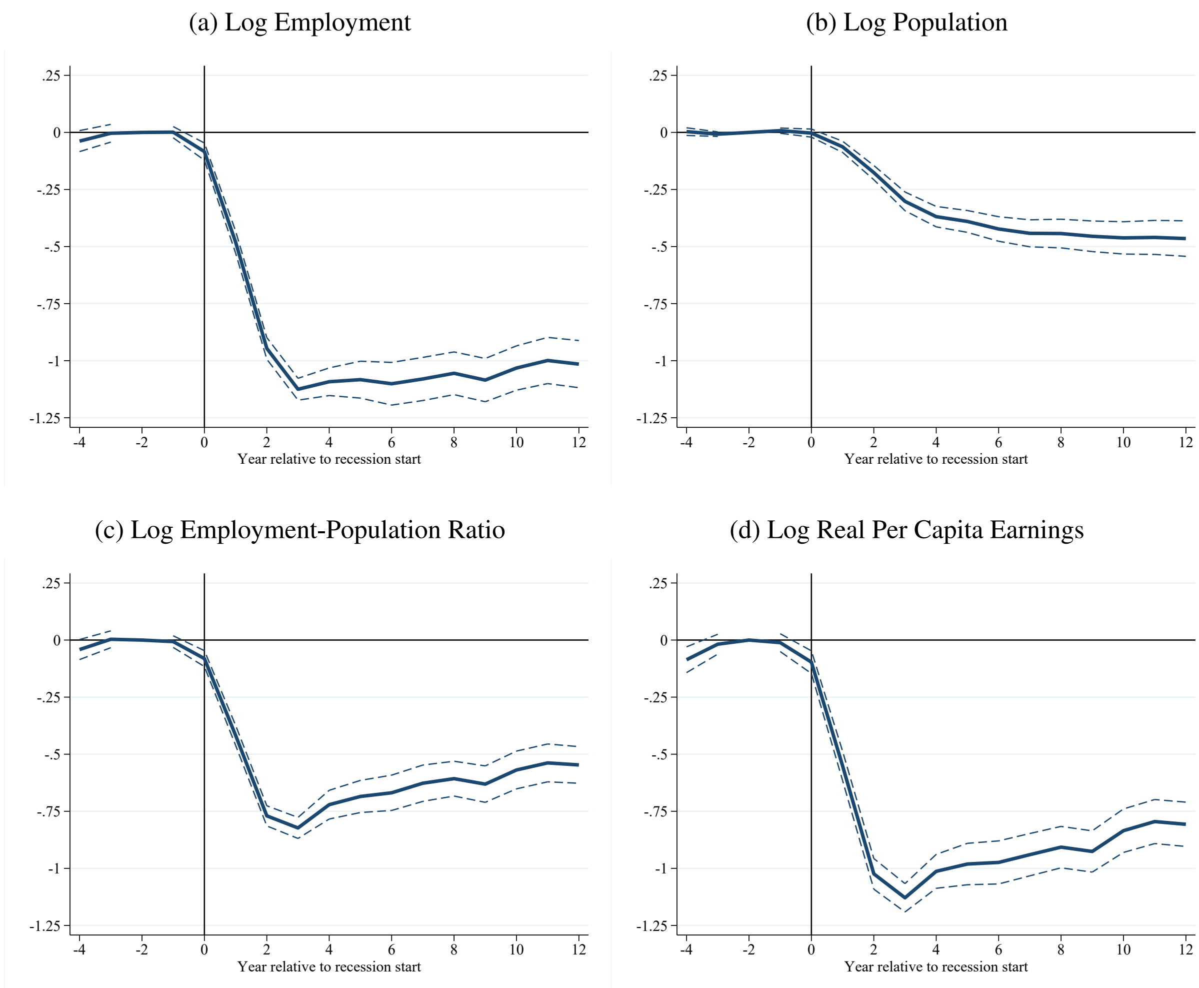


(d) Log Real Per Capita Earnings



Notes: Figure reports estimates of equation (1). The dependent variable is log wage and salary employment in Panel A, log population age 15 and above in Panel B, the log ratio of wage and salary employment to population age 15 and above in Panel C, and log real earnings per capita (age 15+) in Panel D. The key independent variable is the change in log wage and salary employment during the recession from BEAR data. The estimates in the blue, solid line come from our baseline specification, which includes division-by-year fixed effects and controls for pre-recession population growth. The estimates in the red line (circle markers) come from a specification that replaces the division-year fixed effects with state-year fixed effects to control for changes over time in policies and other confounding factors at the state-level. For metro areas that lie in multiple states, we use the state holding the largest share of each metro's population in the year 2000.
Source: Authors' calculations using BEAR and SEER data.

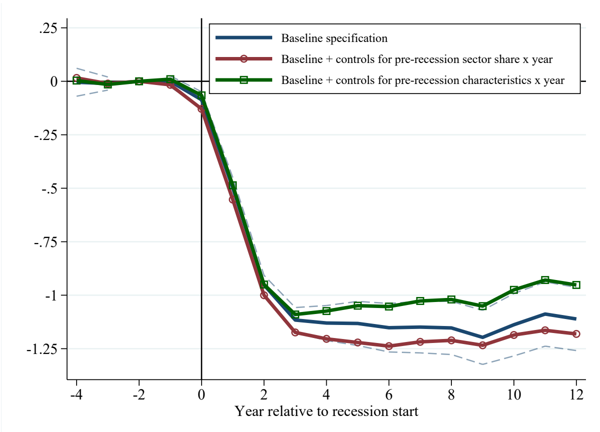
Appendix Figure 15: The Evolution of Commuting Zone Labor Market Outcomes After Recessions



