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Research Article

The Great Recession and America's geography of unemployment

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Abstract

BACKGROUND
The Great Recession of 2007–2009 was the most severe and lengthy economic crisis in the US since the Great Depression of the 1930s. The impacts on the population were multi-dimensional, but operated largely through local labor markets.

OBJECTIVE
To examine differences in recession-related changes in county unemployment rates and assess how population and place characteristics shaped these patterns.

METHODS
We calculate and decompose Theil Indexes to describe recession-related changes in the distribution of unemployment rates between counties and states. We use exploratory spatial statistics to identify geographic clusters of counties that experienced similar changes in unemployment. We use spatial regression to evaluate associations between county-level recession impacts on unemployment and demographic composition, industrial structure, and state context.

RESULTS
The recession was associated with increased inequality between county labor markets within states, but declining between-state differences. Counties that experienced disproportionate recession-related increases in unemployment were spatially clustered and characterized by large shares of historically disadvantaged racial and ethnic minority populations, low educational attainment, and heavy reliance on pro-cyclical industries. Associations between these sources of vulnerability were partially explained by unobserved state-level factors.

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CONCLUSIONS
The local consequences of macroeconomic trends are associated with county population characteristics, and the structural contexts and policy environments in which they are embedded. The recession placed upward pressure on within-state disparities in local labor market conditions.

CONTRIBUTION
To present new estimates of the recession's impact on local labor markets, quantify how heterogeneous impacts affected the distribution of unemployment prevalence, and identify county characteristics associated with disproportionately large recession-related increases in unemployment.

1. Introduction

The Great Recession of 2007 to 2009 was the most severe and lengthy economic crisis since the Great Depression in the 1930s. Precipitous decreases in housing values and ownership, employment, and equity markets contributed to marked declines in the economic wellbeing of many Americans. These changes also triggered several broad social and demographic changes that will likely have significant consequences in years to come. Although the Great Recession has been framed as a national phenomenon (Mitchell 2013), its effects varied considerably across different places within the country (Campbell and Sances 2013; Coleman-Jensen 2012; Owens and Cook 2013; Slack and Myers 2012). Such spatial variation in the recession's impact has likely reshaped social and economic inequality between places and across broader geographic spaces. Yet the precise extent and character of such changes remain unknown, as do the factors that differentiated recession impacts between places. Were pre-recession trends in spatial inequality exacerbated by the Recession, or has it produced a qualitatively new social and economic geography in the United States (US)? To what extent does variation in the recession's impact between places reflect differences in population composition versus structural factors? These and related questions remain largely unanswered to date.

This paper attempts to address these issues, and to contribute to knowledge about spatial inequality more broadly by examining recession-related changes in the distribution of one specific measure of economic wellbeing – the unemployment rate – between US counties and states, and by identifying population and place characteristics that underlie such changes. Our focus on unemployment is motivated by the central role work plays in many aspects of social and economic life in the US. We argue that understanding unemployment dynamics at the local level can provide insight into how

the recession affected broader forms of social and economic disadvantage and its distribution across local areas. These findings may be of interest to policymakers planning for future downturns. By knowing the characteristics of places that were disproportionally impacted by the recession, federal, state, and local leaders can anticipate the types of communities most likely to be negatively affected.

To reach our overall goal we address three specific objectives. First, we describe recession-related changes in the distribution of unemployment prevalence between counties and within and between states. Second, we identify geographic clusters of counties that experienced similar changes in unemployment during the recession. Third, we use spatial regression to evaluate associations between county-level changes in unemployment during the recession and demographic composition, industrial structure, and state context. Our findings contribute new evidence regarding the Great Recession's spatially uneven effects on local labor markets and communities, and yield new insight into the social and demographic forces shaping local vulnerability to macroeconomic change.

2. Work, labor markets, and the Great Recession

We examine the recession's impact on local labor markets, which we measure by tracking changes in county unemployment rates. Our focus on unemployment is motivated by the centrality of work (or lack thereof) in the lives of most Americans, and the consequences of changing work patterns for individuals and the communities they inhabit. Given the strong links between unemployment and multiple forms of social and economic disadvantage (Brand 2015), county unemployment rates serve as a proxy for the prevalence of disadvantaged populations and a broad set of correlated social problems at the local level.

Formal work remains the most widespread means of accumulating economic resources. In 2013 the official US poverty rate was 14.5%. However, it was 32.3% among unemployed working-age adults versus just 7.3% among workers (DeNavas-Walt and Proctor 2014). Further, many public sector supports are increasingly targeted at workers, effectively increasing the penalty for unemployment. Examples range from work requirements for participation in the Supplemental Nutrition Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF) to the Earned Income Tax Credit (EITC), which has largely replaced unconditional cash transfers and is limited to low-income workers.

The consequences of unemployment also extend beyond short-term economic hardship. Because certain groups are less likely than others to have access to full-time employment, the labor market is a mechanism of socioeconomic stratification (Wilson,

Tienda, and Wu 1995). Work also provides a site for building skills and socialization into mainstream norms essential for career advancement (Newman 1999). By contrast, unemployment is often associated with adverse social and psychological outcomes. A recent review by Brand (2015) documents the links between job loss and declines in physical and mental health, social isolation, family disruption, and adverse outcomes among children. Brand also documents the persistence of these effects. The immediate consequences of unemployment may feed back and undermine one's ability to re-enter the workforce or attain pre-unemployment job quality and earnings. Finally, research has shown that exposure to high-unemployment contexts can have effects on social and health outcomes regardless of individual characteristics (Leventhal and Brooks-Gunn 2003). Through these mechanisms, unemployment increases the risk of experiencing long-term disadvantage.

In addition to the adverse consequences of unemployment, the process of job displacement often reflects important social and economic forces. For example, race- and gender-based discrimination may increase the likelihood of job loss among certain demographic groups, particularly during periods of poor macroeconomic conditions (Couch and Fairlie 2010). Declines in unionization and shifts in the structure of production (among other changes) have also increased the share of the labor force employed in precarious jobs and at risk of experiencing poor labor market outcomes (Brady, Baker, and Finnigan 2013; Kalleberg 2011; Lobao 2014; Lobao and Hooks 2003). Disproportionate increases in unemployment in particular places should therefore be viewed as both the product of social processes creating vulnerability in a given labor market and as a cause of multiple disadvantages in communities experiencing further job losses.

The Great Recession had a profound impact on labor markets. The level and duration of unemployment increased markedly as the national economy contracted (Freeman 2013). Between 2007 and 2009 over 7.5 million jobs were lost, pushing the national unemployment rate from 4.4% to 10.1%. For many who lost jobs, replacements were difficult to find. By 2010 more than a third of the unemployed had been searching for work for at least six months (Grusky, Western, and Wimer 2011). These historically high levels of long-term unemployment put strains on households affected by job displacement and on the public sector, as evidenced by unprecedented spending increases in federal and state transfer programs (e.g., food stamps, unemployment insurance). Indeed, the unemployment crisis was not limited to those who lost jobs, but also affected the households and places in which they lived (e.g., Jones and Pridemore 2016). As such, we argue that county unemployment rates provide one meaningful indicator of how working-age adults, as well as their dependents and fellow community members, were affected by the recession. Below, we discuss

explanations of why we expect the effects of the recession on unemployment to have varied geographically.