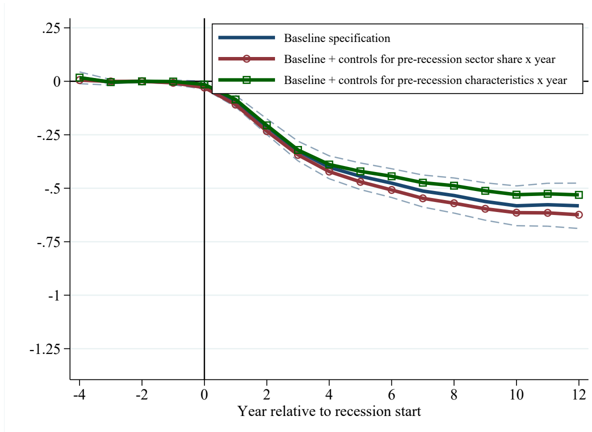
Notes: Figure reports estimates of equation (1). The dependent variable is log wage and salary employment in Panel A, log population age 15 and above in Panel B, the log ratio of wage and salary employment to population age 15 and above in Panel C, and log real earnings per capita (age 15+) in Panel D. There are 691 commuting zones in the sample. Standard errors are clustered by commuting zone. See notes to Figure 4.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 16: The Evolution of Metropolitan Area Labor Market Outcomes After Recessions, Robustness to Controlling for Pre-Recession Sector Employment Shares and Labor Market and Demographic Characteristics