3. Conceptual framework

3.1 Space and place in the US

Our approach to studying the recession's spatially differentiated impact on county labor markets is premised on the ideas that, first, space and place are key arenas in which social inequality emerges, operates, and changes over time; and second, that middle-range spatial scales and subnational inequality are important foci for research (Lobao 2004; Howell, Porter, and Matthews 2016; Tickamyer 2000). Social scientists have found significant between-place differences in many indicators of wellbeing in the US, including employment (Smith and Glauber 2013), income (Peters 2013), education (Roscigno, Tomaskovic-Devey, and Crowley 2006), poverty (Cotter, Hermsen, and Vanneman 2007; Curtis, Voss, and Long 2012), program participation (Slack and Myers 2014), health and mortality (Burton et al. 2013; Sparks and Sparks 2010), and residential segregation (Downey 2003). Many of these studies examine outcomes at the county level, but others explore employment, wage, educational, and health disparities at other geographic scales (e.g., states, regions, and (non)metropolitan areas) (Lochner et al. 2001; Smith and Glauber 2013). Decisions regarding the unit of analysis are analytically important because they may affect inferences about how outcomes are distributed across space (Openshaw 1983; Peters 2012). Yet scale is substantively important as well: Social processes that produce and reproduce inequality operate at particular scales. Close attention to geography is therefore necessary for targeting policy and political action (Lobao, Hooks, and Tickamyer 2008).

In this paper we explore variation in recession-related unemployment rate changes between counties and states. Counties are an appropriate scale for studying local variation in unemployment across the US. They are small enough to reflect conditions within the spaces that people inhabit and where they interact, but are also important political and economic units that are large enough to be meaningful for social policy. County governments often implement economic development strategies to recruit new industries and may set important social policies (e.g., the minimum wage) that may have implications for community resilience during economic downturns. Additionally, transfer program resources (e.g., TANF) are often distributed at the county level through processes of second-order devolution, leading to discretion in how programs are administered. For example, previous research documents significant variation in TANF administration according to county racial composition (Monnat 2010), thereby

putting residents of some counties at increased risk of the negative consequences of unemployment relative to residents in other counties. Finally, from a practical standpoint, county-level analyses are advantageous relative to other low-level geographic units (e.g., census tracts, labor market areas) because of boundary stability and extensive data coverage over time. Previous analyses have often focused on the county level when studying local labor market conditions (Gould, Weinberg, and Mustard 2002; Hoynes 2000).[3]

States are also important policy-making and -implementing units. They hold administrative jurisdiction over defined geographic areas that are demographically and spatially diverse (Lobao, Hooks, and Tickamyer 2008). States implement and enforce a range of social policies, budgets, and revenue generation strategies, including minimum wage policies, 'right to work' laws, and immigrant rights statutes (Coleman 2012; Dube, Lester, and Reich 2010; Holmes 1998). Brady and colleagues (2013) provide a particularly relevant example, showing that state-level union density – a correlate of state labor regulations – is a significant determinant of working poverty rates. States also establish rules and procedures for, administer, and/or fund several public sector programs upon which unemployed residents often rely, including unemployment insurance, TANF, General Assistance, SNAP, housing assistance, Medicaid, and the State Children's Health Insurance Program. Variation in these rules and their administration may affect unemployment rates such that otherwise demographically and economically comparable counties in different states may have experienced different levels of unemployment, poverty, and related outcomes during the recession (Farber and Valletta 2015).

3.2 County-level vulnerability to economic crisis: competing explanations

Macroeconomic crises do not have uniform impacts on local outcomes, but rather are shaped by place-specific conditions associated with vulnerability to shocks. How these local conditions mediate macro-level trends is debated, however. On the one hand, outcomes may reflect the social and demographic composition of a county's population. Places with high shares of vulnerable individuals may experience worse outcomes because of a direct link between macroeconomic conditions and population composition. On the other hand, local political and economic structures may mediate the relationship between national and local trends. The structure of local economic

[3] Counties and county equivalents are imperfect units of analysis. For example, counties in some parts of the country (e.g., the southwest) are very large, and may therefore not represent a single labor market. The political power of counties also varies across states. As an alternative, existing research has utilized multi-county labor market areas (LMAs) to measure local economic conditions (Fowler, Rhubart, and Jensen 2016).

systems, policies, and even the norms shaping economic behavior may protect or expose places to macroeconomic currents.

3.2.1 Social and demographic composition

Variation in the recession's impact on county unemployment rates may reflect differences in human capital composition across counties. Certainly, these compositional differences are often the result of longer-term structural processes that shape the distribution of resources and residential patterns among different social groups. For example, low educational attainment may reflect the long-term consequences of how education systems are structured. Yet the fact that population composition is often the result of structurally determined processes does not negate the vulnerability of a given population to macroeconomic downturns in the short term.

Human capital theory suggests that employment opportunities are determined by workers' education, training, skills, expertise, and other competencies (Becker 1991). Education and other attributes should enhance relative levels of job security during crises and diminish the risk of long-term unemployment (Hout, Levanon, and Cumberworth 2011; Riddell and Song 2011). By contrast, those with less human capital – particularly those without a high school diploma – are expected to be at the greatest disadvantage in the labor market (Kalleberg 2011; Katz 2010). Such disadvantage has been observed during good times, but those with little human capital may be especially at risk during crises. Vulnerability is likely pronounced in the contemporary context, as structural changes have made it more difficult for displaced low-skilled workers to locate alternative employment. Indeed, unemployment rates among low-skilled workers increased from 7% to over 15% between 2007 and 2010 (Bureau of Labor Statistics 2013). Given these trends, we expect counties with relatively large proportions of workers with low education to have experienced larger recession impacts on unemployment than counties with large shares of highly educated workers.

Race and ethnicity is also associated with unemployment risk during periods of economic crisis. Workers with comparable levels of education should experience similar unemployment rates during economic downturns, but prior research documents persistent racial and ethnic inequalities in labor market outcomes (Iceland 2006; Massey 2007). Moreover, racial minorities are uniquely disadvantaged by macroeconomic change (Orrenius and Zavodny 2009). Although workers from these groups are not necessarily 'last hired', they are often 'first fired' (Couch and Fairlie 2010). With respect to the Great Recession, Hout and colleagues (2011) find that black workers experienced not only a greater rate of job loss, but also diminished returns to education. Kochhar (2009) also shows severe impacts on employment among native-

and foreign-born Hispanics early in the recession. On the other hand, Sisk and Donato (2013) find that low-skilled Mexican immigrants were less likely than similarly skilled white men to become unemployed during the recession, and Kochhar, Espinoza, and Hinze-Pifer (2010) find that immigrant workers were more likely than native-born workers to gain jobs at the tail end of the recession. Nativity status seemingly had a distinctive, if idiosyncratic effect on workers' labor market positions during the recession.

Overall, previous research suggests that geographic areas with relatively large proportions of at-risk workers likely experienced correspondingly large increases in unemployment during the recession. However, the 2007–2009 recession was so severe that few groups of workers were spared adverse effects (Katz 2010). Moreover, some of the most salient impacts of the recession (e.g., high rates of home foreclosures, crashes in house prices) were in states with robust economic growth, high median incomes, and low poverty and unemployment rates just prior to the recession (e.g., Nevada, Florida). In the absence of equally rapid population change, rapid reversals in the economic fortune of such places are inconsistent with accounts that solely emphasize the role of social and demographic characteristics. Such cases suggest that it was not just the composition of workers but also the structural conditions of the places workers lived that affected the severity of the recession's impact.

3.2.2 Structural characteristics

In contrast to approaches that emphasize population composition, some research suggests that between-place differences in the sectoral composition of employment, occupational structure, collective bargaining laws, and other institutions shaping local labor markets contributed to unequal exposure to the recession's effects. Recession impacts were not randomly distributed across industries. Some sectors, like energy, experienced unprecedented growth during the recession, whereas construction, manufacturing, and other pro-cyclical sectors were hard hit. Given disproportionate male employment in these sectors, men experienced a disproportionate burden of recession-related layoffs (Hout, Levanon, and Cumberworth 2011). Occupational segregation by race and ethnicity and educational attainment had similar confounding effects, suggesting that structural processes may underlie what appear to be demographic-driven trends.

In addition to the industrial composition of employment, local labor markets are embedded within unique political and institutional contexts. For example, unified theory has suggested that unemployment, wage levels, and wage inequality are contingent upon institutional factors, including welfare generosity and union power

(Blau and Kahn 2002; DiPrete et al. 2006). Proponents of this idea argue that market-driven, flexible labor markets generate less unemployment and are more resilient to macroeconomic shocks than more rigid labor markets in which workers are relatively well-protected. The latter, by contrast, are associated with higher wages and lower inequality but higher levels of unemployment and less resilience to shocks.

These insights – largely derived from macro-level studies – may also be relevant at lower-level geographic scales. Moller, Alderson, and Nielsen (2009) find significant associations between county-level income inequality and collective bargaining power, minimum wage ordinances, political structure, and spending on public welfare and education. Other work shows similar links. For example, union density is associated with economic welfare among workers at the state level (Brady, Baker, and Finnigan 2013), and economic wellbeing is generally higher in locations with a relatively large public sector presence (e.g., federal employment, transfer program generosity) (Lobao and Kraybill 2003). Insights into the association between institutions – particularly at the state-level – and local economic outcomes are relevant to understanding intra-national variations in the recession's impact. As one example, Campbell and Sances (2013) find that revenue and tax increases during the recession were more likely in states with Democratic legislatures, and midyear expenditure cuts were less likely in states with strong public sector unionization. Overall, these studies suggest that multiple dimensions of workers' economic status are determined by institutional factors that shape the demand for labor, wages, and workers' job security. We expect similar effects on the unemployment rate.

Finally, much has been written about rural–urban spatial economic inequality, but less is known about whether and how the recession differentially impacted rural and urban counties. Economic restructuring and public policy devolution have had significant but differential implications for employment in rural and urban areas, leaving both uniquely vulnerable to macroeconomic change (Lobao 2014). Many rural areas have particularly disadvantaged labor markets because of low educational attainment, aging populations, and the structural changes they reflect (Bailey, Jensen, and Ransom 2014). These processes are particularly common in places that were already experiencing economic declines in manufacturing prior to the recession (Slack 2014). However, the average increases in rural unemployment during the recession were actually less than those experienced in urban areas (Mattingly, Smith, and Bean 2011). This may reflect the fact that many rural areas were already disadvantaged prior to the recession and had relatively less room for downward mobility. Indeed, prior to the recession, rural unemployment rates were significantly higher than those in central cities and suburbs. By 2010, however, the central city unemployment rate had surpassed that of rural and suburban areas (Mattingly, Smith, and Bean 2011).

Together, this body of research suggests that the characteristics of places themselves, and not only their populations, were important determinants of the recession's impact on local unemployment. In particular, these previous studies focus attention on counties' economic structure – as revealed by industrial composition – and the institutions that shape the structure and flexibility of labor markets. Importantly, these factors operate at both the county and state levels, suggesting that recession-related changes in stratification between places may occur unevenly between and within states. We begin to address this complex geography of the recession in the analyses below.

4. Current study

This paper engages debates on explanations of between-place inequality by analyzing variation in recession-related changes in unemployment rates across US counties. We address three specific objectives. First, we assess whether and to what extent the recession changed the distribution of unemployment rates between counties, both within and between states. Second, we identify contiguous groups of counties that experienced similar changes in unemployment during the recession. Finally, we evaluate associations between county-level recession impacts and demographic composition, industrial structure, and unobserved state-level factors.

4.1 Data

Our analyses draw upon county unemployment rate estimates from the Bureau of Labor Statistic's Local Area Unemployment Statistics (LAUS). The LAUS include annual unemployment data for a number of geographic units. We focus on counties in the 48 contiguous US states.[4] This choice is justified largely by counties' policy-making and -implementing roles, which make them important axes of social and economic differentiation within states. Counties are also the highest-resolution geographic unit with complete coverage across the US in the LAUS and our other data (see below). County measures therefore provide the best picture of the local conditions people across the entire US faced in their daily lives. Here, we note that our emphasis is squarely on unemployment rates, and as such none of our analyses weight counties by population size.

[4] Our analysis excludes seven Louisiana parishes for which no 2006 data are available due to the impact of Hurricanes Katrina and Rita. We treat the District of Columbia (DC) as a single county.

We also draw upon data from 2000 Decennial Census summary files; county-level oil and gas production data from the US Department of Agriculture's (USDA) Economic Research Service (ERS); and the 2003 ERS county classifications, which correspond to population figures from the 2000 Census. Together, these sources provide data about counties' pre-recession social and demographic composition, industrial structure, and geographic characteristics.[5]

4.2 Analytic strategy

We use descriptive statistics, exploratory spatial data analysis, and spatial regression analysis to examine variation in the estimated impact of the recession on county unemployment rates.

4.2.1 Estimating the recession's impact

We estimate recession-related changes in county-level unemployment rates and other measures derived from these rates (e.g., labor market inequality) using a simple interrupted time series approach. We estimate the recession's impact (Y) on the unemployment rate (R) in each i county by taking the difference between Y observed during the final year of the recession (2009) and Y expected if pre-recession (2004 to 2006) trends had continued from the year before the recession (2006) to its end in 2009.[6] This can be expressed formally as:

$$Y_i = R_{i,2009} - \left(\left[\frac{2009-2006}{2006-2004} \times \left(R_{i,2006} - R_{i,2004}\right)\right] + R_{i,2006}\right) \quad (1)$$

[5] There is some risk that drastic changes in population composition between 2000 (when many covariates were measured) and 2004 (the start of the baseline period for our outcome measure) affected our results. We believe this risk is low, limited only to a few very small counties, and would manifest as outliers in our data (see note #12). Also, our method of estimating recession impacts (see Section 4.2: Analytic strategy) controls for the effect of secular compositional change on unemployment rates to the extent that change was linear throughout the study period.

[6] Because unemployment rates are a function of both job loss and exit (entrance) into the labor market, our focus on unemployment rates during the peak of the recession is most likely to accurately capture the magnitude of job loss. Those who would eventually become discouraged workers and drop out of the labor market were still likely to be captured as unemployed in these data.

We use 2004 to 2006 as the pre-recession baseline, since this represents the longest uninterrupted period of decline in unemployment since 2000.[7] We use an identical approach to estimate the recession's impact on outcomes derived from *R*, namely between-county inequality in unemployment rates.

4.2.2 Measuring heterogeneity

Our first objective is to describe recession-related changes in between-county and between-state heterogeneity with respect to county unemployment rates. We measure heterogeneity using the Theil Index (*T*). The Theil Index is one of the Generalized Entropy (GE) measures of inequality, and ranges from 0 (perfect equality) to 1 (perfect inequality). The specific values of the Theil Index lack a straightforward meaning but indicate the extent to which above- or below-mean unemployment rates are concentrated in a small number of counties (a high Theil Index) (Conceicao and Ferreira 2000). For this study, relative change in the Theil Index reflects the degree to which unemployment rates increased disproportionately more (or decreased disproportionately less) in a minority of counties. A similar interpretation holds for our state-level measures.

When measuring total inequality between units – in our case, heterogeneity in unemployment rates between US counties – the Theil Index takes the form:

$$T_t = \frac{1}{\mathrm{N}}\sum_{i=1}^{\mathrm{N}}\left(\frac{\mathrm{x}_{it}}{\bar{\mathrm{x}}_t} \times \ln\frac{\mathrm{x}_{it}}{\bar{\mathrm{x}}_t}\right) \qquad (2)$$

for *i* counties 1 to N, where N equals the total number of counties and county equivalents in the continental US (3,102[8]), x_{it} represents the unemployment rate in county *i* in year *t*, and $\bar{x}_t$ is the mean unemployment rate among US counties during year *t*. We calculate *T* for all years *t* = 2004, 2006, and 2009. Like other GE measures, the Theil Index has the advantageous characteristic of additive decomposability, which allows for straightforward decompositions of heterogeneity between social groups or geographic units.

[7] Given that many of our covariates were measured in 2000, using the 2000 to 2006 period is a potential alternative to the approach used in these analyses. In separate analyses not shown, we find that our results are generally robust to this alternative measure. We ultimately decide against this alternative because the 2000 to 2006 period was affected by the early-2000s recession.