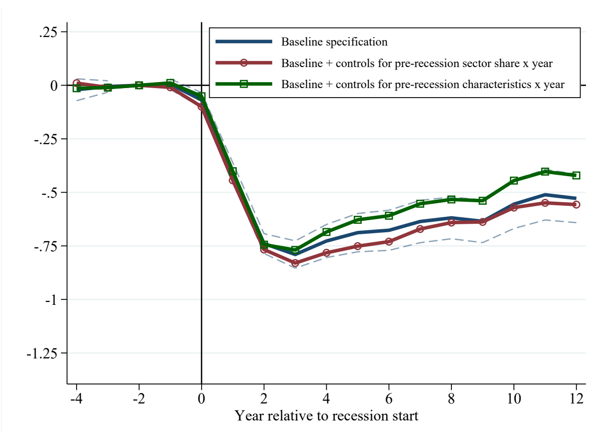
(a) Log Employment



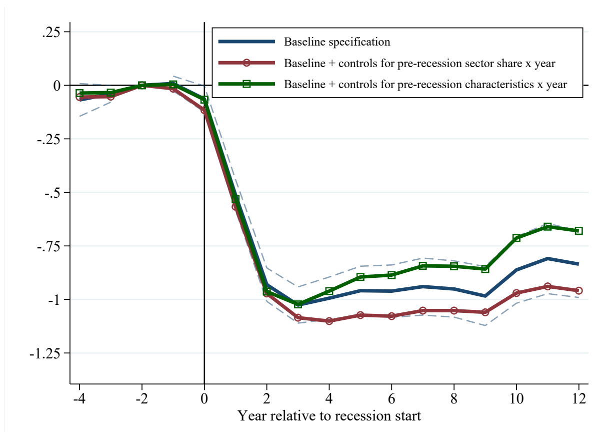
(b) Log Population



(c) Log Employment-Population Ratio

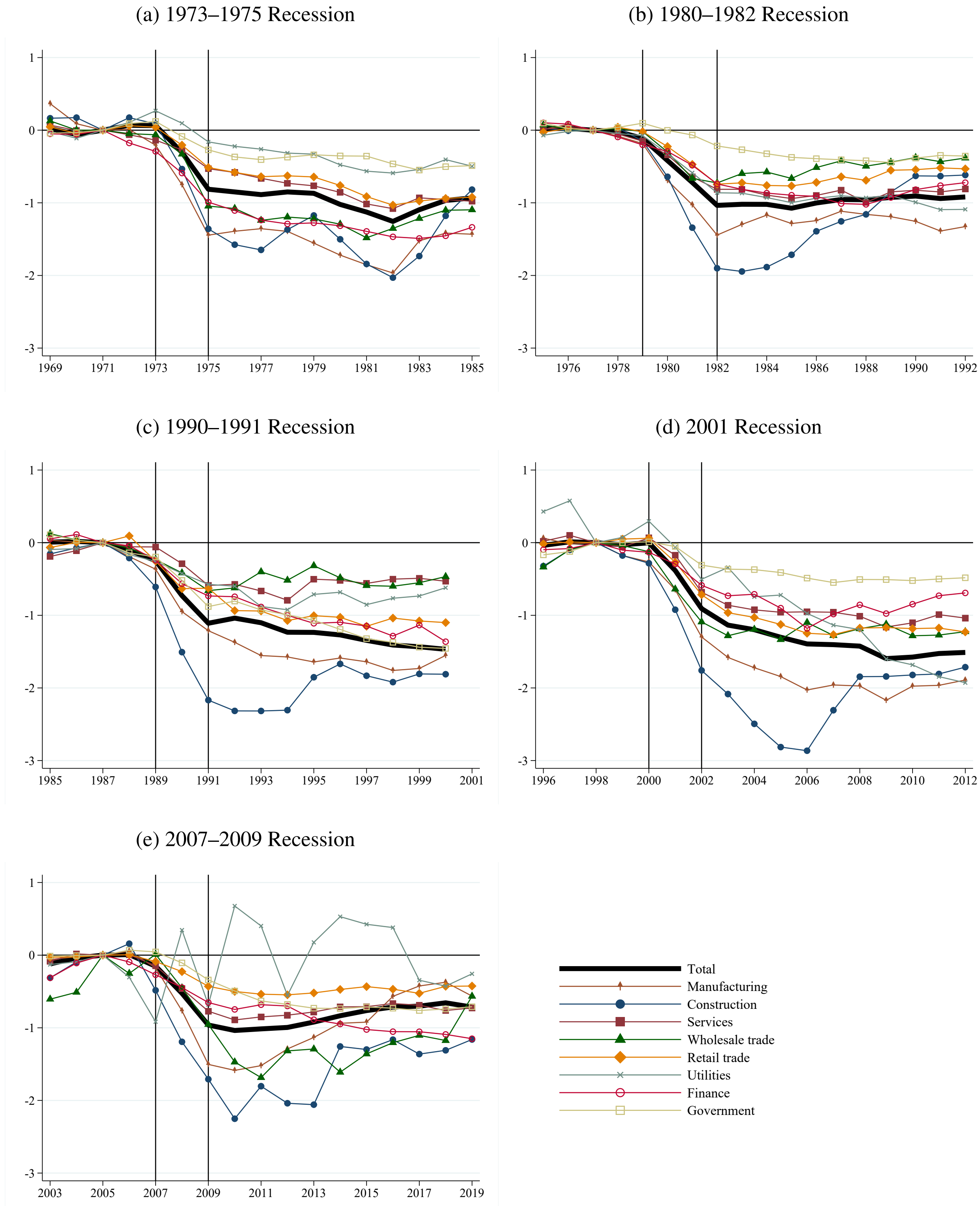


(d) Log Real Per Capita Earnings



Notes: Figure reports estimates of equation (1). The dependent variable is log wage and salary employment in Panel A, log population age 15 and above in Panel B, the log ratio of wage and salary employment to population age 15 and above in Panel C, and log real earnings per capita (age 15+) in Panel D. The key independent variable is the change in log wage and salary employment during the recession from BEAR data. The estimates in the blue, solid line come from our baseline specification, which includes division-by-year fixed effects and controls for pre-recession population growth. The estimates in the red line (circle markers) come from a specification that also includes interactions between year fixed effects and the pre-recession share of employment in ten sectors: agriculture, construction, finance, government, manufacturing, mining, retail trade, services, utilities, and wholesale trade. The estimates in the green line (square markers) come from a specification that also includes interactions between year fixed effects and several pre-recession labor market and demographic characteristics: log population, the log employment-population ratio, log real earnings per capita, the share of individuals with a high school degree or some college, the share of individuals with a BA degree or more, the share of individuals that are nonwhite, and the share of individuals that are foreign-born. There are 358 metropolitan areas in the sample. Standard errors are clustered by metropolitan area. See notes to Figure 4.
Source: Authors' calculations using BEAR and SEER data.

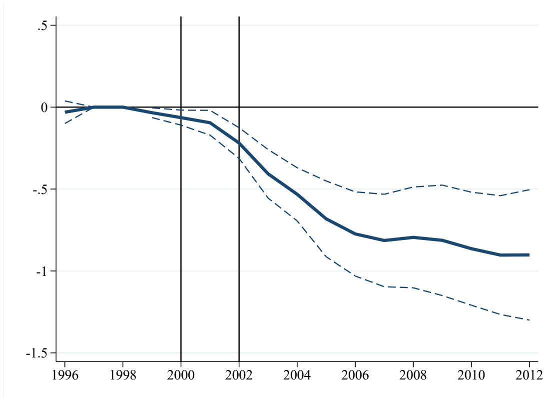
Appendix Figure 17: The Evolution of Metropolitan Area Log Employment by Sector and Recession



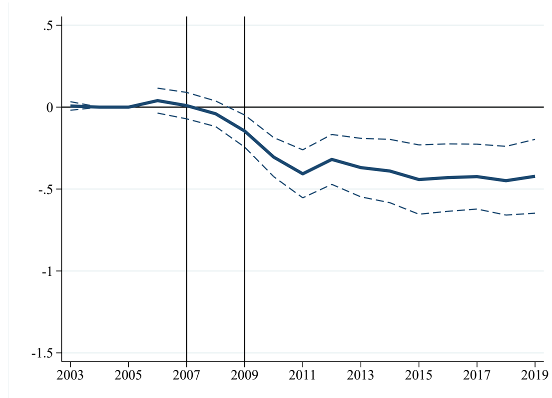
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is log employment from the indicated sector. We use BEAR data for the 1973–75, 1980–82, 1990–91, and 2007–09 recessions. We use QCEW data for the 2001 recession (due to SIC-NAICS industry seaming issues), except for government, which comes from BEAR. See notes to Figure 3. Source: Authors' calculations using BEAR, SEER, and QCEW data.

Appendix Figure 18: The Evolution of Metropolitan Area In-Migration and Out-Migration, by Recession

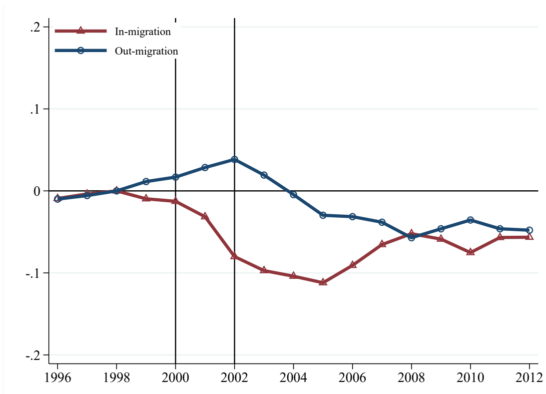
(a) 2001, DV: Population



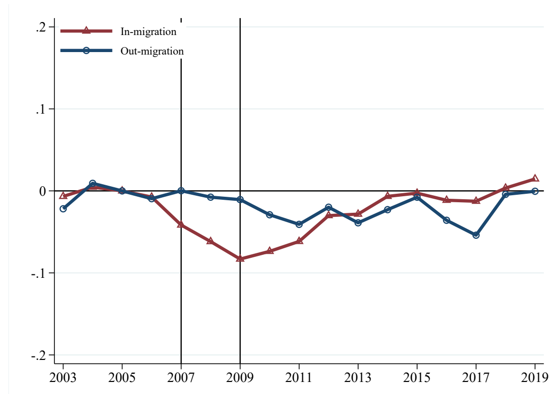
(b) 2007–2009, DV: Population



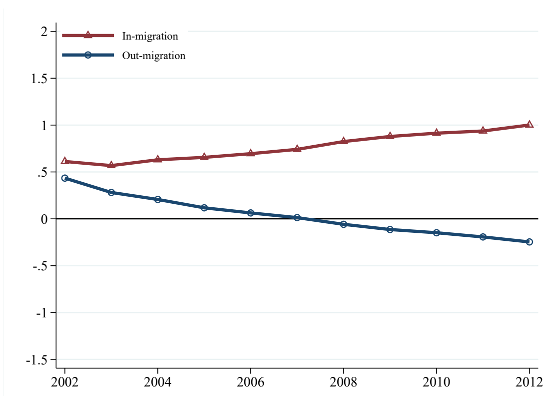
(c) 2001, DV: In-Migration and Out-Migration