[8] All data for our analysis of heterogeneity were collected in 2005–2010, during which county boundaries did not change. We therefore consider all 3,102 contiguous counties here. By contrast, our regression analyses (below) must account for county boundary changes because they draw upon the 2000 decennial census. As a result, we construct two consistent boundary areas by aggregating counties affected by boundary change, reducing our number of observations to 3,097.

After estimating recession-related changes in between-county unemployment heterogeneity, we decompose these estimates into between- and within-state components. This approach rests on the conceptualization of between-county labor market inequality across the US as a hierarchical, or nested, structure (Akita 2003). Here, the nation is comprised of states (j), in which counties (i) are nested. Under this conceptualization, the Theil Index for year t takes the form:

$$T_t = \sum_{jt} \sum_{it} \left(\frac{y_{jit}}{Y_t} \times \ln \frac{\frac{y_{jit}}{Y_t}}{\frac{n_{jit}}{N_t}} \right) \quad (3)$$

This serves as the basis for a decomposition that yields estimates of between- and within-state heterogeneity in local labor market conditions. This framework is consistent with the policy hierarchy described above, and provides insight into the geographic levels at which the recession's impact varied most.

4.2.3 Identifying sources of heterogeneity

Building upon the descriptions of these inequality dynamics, we analyze sources of between-county variation in recession-related changes in the unemployment rate.[9] By definition, any observed changes in between-county inequality attributable to the recession can be explained by differential impacts among counties.[10] Understanding the substantive forces that shaped the recession's effects on county-level labor markets is therefore an important and complementary task for our initial analyses. We present results from two regression models that estimate associations between county-level demographic and economic variables measured pre-recession ($x_1 \ldots x_k$) and the recession's impact on county i's unemployment rate (Y, equation 1).[11, 12] By

[9] We estimate the models in this section using data from 3,097 counties and consistent boundary areas that account for county boundary changes in Colorado and Virginia between the 2000 Census and the 2004–2009 period for which unemployment data were collected.

[10] Null changes in inequality may also be the result of heterogeneous but offsetting effects among counties or groups of counties (see Allison 1978 for discussion of scale-invariant inequality measures).

[11] Tests for multicollinearity revealed no concerns for our statistical analyses.

[12] In reviewing model diagnostics, we found 31 counties with unusually high model influence (high scores on at least 3 out of 4 influence statistics: studentized residual, leverage, Cook's D, and DFFITS). These counties are geographically dispersed across all four US regions, but just under half are located in the west, and half are rural counties not adjacent to a metropolitan area (RUCC code = 9). Difference of means tests revealed that the influential counties had a significantly higher mean recession impact, 2006 unemployment rate, percentage Hispanic, and percentage without a high school diploma, and a significantly lower mean percentage of workers in manufacturing relative to the rest of the counties in the analyses. To check the sensitivity our results, we reran the regression analyses excluding these 31 counties. The results were robust,

considering only pre-recession characteristics, we ensure that the explanatory variables were not affected by the recession's impact.[13]

The assumption of independence in traditional regression models is not viable in our analysis because county-level unemployment rates are often associated with the economic conditions of neighboring counties. Although counties are accepted units for identifying local labor market conditions, few would argue that they represent autarkic units. Considerable exchange occurs between counties, from economic transactions to commuting and other forms of population mobility. As such, social and economic conditions in one county are likely to influence conditions in surrounding counties. To account for these spatially dependent relationships (i.e., spatial autocorrelation), we introduce a spatial lag term in our regression analysis. This term accounts for the influence of the recession impact on unemployment in neighboring counties on the outcome in county *i*. The spatial lag is the average recession impact on unemployment among a county's neighbors. We use a queen weights matrix with a single order of contiguity: Any county that shares a border or matrix with a given county is considered a neighbor.[14]

Our initial model takes the form:

$$Y_i = \alpha + \beta_1 x_{i1} + \cdots + \beta_k x_{ik} + \delta lag_i + \varepsilon \quad (4)$$

where Y_i is the recession-related change in county *i*'s unemployment rate (Equation 1); $x_1 \ldots x_k$ represent a set of *k* county characteristics measured prior to the recession (see Table 5); and *lag* represents the spatial lag variable.

As we have argued, counties are nested in unique state policy environments. Given data limitations and the objectives of this paper, we do not attempt to identify particular state policies or characteristics associated with recession impacts. Instead, and consistent with previous studies (Lobao and Hooks 2003, Slack and Myers 2014), we account for state-specific county-invariant factors by including state fixed effects in our second model. Denoting states at *j*, this model takes the form:

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with the exception of the coefficient for the 2006 unemployment rate. In the state fixed effects model without the influential counties, the 2006 unemployment rate was no longer a significant predictor of recession impact. The magnitude of some coefficient estimates also varied according to inclusion of the influential results, but did not affect substantive conclusions. A list of the 31 influential counties and the alternative regression results is available from the authors upon request.

[13] This precludes us from fully capturing the effect of responses to the recession's initial impact at various levels that undoubtedly affected *Y*. However, our models presumably capture differences in responses that were determined by observed pre-recession county characteristics.

[14] We use queen weights instead of rook weights because they provide a better model fit. We also tested a queen weights matrix with two orders of continuity, and the results were similar to those from the one contiguity model.

$$Y_{ji} = \alpha + \beta_1 x_{ji1} + \cdots + \beta_k x_{jik} + \delta lag_{ji} + \lambda state_i + \varepsilon \qquad (5)$$

This model is identical to that in Equation 4, with the exception of introducing $state$, which represents a vector of state indicator variables. We conclude that this model is most appropriate, but we present estimates with and without state fixed effects to demonstrate the implications of accounting for state-level factors.

5. Results

5.1 County unemployment rates

We begin by describing trends in county unemployment between 2004 and 2009. Across the country the mean county unemployment rate dropped between 2004 (5.6%) and 2006 (4.9%), with a sharp upturn to 9.0% by the final year of recession (2009). Variation about the mean increased during the recession: the standard deviation (SD) of county unemployment increased from 1.7 in 2006 to 3.2 in 2009. The range of county unemployment rates also increased by 10.3 percentage points – from 15.5% to 25.8% – during that same interval. This dispersion highlights the heterogeneous effects of the recession across counties.

State-level conditions and policies may be one source of variation in the recession's effect across counties. The levels and trends of county unemployment varied considerably across states (see Table A1 in the Appendix). For example, the average county unemployment rate in one epicenter of the foreclosure crisis, Nevada, was below the mean prior to the recession (4.5% in 2004, 4.7% in 2006), but shot to 9.9% in 2009 – nearly a full percentage point above the national mean that year. By contrast, counties in the Dakotas – where energy production boomed during the recession – remained well below average during the entire 2004–2009 period.

Changes in unemployment rates during the recession could simply reflect a continuation of pre-recession trends. Therefore, we implement a basic control for these pre-recession trends in our estimates of recession impacts on county unemployment rates (see Equation 1). We find that unemployment in the average county was 5.1 percentage points higher in 2009 relative to the rate we would have observed had 2004-2006 trends continued (Table 1). However, recession impacts varied across the country. For example, the worst-affected county (Wilcox County, AL) saw a 21 percentage point recession-related increase in unemployment; whereas the unemployment rate dropped by 10.5 percentage points relative to pre-recession trends in Harrison County, MS. Cases of recession-related reductions in unemployment, so defined, were extremely rare (only 35 counties). Mean county-level impacts also varied across states, ranging from