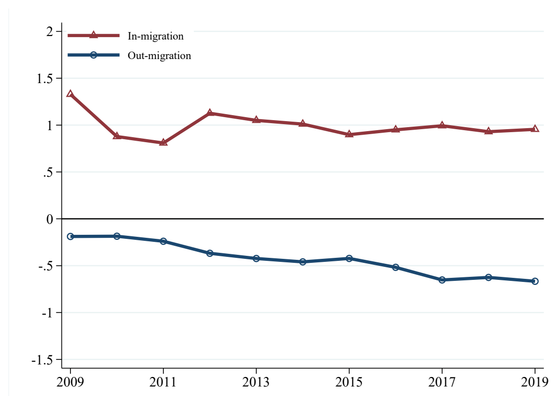
(d) 2007–09, DV: In-Migration and Out-Migration



(e) 2001, Share of Total Change Due to In-Migration and Out-Migration



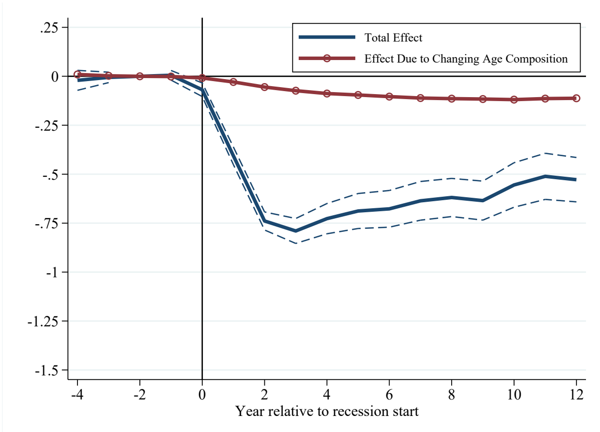
(f) 2007–09, Share of Total Change Due to In-Migration and Out-Migration



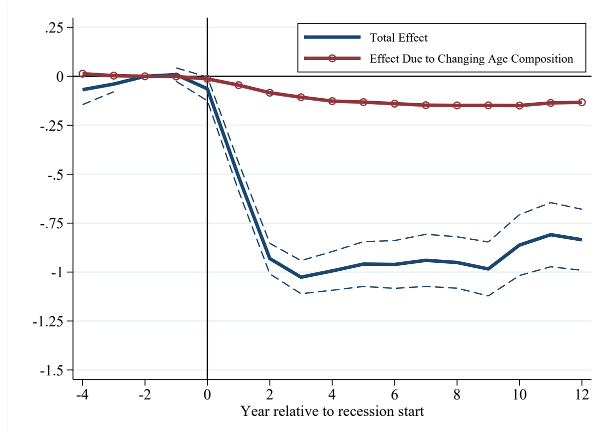
Notes: Figure reports estimates of a variant of equation (1) in which the dependent variable is the outcome in year t and we control for interactions between year fixed effects and in-migration, out-migration, and net birth rates in year $p(r) - 2$. This approach facilitates an exact decomposition using the regression coefficients (including net births, which we don't show for brevity). In Panel A, the dependent variable is the number of exemptions in year t divided by the same variable in year $p(r) - 2$. In Panel B, the dependent variables are in-migration and out-migration relative to the number of exemptions in year $p(r) - 2$. In Panel C, we divide cumulative sums of the coefficients from Panel B by the coefficients in Panel A; we multiply the out-migration coefficient by -1 so that a positive number indicates that a given population component contributes to the post-recession population decline. Regressions also include specification 2 controls described in the notes to Figure 3. Source: Authors' calculations using CBP, BEAR, and SOI data.

Appendix Figure 19: The Role of Age Distribution Shifts on the Evolution of the Log Employment-Population Ratio and Earnings per Capita After Recessions

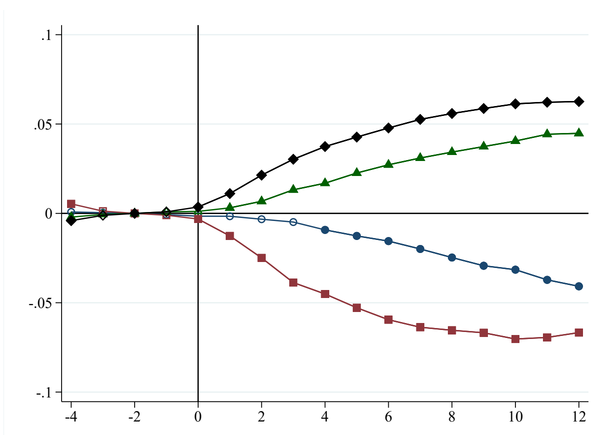
(a) Log Employment-Population Ratio



(b) Log Earnings per Capita



(c) Share of Population in Each Age Group

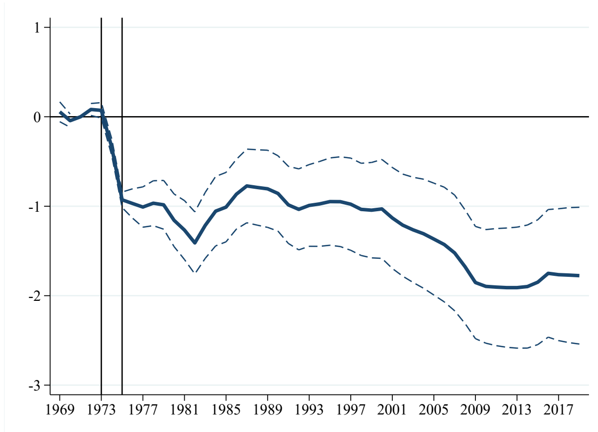


Notes: Panels A and B repeat the baseline estimates of equation (1) for the log employment-population ratio and log earnings per capita as in Panels B and C of Figure 4 but also show the predicted change in these outcomes due to post-recession changes in the age structure. The dependent variables in Panel C are the shares of the population of various ages as indicated in the legend. The estimates in Panel C are based on a variant of equation (1) in which the dependent variable in year t is a given age share and we control for interactions between year fixed effects and all-but-one age share in year $p(r) - 2$. This approach facilitates an exact decomposition using the regression coefficients. To estimate predicted changes in the first two panels, we combine the estimates from Panel C with estimates of the cross-sectional, pre-recession relationship between the log employment-population ratio or log earnings per capita and these age shares.