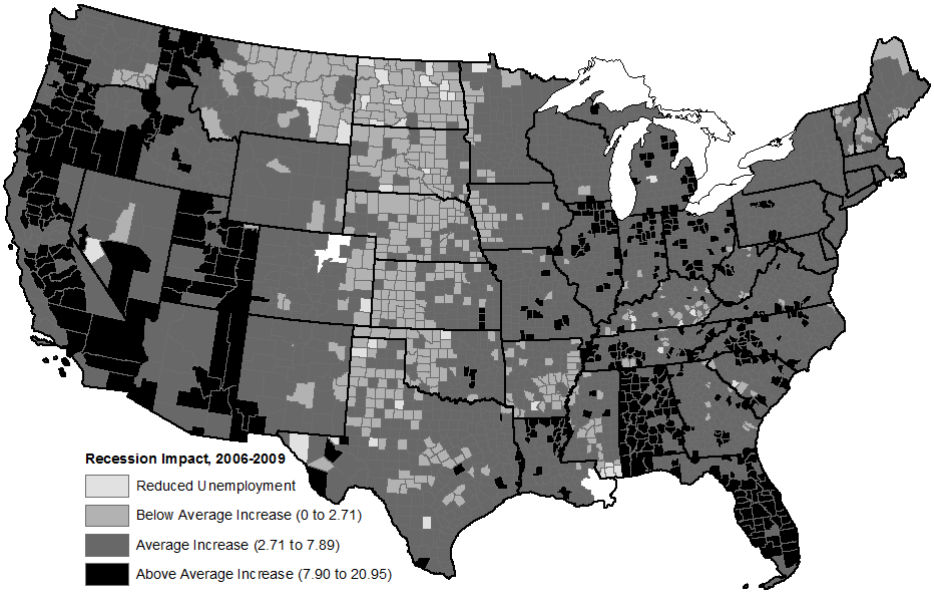
an average recession-related increase of 10.3 percentage points in Alabama to 0.9 percentage points in North Dakota (Table 1).

Table 1: Estimates of recession's impact on county unemployment rates for the US and by state (2006–2009)

State	Mean	SD	State	Mean	SD
Total	5.2	2.7	Montana	3.3	2.2
Alabama	10.3	2.9	Nebraska	2.5	1.0
Arizona	8.6	3.2	Nevada	5.0	2.6
Arkansas	2.9	1.6	New Hampshire	3.0	0.7
California	8.3	1.9	New Jersey	4.8	0.7
Colorado	4.7	2.0	New Mexico	5.3	2.7
Connecticut	4.3	0.5	New York	4.6	1.1
Delaware	5.0	0.2	North Carolina	7.0	2.0
D.C.	6.7	---	North Dakota	0.9	1.5
Florida	8.5	1.9	Ohio	7.0	2.0
Georgia	5.7	1.9	Oklahoma	4.1	2.2
Idaho	6.7	2.5	Oregon	8.4	2.6
Illinois	6.6	1.8	Pennsylvania	5.3	1.6
Indiana	6.3	2.0	Rhode Island	5.7	0.7
Iowa	4.0	1.4	South Carolina	6.3	2.6
Kansas	3.5	2.0	South Dakota	2.3	1.4
Kentucky	4.2	2.1	Tennessee	6.8	2.9
Louisiana	7.3	2.7	Texas	3.9	2.1
Maine	3.5	0.9	Utah	8.2	2.1
Maryland	4.6	1.1	Vermont	3.4	0.9
Massachusetts	3.9	0.7	Virginia	5.7	2.3
Michigan	6.5	2.2	Washington	6.1	2.3
Minnesota	4.3	1.5	West Virginia	4.8	1.8
Mississippi	3.7	3.1	Wisconsin	4.5	1.1
Missouri	5.8	1.7	Wyoming	4.1	1.1

The geographic distribution of the recession's impact on unemployment is illustrated in Figure 1. This map shows counties with recession-related unemployment increases that were a) above average (greater than one SD above the mean), b) average (within one SD above or below the mean), c) below average (greater than one SD below the mean or nil), and d) paradoxical (recession-related declines in unemployment). Of special note is the regional clustering in above-average recession increases, which appear in the southwest, northwest, and parts of the southeast. Below-average recession-related increases are clustered mainly in the Midwest heartland region. In addition to the regional clustering of recession impacts, the map illustrates often-stark differences along state borders. For example, the cluster of above-average recession impacts in western Alabama stops exactly at the border with Mississippi. Similarly clear divides are apparent at other state borders, such as between Colorado and New Mexico, suggesting that state-level factors likely had significant effects on employment outcomes during the recession.

Figure 1: Recession impact on county-level unemployment rates, 2006–2009

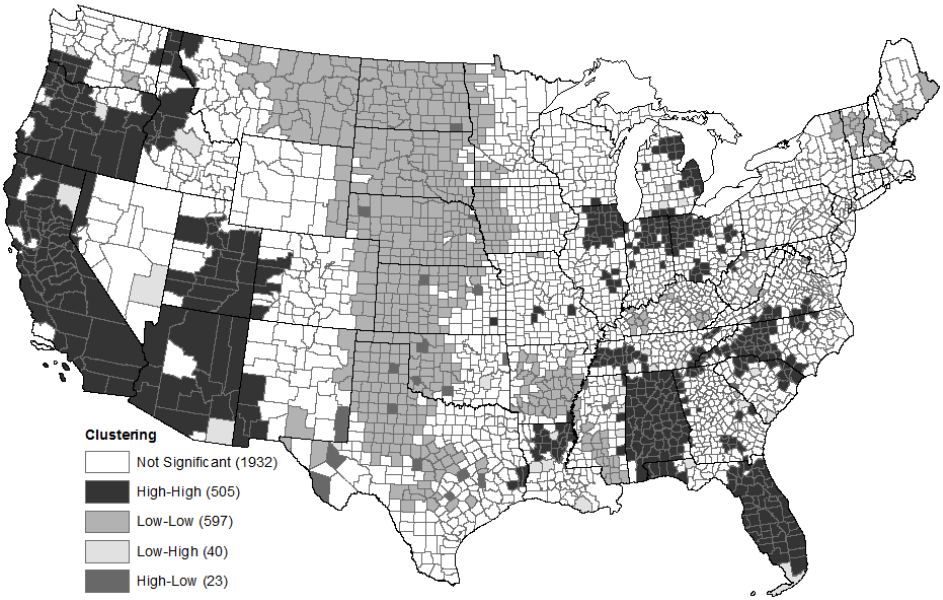


Note: Above average = greater than one standard deviation above the mean; Average = within one standard deviation above or below the mean; Below average = greater than one standard deviation below the mean or nil.

The geographic clustering of the recession's estimated impact on county unemployment is even more starkly illustrated in the Local Indicators of Spatial Association (LISA) map (Figure 2).[15] Here, 'high-high' refers to counties that experienced large non-random recession-related increases in unemployment and that are surrounded by counties with similarly high recession impacts. 'Low-low' refers to counties that experienced small non-random recession-related impacts on unemployment and that have similarly affected neighboring counties. The Moran's *I* (a measure of spatial autocorrelation) of 0.60 demonstrates significant spatial autocorrelation in both high (N=505) and low (N=597) county-level recession impacts on unemployment (Figure 2). Significant clusters of high recession impacts appear in areas hit hardest by the foreclosure crisis, including most of California and Arizona, southern Nevada, and Florida. Clustering in Oregon, Utah, Louisiana, Mississippi, Tennessee, North Carolina, and South Carolina is also apparent. Low-low clusters appear in the Dakotas – which likely benefited from a natural gas boom – as well as Texas, Vermont, New Hampshire, Montana, Minnesota, Nebraska, Kansas, and Arkansas.

[15] The LISA cluster map shows regions that contribute significantly to positive spatial autocorrelation, as indicated by Moran's I. See Anselin (2005) for details of how these measures were calculated using GeoDa.

Figure 2: Local Indicator of Spatial Association (LISA) map of county-level recession impact, 2006–2009



Notes: Moran's I = 0.60; "Low-low" refers to counties at the center of geographic clusters with significantly lower recession impact on unemployment than would be expected at random. "High-high" refers to counties at the center of geographic clusters with significantly greater recession impact on unemployment than would be expected at random. $p<0.05$.

5.2 Between-county inequality

Our initial results demonstrate that the 2006–2009 trends in county unemployment rates varied markedly between states and counties. To quantify changes in the distribution of unemployment levels among counties, we estimate Theil Indexes for all counties in 2004, 2006, and 2009 and decompose this measure to account for between- and within-state heterogeneity in unemployment rates and changes therein (Table 2). Low levels of the Theil Index largely reflect the limited range of county unemployment rates, yet even small differences may have large substantive implications given that fractions of a percent can represent thousands of jobs.

We found that total unemployment heterogeneity was low but increased year-to-year, from 0.047 in 2004 to 0.055 in 2006 and then to 0.063 in 2009. Total between-

county inequality increased at a somewhat lower rate from 2006 to 2009 than in the pre-recession period (2004–2006). In 2009 the Theil Index was 0.004 (7.3% of the 2006 level) less than the level expected if the 2004–2006 trend had continued throughout the 2006–2009 period. This suggests that the crisis suppressed the overall level of between-county differences in unemployment rates.

Table 2: Decomposition of between-county inequality, unemployment rate, by year

Year	*T* (Total)	Between state		Within state	
		T	*T/total*	*T*	*T/total*
2004	0.04669	0.01735	0.37	0.02934	0.63
2006	0.05500	0.02670	0.49	0.02830	0.51
2009	0.06345	0.03510	0.55	0.02835	0.45
Est. impact	–0.00402	–0.00562	–0.10	0.00160	0.10
Est. % impact*	–7.31%	–21.06%		5.66%	

*2006 as base year

To assess the importance of systematic variation between states, we partition overall between-county heterogeneity into between- and within-state components for each year. We also estimate recession impacts for each of these components using the same approach outlined above. We found that between-state heterogeneity increased from 0.017 in 2004 to 0.027 in 2006 and to 0.035 in 2009. The 2006–2009 change was 0.006 (–21.1% of 2006 Theil Index levels) less than if the 2004–2006 change had continued to 2009, suggesting that the recession stymied a trend toward larger between-state differences in unemployment rates. By contrast, within-state inequality decreased from 0.029 to 0.028 from 2004 to 2006, and then increased very slightly through 2009. The level of within-state heterogeneity in 2009 was 0.002 more (5.7% of 2006 Theil Index levels) than if the pre-recession trend had continued. This suggests that the recession had a modest stratifying effect on county-level unemployment within states. Finally, we also found that the share of overall between-county difference in unemployment explained by variation between states was nearly one-tenth lower in 2009 than if pre-recession trends had continued. This indicates that the recession moderated a pre-recession trend toward increasingly large between-state differences in unemployment relative to that within states, and did so by slowing the growth in between-state heterogeneity and stalling a pre-recession decline in within-state heterogeneity.

5.3 Sources of heterogeneity in county-level impacts

We next estimate two spatial lag regression models to identify factors associated with recession-related changes in county unemployment rates (Table 4). Each model includes twelve explanatory variables accounting for counties' human capital composition, racial and ethnic composition, industrial structure, metropolitan status, and pre-recession unemployment rate. Summary statistics for each of these variables are shown in Table 3.

Table 3: Summary of county characteristics

Variable	Mean	SD
Unemployment rate, 2006	4.9	1.7
% Non-Hispanic black	8.7	14.5
% Hispanic	6.2	12.1
% Foreign-born	3.4	4.9
% No high school diploma	22.7	8.7
% Bachelor's degree+	16.5	7.8
% Workers agriculture, forestry, fishing, hunting, mining	7.3	7.6
% Workers construction	7.7	2.4
% Workers education, health, social services	20.3	4.4
% Workers manufacturing	16.0	9.1
Oil and gas production, 2006 (yes)	0.349	---
Metropolitan Status		
Large Metropolitan (1 million+ population)	0.137	---
Small/medium metropolitan (250,000–1 million pop)	0.233	---
Large nonmetropolitan, adjacent to metro	0.068	---
Large nonmetropolitan, not adjacent to metro	0.029	---
Rural, adjacent to metropolitan	0.189	---
Rural, not adjacent to metropolitan	0.273	---
N=3097		

*Characteristics measured in 2000, except unemployment rate and oil/gas production (2006) and metropolitan status (2003)

In Model 1 we examine associations between county composition and structural characteristics and recession-related changes in unemployment without accounting for

systematic state-level variation. We then compare these results with those from the state fixed effects model to identify whether and how state conditions attenuate statistical relationships between county characteristics and recession labor market impacts.

Estimates from this initial model show that counties with large proportions of historically disadvantaged racial and ethnic populations experienced larger recession-related increases in unemployment compared to counties with relatively large shares of white residents. The percentage black, percentage Hispanic, and percentage foreign-born are positively associated with recession impacts on unemployment. With respect to human capital, both the proportions of the population (age 25+) with at least a bachelor's degree and without a high school diploma were negatively associated with increases in unemployment. County industrial structure also mattered. The shares of workers in agriculture, forestry, fishing, hunting, and mining were associated with lower county-level recession impacts. By contrast, higher percentages of employment in construction and manufacturing – relatively pro-cyclical sectors – were strongly associated with larger recession impacts on county unemployment. The presence of oil and gas production[16] and the share of workers employed in education, health and social services prior to the recession were not associated with recession impact.

Size, location, and economic ties to major urban centers – as indicated by counties' classification in the Rural–Urban Continuum Codes (RUCC) – differentiated recession-related changes in unemployment in Model 1.[17] Compared to large metropolitan counties (1 million or more residents), metropolitan counties with fewer than 1 million residents experienced significantly smaller recession impacts. By contrast, nonmetropolitan counties adjacent to metropolitan areas experienced significantly greater recession impacts, on average, than large metropolitan counties.[18] The spatial lag term is positive and statistically significant, indicating that the average recession impact in neighboring counties is significantly and positively associated with impacts for each county in question. Finally, the association between counties' baseline (2006)

[16] Our analyses use an indicator variable that denotes whether any oil or gas production took place in the county. In supplementary analyses, we also tested models that included measures of per capita oil and gas production and found similar results to those using the indicator variable.

[17] These metropolitan categories represent a coarse measure of population size. As an alternative, we estimate a model that controls for a continuous measure of population size. There are not substantive differences between these estimates and those presented in this paper.

[18] In an unadjusted spatial lag model, metropolitan counties with fewer than 1 million residents and nonmetropolitan counties (small and large) that are not adjacent to metropolitan areas experienced significantly lower recession impacts compared to metropolitan counties with more than 1 million residents. However, nonmetropolitan counties (both small and large) that are adjacent to metropolitan areas experienced significantly larger recession impacts than metropolitan counties with more than 1 million residents. Unadjusted mean recession impacts by metropolitan category are as follows: large metropolitan (5.69), small/medium metropolitan (5.33), large nonmetropolitan adjacent to metropolitan area (6.29), large nonmetropolitan not adjacent to metropolitan area (4.58), rural adjacent to metropolitan area (5.88), and rural not adjacent to metropolitan area (4.26).

unemployment rate and recession-related changes in unemployment was only marginally significant, but indicated that higher 2006 unemployment rates were associated with smaller recession-related impacts on county unemployment rates.