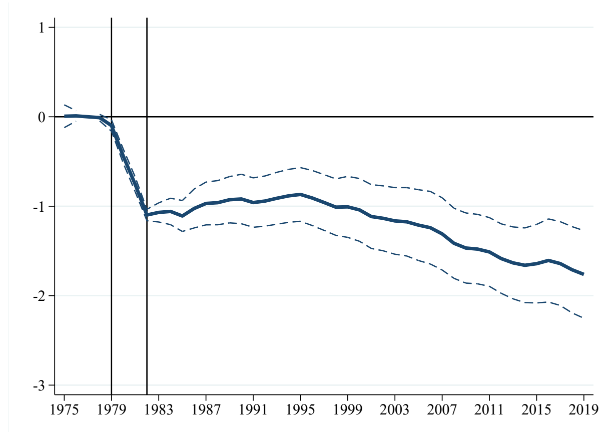
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 20: The Evolution of Metropolitan Area Log Employment After Recessions, Longer Horizon

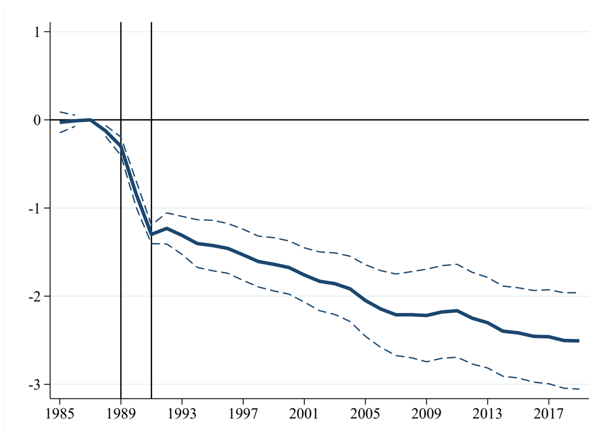
(a) 1973–1975 Recession



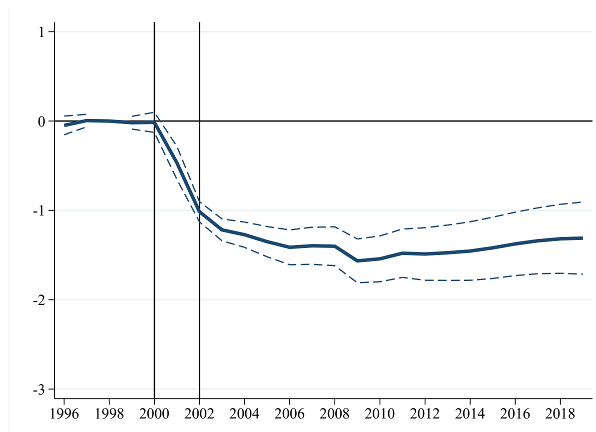
(b) 1980–1982 Recession



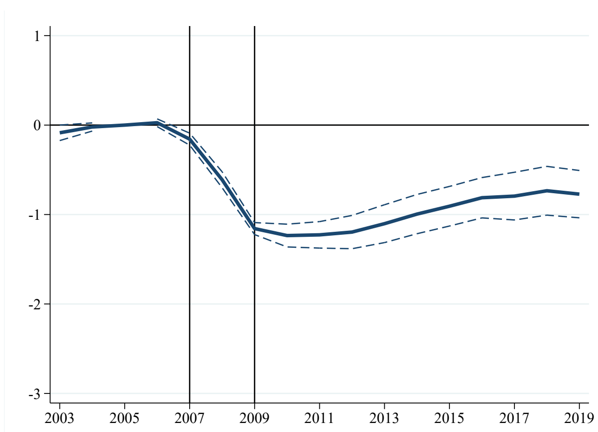
(c) 1990–1991 Recession



(d) 2001 Recession



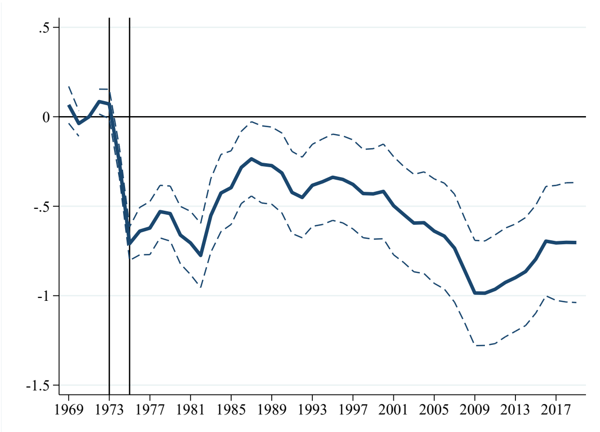
(e) 2007–2009 Recession



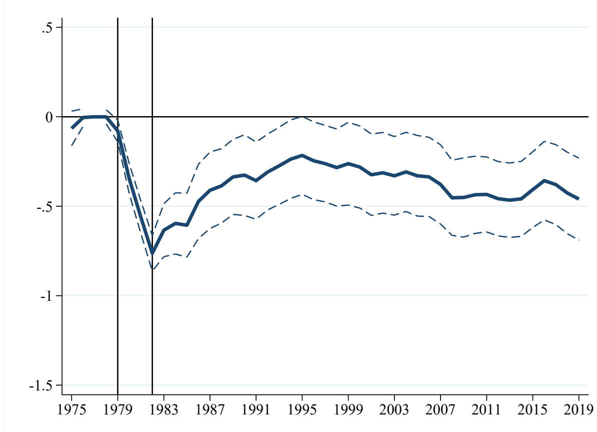
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is log wage and salary employment from BEAR data. See notes to Figure 3, which reports estimates over a shorter time horizon.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 21: The Evolution of the Metropolitan Area Log Employment-Population Ratio After Recessions, Longer Horizon

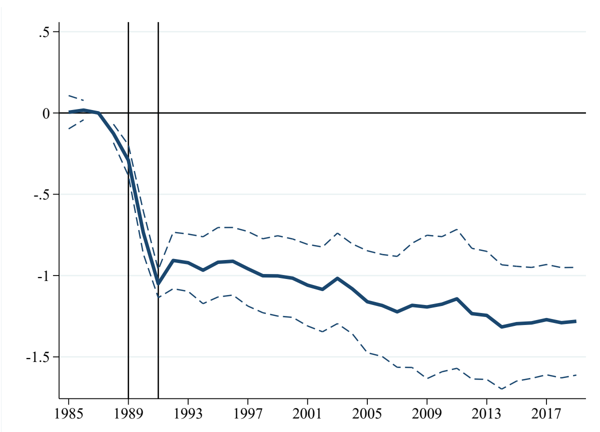
(a) 1973–1975 Recession



(b) 1980–1982 Recession

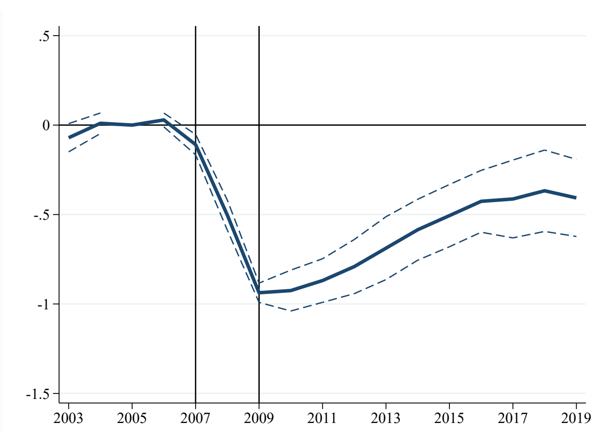


(c) 1990–1991 Recession



(d) 2001 Recession

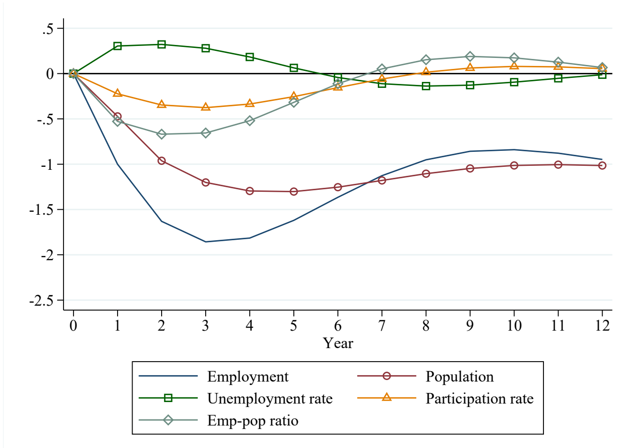
(e) 2007–2009 Recession



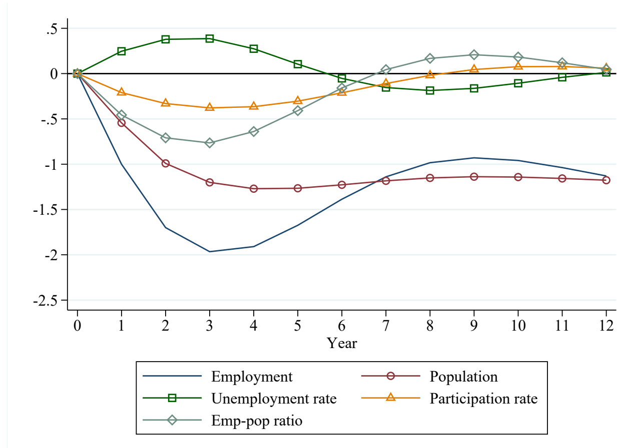
Notes: Figure reports estimates of equation (1), separately for each recession. The dependent variable is the log ratio of wage and salary employment to population age 15 and above. See notes to Figure 6, which reports estimates over a shorter time horizon.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 22: Comparison of Vector Autoregression Impulse Response Functions Estimated for Different Time Periods

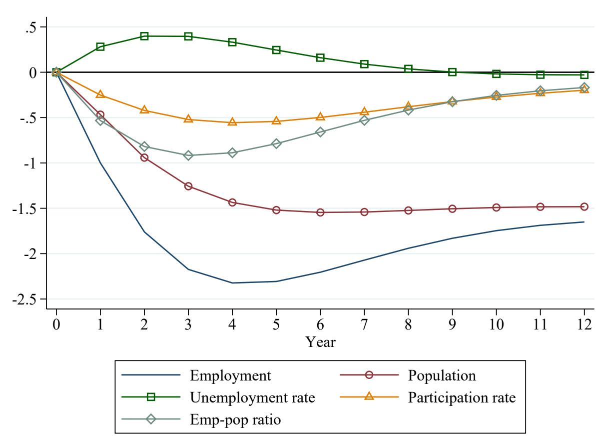
(a) Original BK Years: 1976–1990



(b) Same Number of Years, Different Period: 2003–2017



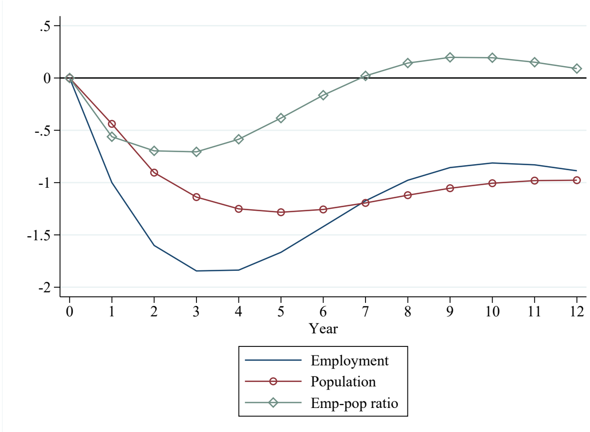
(c) Additional Number of Years: 1976–2019



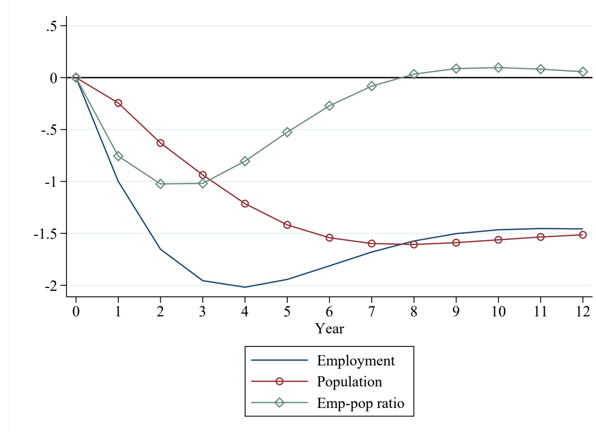
Notes: Figure shows impulse response functions of indicated variables with respect to a negative log employment shock. We construct impulse response functions for the BK VAR using estimates of equations (4)–(6). Sample contains 50 states and Washington, D.C. Panel A estimates the VAR using data from 1976–1990 as in Blanchard and Katz (1992). Panel B uses data from 2003–2017, which represents the same number of years and a similar point in the business cycle. Panel C uses data from years 1976–2019.
Source: Authors' calculations using CES and LAUS data.