Table 4: Estimates of regression models predicting recession-related change in county unemployment (2006–2009)

Variable	No state fixed effects			W/state fixed effects		
	β	*SE*		*β*	*SE*	
Unemployment rate, 2006	–0.039	0.022	^	0.056	0.029	^
% Non-Hispanic black	0.011	0.003	***	0.018	0.003	***
% Hispanic	0.009	0.004	*	0.016	0.005	**
% Foreign-born	0.047	0.010	***	–0.003	0.011	
% No high school diploma	–0.013	0.006	*	0.020	0.008	*
% Bachelors degree+	–0.053	0.007	***	–0.017	0.008	*
% Workers agriculture, forestry, fishing, hunting, mining	–0.026	0.006	***	–0.024	0.007	***
% Workers construction	0.078	0.016	***	0.104	0.017	***
% Workers education, health, social services	–0.006	0.009		–0.011	0.009	
% Workers manufacturing	0.035	0.006	***	0.071	0.006	***
Oil and gas production, 2006 (yes)	–0.047	0.067		–0.049	0.085	
Metropolitan status (Large metropolitan [1 million+ population]=ref)						
Small/medium metropolitan (250,000-1 million pop)	–0.231	0.094	*	–0.266	0.092	**
Large nonmetropolitan, adjacent to metropolitan	0.307	0.137	*	0.163	0.133	
Large nonmetropolitan, not adjacent to metropolitan	–0.311	0.193		–0.222	0.188	
Rural, adjacent to metropolitan	0.239	0.102	*	0.121	0.099	
Rural, not adjacent to metropolitan	–0.020	0.101		–0.035	0.100	
Spatial lag	0.727	0.014	***	0.508	0.019	***
Intercept	1.657	0.409	***	2.180	0.516	***
N	3097			3097		
Psuedo R-squared	0.614			0.652		
P > Likelihood ratio vs. null	1650.55***			533.11***		

^p<0.10 *p<0.05 **p<0.01 ***p<0.001

The second model introduces fixed effects that account for state-level factors and systematic between-state variation in county-level recession impacts, which prior research and our descriptive analyses suggested are important. Differences between the estimates from the first model and this second model with fixed effects provide evidence that state-level factors partially underlie the associations we observed in the first model. First, the magnitude of some coefficients increased when state effects were included. For example, the percentage black and percentage Hispanic remain positively associated with recession impacts, but both have larger coefficients in the second model. By contrast, the introduction of state fixed effects fully attenuated the association between recession impact and percentage foreign-born, and partially attenuated the association between percentage of adults with a bachelor's degree or higher and recession-related changes in unemployment. State factors also attenuated the difference in recession impact between large metropolitan counties and metropolitan-adjacent nonmetropolitan counties. Only small metropolitan counties continue to show significantly different (lower) recession impacts on unemployment relative to large metropolitan counties

Second, the negative association between the recession's impact on unemployment and the share of a county's adult population with less than a high school diploma reversed signs to a positive association in Model 2. Counties with a larger share of residents who did not complete high school experienced greater recession-related increases in unemployment than counties with a lower share of residents without a high school diploma, net of state-level factors and county industrial structure.

Third, the coefficient of the baseline (2006) unemployment rate reversed signs from negative to positive (though still only marginally significant) in the state fixed effects model. Net of state factors, counties with higher baseline unemployment experienced larger recession-related increases in unemployment relative to otherwise comparable counties in the same state. The opposite is true in the first model, which does not account for systematic differences between states. The difference between these models suggests that, on average, counties in states with high unemployment in 2006 experienced smaller increases in unemployment than counties in low unemployment states (at baseline). Within states, however, baseline unemployment was positively associated with the magnitude of recession impacts. Together, the findings from both models are consistent with the results of the decomposition analysis, which showed that the recession was associated with reduced between-state inequality in unemployment rates, but increased inequality within-states.

Finally, the introduction of state fixed effects partially attenuated the spatial lag coefficient, but it remained statistically significant. On the one hand, this change suggests that underlying state-level conditions partially account for the spatial clustering of recession impacts. On the other, the continued significance of the spatial

lag indicates that there are additional factors not included in the model that underlie the spatially clustered nature of the recession's impact on county unemployment rates.

6. Discussion and conclusion

Our analyses demonstrated that the impact of the Great Recession on county-level labor markets varied across the country, and in a pattern that diminished between-state heterogeneity but had a positive effect on between-county inequality within states. These findings suggest that the recession had complex effects on the geography of unemployment across the US. On the one hand, the recession seemingly had a suppressive effect on a trend toward increasing between-state heterogeneity. Between-state inequality still increased, but at a lower rate than expected had pre-recession trends persisted. On the other hand, pre-recession declines in within-state heterogeneity stalled, and by 2009 were higher than the level expected given trends before the recession. To ensure that future crises do not exacerbate such spatial inequalities within states, federal and state governments could target stimulus and recovery resources directly to the counties most impacted by economic downturns (e.g., rather than states).

Beyond this initial decomposition exercise, our analyses uncovered the common characteristics of these especially vulnerable counties, providing direction for targeted intervention. Specifically, we found that differences in recession impacts on county-level unemployment were attributable to both population composition and structural characteristics. Consistent with structural perspectives, recession-related changes in unemployment were not only associated with baseline unemployment rates but also with the industrial composition of counties' workforces. Counties with greater reliance on pro-cyclical industries (e.g., construction and manufacturing) experienced larger recession impacts on unemployment than counties with larger shares of workers in agriculture, forestry, and related sectors. Moreover, the sometimes-stark differences between a naïve regression model and a second model that included state fixed effects indicated that state-level factors often mediate associations between county compositional and structural characteristics and recession impacts on county unemployment rates. For example, the association between a county's reliance on manufacturing and construction employment and recession impact was amplified after accounting for unobserved state-level characteristics.

In exploring this relationship, we found that many counties with above-average pre-recession shares of workers in construction and manufacturing are located in states that experienced below-average recession impacts. For instance, counties in Colorado, Maryland, and Texas had above-average shares of workers employed in construction in 2000, but below average recession impacts. Similarly, counties in Arkansas, Kentucky,

Georgia, and Wisconsin had above-average shares of workers employed in manufacturing in 2000, but below average recession impacts. Once we accounted for the effect of being located within a state that fared well on average, we saw that counties that were reliant on manufacturing and construction were significantly more vulnerable to recession impacts relative to counties with different industrial structures in the same state. Future research could explore specific state-level factors (e.g., fiscal and policy responses, labor laws) that may have exacerbated (mitigated) the hardship faced by construction and manufacturing-dependent counties in some states.

We also found that counties with relatively high unemployment rates just before the recession may have experienced larger recession-related impacts on unemployment than those with low unemployment rates at baseline. This association is net of controls for county population composition, industrial structure, metropolitan status, and state factors, which suggests that a number of unobserved county-level conditions may have contributed to both poor pre-recession economic conditions and heightened vulnerability to the crisis. Of course, there were exceptions. For example, Clark County, NV – the county that includes Las Vegas – had very low pre-recession unemployment but was among the counties with the highest unemployment rates during the recession.

Beyond structural explanations, our results provide support for human capital approaches that emphasize the importance of workers' education and training for employment security (Becker 1991). Here we stress that human capital is a proximate determinant of vulnerability. Counties with large proportions of residents without a high school diploma fared poorly on average, while those with more highly educated adult populations were relatively resilient during the recession. Notably, however, counties with less-educated populations were disproportionately located in states that fared relatively well with respect to unemployment during the recession. This was evident in our finding that the share of county population without a high school diploma was associated with smaller recession impacts in the naïve regression model, but larger recession impact in the model with state fixed effects.

To further examine this result, we conducted supplemental analysis (results available upon request) and identified 377 counties with concomitant above-median shares of adults with high and low education.[19] Consistent with the findings of the first model (without state fixed effects), these high-skill/low-skill counties experienced significantly lower recession impacts on unemployment (mean of 4.7 versus 5.3 among other counties). However, they were also disproportionately located in Texas, where the recession's impact on unemployment was far below the national average. This suggests that the finding in the naïve model largely reflected the fact that these high-skill/low-skill counties were clustered in Texas, where the recession's impact on county

[19] This is indicated by the shares of the population age 25+ with a bachelor's degree or more and less than a high school education, respectively.

unemployment was below the averages of most other states. After controlling for state effects – effectively shifting the analysis from national to within-state comparisons – the unexpected negative relationship between the share of adults without a high school diploma and recession-related changes in unemployment was reversed. Compared to other counties with similar characteristics in a given state, those with high shares of low-skill workers experienced greater recession-related increases in unemployment. This finding is consistent with longer-term shifts among low-skilled workers away from unionized industrial jobs and into the service sector and other occupations with relatively low job security and high exposure to changes in consumer demand. Patterns of inequality already in place prior to the recession – due to structural changes that placed low-skilled workers at an increasing disadvantage – were seemingly reinforced by the downturn.

Relatedly, prior to controlling for state fixed effects, the percentage foreign-born was associated with a greater recession-related impact on county unemployment rates. This finding is consistent with those of Kochhar (2009) and Hout, Levanon, and Cumberworth (2011), who show that the recession reduced employment more rapidly among the foreign-born than US-born whites. However, the introduction of state fixed effects eliminated this association. Many of the counties with large shares of foreign-born are located in the southwestern and southeastern US, where recession-related increases in unemployment were greatest (Figure 1) and highly clustered (Figure 2). Whereas the results in Model 1 suggest that these large recession impacts may be explained by population composition (i.e., share of foreign-born), estimates that control for state-level conditions (Model 2) suggest that the initial model was likely confounded by unobserved state conditions. The lack of association between counties' foreign-born population and recession-related unemployment changes may partially reflect the return of undocumented immigrants to their native countries as economic opportunities in the US decreased (Hout, Levanon, and Cumberworth 2011).[20] It may also reflect the heterogeneous nature of the US foreign-born population, which includes both low- and high-skilled workers, who faced radically different circumstances during the recession.

By contrast, differences according to counties' racial and ethnic composition were salient in both models. Counties with large shares of Hispanic and non-Hispanic black populations experienced relatively large recession-related increases in unemployment. This result is not consistent with the human capital perspective, and provides suggestive evidence that minority workers faced disadvantages in the labor market irrespective of their educational attainment (Couch and Fairlie 2010). This also suggests that the

[20] The number of undocumented immigrants living in the US dropped from 11.6 million in January 2008 to 10.8 million in January 2009 (Hoefer, Rytina, and Baker 2011). There is a positive, but only very weak correlation between county percentage of non-citizens and recession impact (0.063, $p<0.001$).

economic structure of these places may be different from that in counties with large shares of non-Hispanic whites. This notion is consistent with studies that suggest job opportunities may vary inversely with the share of the population identified as black (Kain 1992; Huffman and Cohen 2004). One implication may be that the types of employers located in counties with large minority representation may have been more affected by the recession, or at least more likely to eliminate workers during that time.

Finally, our results underline differences in recession impact on county unemployment rates related to county size, density, and economic linkages to urban areas, as indicated by a six-category metropolitan typology. Metropolitan counties with fewer than 1 million residents had significantly smaller recession impacts than the largest metropolitan counties, which may reflect the disproportionately heavy foreclosure burden experienced by the largest urban areas in the US during the recession. It also points to a potential role of policy and regulatory differences between counties in large metropolitan areas and in small-to-medium sized ones. Exploring differences among these county groups could be a productive goal for future research.

Overall, this paper contributes a spatially explicit focus to the growing body of literature on the social and economic impacts of the Great Recession in the US. We expand on previous research by providing what is, to our knowledge, the first multivariate analysis of spatial variation in the impact of the recession on county-level unemployment, and by identifying the structural and compositional characteristics associated with differences in local recession impacts. We demonstrate that the recession's impact on unemployment was not equally distributed across space, which should temper claims that this was a uniformly national or global crisis. We instead show that counties with high proportions of historically disadvantaged racial/ethnic populations, low educational attainment, and dependence on pro-cyclical industries fared significantly worse during the recession than others, and that state-level factors mediated these relationships. These findings imply that policymakers at all levels can enhance resilience to economic cycles by investing in education and workforce development among historically-marginalized populations, and creating incentives that attract diverse industries.

Given the enduring links between unemployment and multiple deleterious social and economic outcomes (Brand 2015), our finding that counties with large shares of disadvantaged populations (i.e., racial minority, low education) experienced disproportionate increases in unemployment suggests that the recession compounded the challenges faced by already struggling communities. We also show that the recession's impact on county-level unemployment was partially a function of state context. In some places, clusters of extremely high recession-related increases in unemployment ended sharply at state borders, suggesting that state-level policy interventions and institutions played an important role. This result underlines the need

to examine state-level policies and consider the diverse consequences of macroeconomic shocks across the country. Indeed, our findings highlight the salience of place, both as spaces where advantaged and disadvantaged populations cluster and as sites where the consequences of particular political and economic structures manifest.

7. Acknowledgements

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Appendix

Table A-1: Summary of county unemployment rates, by year and state

		2004		2006		2009	
State	N	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Alabama	67	5.9	1.6	4.1	1.2	11.7	3.3
Arizona	15	6.9	3.1	5.8	3.0	12.8	4.2
Arkansas	75	6.4	1.6	6.0	1.5	8.3	1.8
California	58	7.5	2.6	6.3	2.3	12.7	3.3
Colorado	64	5.3	1.4	4.2	1.2	7.2	2.0
Connecticut	8	4.8	0.6	4.3	0.6	8.0	0.8
Delaware	3	3.7	0.4	3.4	0.3	7.9	0.1
D.C.	1	7.5	---	5.7	---	9.7	---
Florida	67	4.5	0.9	3.3	0.7	9.9	1.9
Georgia	159	5.1	1.2	5.0	1.1	10.6	2.2
Idaho	44	5.3	2.0	3.5	1.3	7.5	2.6
Illinois	102	6.3	1.1	5.0	0.9	9.8	1.7
Indiana	92	5.5	1.0	5.2	0.9	11.0	2.4
Iowa	99	4.7	0.8	3.9	0.7	6.6	1.5
Kansas	105	4.8	1.2	3.8	0.9	5.9	2.1
Kentucky	120	6.3	1.5	6.6	1.4	11.4	2.0
Louisiana	57	6.8	1.7	4.3	1.1	8.0	2.2
Maine	16	5.2	1.3	5.3	1.2	9.0	1.7
Maryland	24	4.5	1.2	4.1	1.1	8.0	1.8
Massachusetts	14	4.9	1.0	4.6	0.9	8.0	1.2
Michigan	83	7.8	1.7	7.6	1.7	13.8	2.8
Minnesota	87	5.1	1.2	4.7	1.2	8.3	1.9
Mississippi	82	7.5	1.9	7.5	1.8	11.1	2.7
Missouri	115	5.8	1.2	5.0	0.9	9.4	1.8
Montana	56	4.3	1.3	3.5	1.1	5.6	2.3
Nebraska	93	3.6	0.8	2.9	0.6	4.3	1.1
Nevada	17	4.5	0.8	4.7	0.9	9.9	2.9
New Hampshire	10	3.6	0.6	3.4	0.4	6.2	0.8
New Jersey	21	5.0	1.0	4.8	1.0	9.2	1.6
New Mexico	33	6.3	2.3	4.5	1.6	6.9	2.5
New York	62	5.5	1.0	4.8	0.7	8.3	1.0
North Carolina	100	6.0	1.4	5.2	1.1	11.1	2.2

Table A-1: (Continued)

		2004		2006		2009	
State	N	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
North Dakota	53	4.0	1.5	3.8	1.3	4.4	1.7
Ohio	88	6.6	1.4	5.8	1.2	11.4	2.1
Oklahoma	77	5.2	1.6	4.2	0.9	6.8	1.8
Oregon	36	8.0	1.2	6.0	1.0	11.5	2.6
Pennsylvania	67	5.8	1.1	4.8	0.8	8.7	1.7
Rhode Island	5	4.8	0.5	4.7	0.5	10.1	1.1
South Carolina	46	8.0	2.1	7.7	2.0	13.5	3.4
South Dakota	66	4.2	1.6	3.7	1.8	5.4	2.1
Tennessee	95	6.3	1.4	6.1	1.5	12.6	2.7
Texas	254	5.8	1.7	4.8	1.4	7.2	2.0
Utah	29	5.6	1.2	3.4	0.9	8.3	1.7
Vermont	14	4.0	0.6	4.0	0.7	7.4	1.2
Virginia	134	4.4	1.5	3.7	1.2	8.3	2.3
Washington	39	7.1	1.3	5.8	1.2	9.9	2.3
West Virginia	55	5.8	1.3	5.0	1.0	8.7	1.9
Wisconsin	72	5.4	1.2	5.2	1.1	9.3	1.6
Wyoming	23	4.0	0.7	3.3	0.7	6.3	1.1