Appendix Figure 23: Comparison of VAR Results for State and Metro Areas

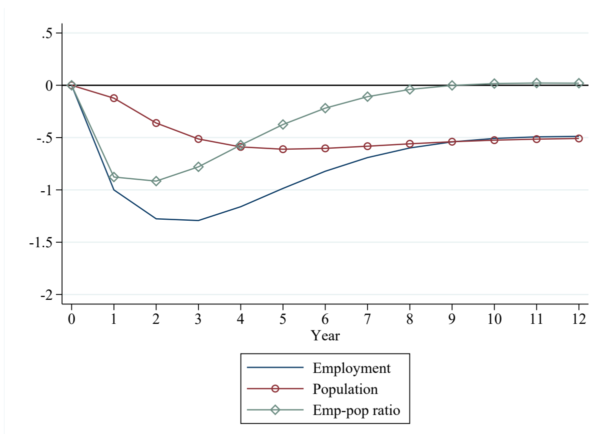
(a) State-Level Data, 1976–1990, BEA Employment and LAUS Implied Population



(b) State-Level Data, 1976–1990, BEA Employment and Census Population

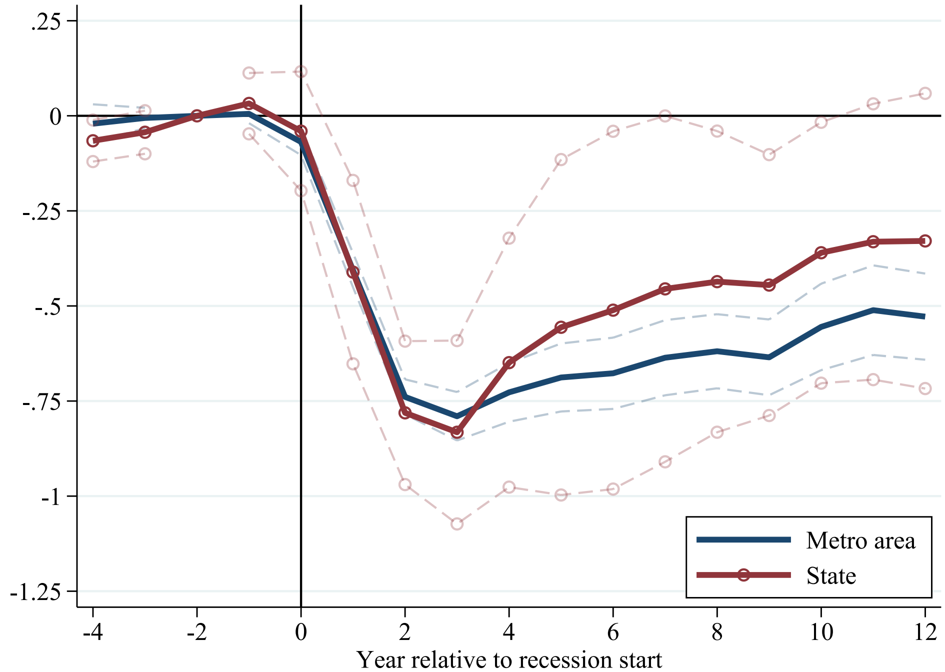


(c) Metro-Level Data, 1976–1990, BEA Employment and Census Population



Notes: Figure shows impulse response functions of indicated variables with respect to a negative log employment shock. We construct impulse response functions using estimates of a two-equation VAR where the dependent variable in the first equation is the change in log employment and the dependent variable in the second equation is the log employment-population ratio. Otherwise, we use the same lag structure as in the BK VAR. Panel A reports results after replacing the Current Employment Statistics establishment-level employment estimates used by BK with the analogous employment measure available in BEA data. Panel B reports results after using estimates of the population ages 15 and above from SEER in place of BK's approach, which estimates population as the sum of establishment-level employment and survey measures of the number of individuals who are unemployed or not in the labor force. Panel C uses the same underlying data as Panel B, but for metro areas.
Source: Authors' calculations using BEAR, CES, LAUS, and SEER data.

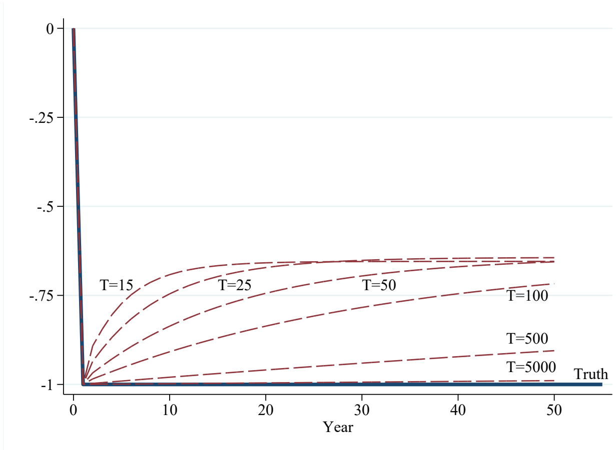
Appendix Figure 24: Comparison of Event Study Estimates for the Log Employment-Population Ratio for Metro Areas and States



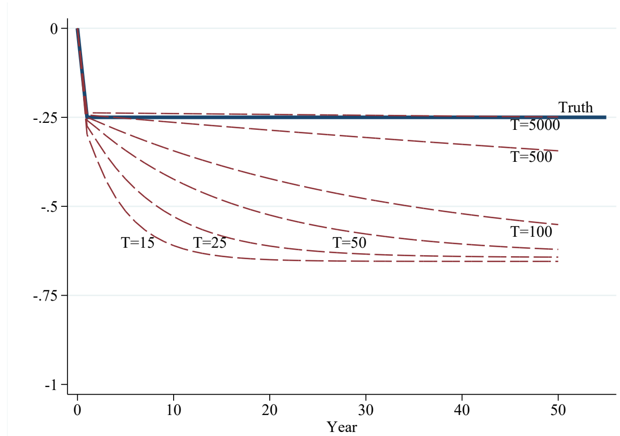
Notes: Figure reports estimates of equation (1). The dependent variable is the log ratio of wage and salary employment to population age 15 and above, and the key independent variable is the change in log wage and salary employment during the recession from BEAR data. The estimates in the solid blue line are for metro areas, and the estimates in the red line with circle markers are for states. The metro specification includes division-year fixed effects, and the state specification includes region-year fixed effects. Both estimates control for the pre-recession change in population. Standard errors are clustered by metro area or state.
Source: Authors' calculations using BEAR and SEER data.

Appendix Figure 25: Finite Sample Bias from Vector Autoregression Impulse Response Functions for All Outcomes

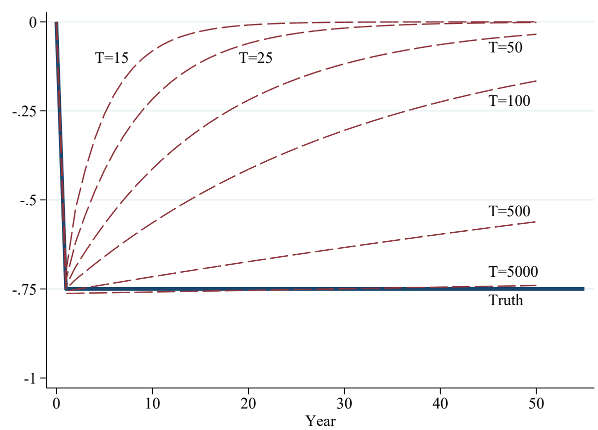
(a) Log employment



(b) Log population



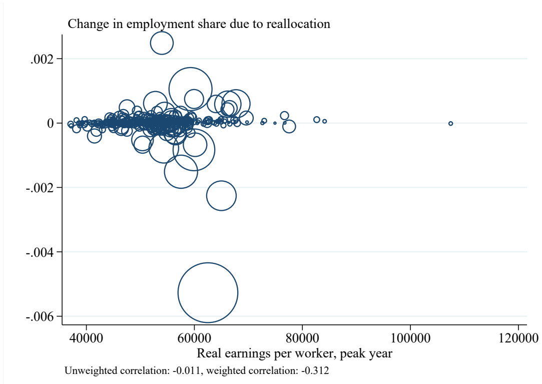
(c) Log employment-population ratio



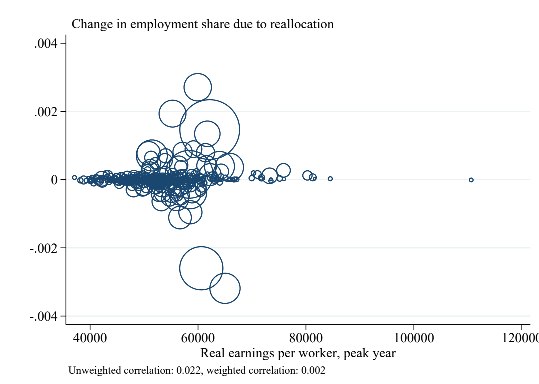
Notes: Figure displays average estimates of impulse response functions of the indicated variable with respect to a negative log employment shock based on estimates of equations (7)–(8). We simulate data following equations (12)–(14). We set $e_{i,0} \sim \mathcal{N}(13.88, 1.03^2)$, $p_{i,0} \sim \mathcal{N}(14.43, 1.05^2)$, $\varepsilon_{i,e,t} \sim \mathcal{N}(0, 0.015^2)$, $\varepsilon_{i,p,t} \sim \mathcal{N}(0, 0.015^2)$, $\phi = -0.75$, and $N = 50$. Results are based on 499 Monte Carlo simulations.

Appendix Figure 26: Correlation between Reallocation-Induced Change in Employment Share and Peak Year Earnings per Worker

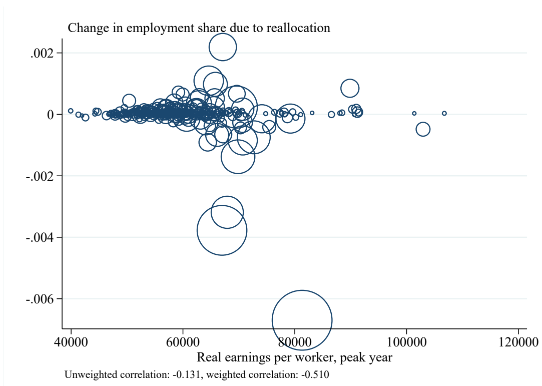
(a) 1973–1975 Recession



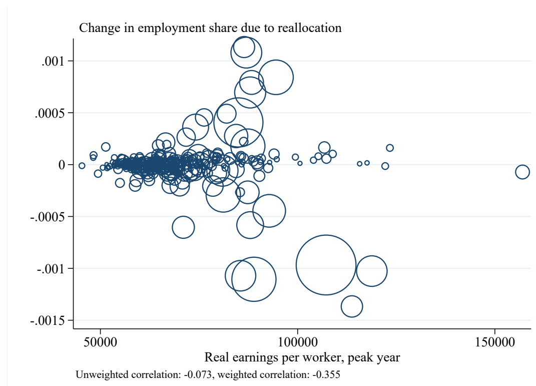
(b) 1980–1982 Recession



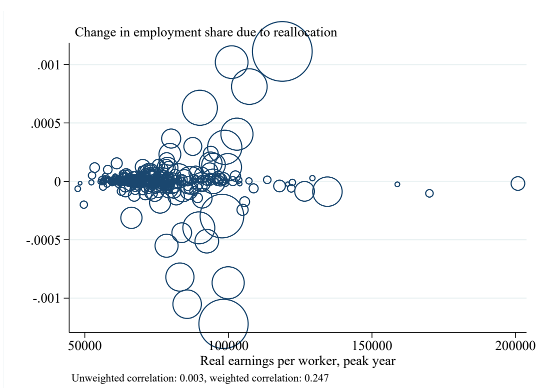
(c) 1990–1991 Recession



(d) 2001 Recession



(e) 2007–2009 Recession



Notes: Change in metro employment share is the employment share under the counterfactual minus the employment share in the business cycle peak year. Marker size is proportional to peak year employment share. Unweighted and peak-year-employment-share weighted correlations are reported. See notes to Appendix Table 10.
Source: Authors' calculations using BEAR and SEER data.