Disentangling the Spatial Concentration and Temporal Stickiness of Poverty: Industrial Structure, Racial/Ethnic Composition, and the Complex Links to Poverty

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Abstract

This study disentangles the social-structural, spatial, and temporal dimensions of aggregate-level poverty in the US Upper Midwest between 1960 and 2010. Central focus is on the links between local-area poverty, industrial structure and racial/ethnic composition, and the spatial and temporal dimensions of the linkages. During the study period, the region underwent significant industrial restructuring and dramatic change in racial/ethnic concentration. Using newly developed statistical methods for spatial-temporal regression, we explore three hypotheses related to the spatial and temporal dimensions of the complex relationship between poverty, industrial structure, and race/ethnicity. Our approach permits the simultaneous analysis of the multiple dimensions, yielding reliable and interpretable estimates. Results inform theory about the interactive association between industry and race/ethnicity, and its implications for the concentration and persistence of poverty.

Extended Abstract
In spite of having one of the highest average incomes in the industrialized world, the United States has one of the highest poverty rates (Iceland 2006; Smeeding et al. 2001). It is generally believed that social-structural factors and spatial-temporal dimensions are at play in generating patterns of poverty within the United States. A large body of research on local-area poverty has identified industrial structure and racial/ethnic composition as key social-structural contributors (e.g., Cohn and Fossett 1995; Tickamyer and Tickamyer 1988; Tigges and Tootle; Tomaskovic-Devey and Roscigno 1996; Weingberg 1987). Recent research demonstrates the interactive association between these dominant factors. For example, Curtis et al. (forthcoming) demonstrate that industrial structure and racial/ethnic composition are interlinked dimensions of poverty. Consistent with theories about racial/ethnic exploitation and occupational segregation, the link between local-area racial/ethnic composition and poverty is conditioned by industrial structure. This earlier study is an important step toward understanding the complexities of the poverty-generating process. Yet, it does not simultaneously elaborate the spatial and temporal dimensions of the process. Indeed, we are not aware of any study that meets this important challenge.

Research has explored the temporal patterning of poverty. For instance, poverty declined in recent decades, falling from 13.7% in 1969 to 11.3% in 1999 (Dalaker 2001; U.S. Census Bureau 1993). However, recent data have shown poverty is on the rise with nearly 43 million Americans (14.3%) living in poverty in 2009 (American Community Survey 2010). Scholars have also recognized the spatial trend of poverty in the United States and the role place has played in aggravating and reproducing poverty (e.g., Adams and Duncan 1992; Glasmeier 2006; Lobao and Saenz 2002). Yet studies that analyze both spatial and temporal patterns of poverty are much less common. Exceptions are Jha (2000) who employed descriptive techniques that lack statistical inference, and Chokie and Partridge (2008) who included the spatial and temporal effects as fixed. Simultaneous modeling and evaluation of social-structural factors and spatial-temporal patterning of poverty are largely absent and, yet, are needed to develop a comprehensive understanding of the poverty-generating process. To date, no study has fully assessed the spatial concentration and temporal stickiness of poverty in substantive and technical terms.

Our study fills this void. We estimate the interplay of social and demographic factors (namely racial/ethnic composition) with industrial structure to clarify the distribution of poverty in the US Upper Midwest between 1960 and 2010. We do so while disentangling the spatial and temporal dimensions of the poverty process. This region and period provide an ideal case for our analysis given the significant industrial restructuring in the manufacturing and agricultural sectors as well as the marked change in the racial/ethnic composition and distribution of the population.

The primary study objective is to link industrial restructuring to spatial economic vulnerability measured as county-level poverty, with specific focus on the interactive association with race/ethnicity. We extend previous research on place-based poverty that identifies industrial structure as a primary explanatory variable of poverty in two ways: by explicitly assessing the extent to which the magnitude of the relationship varies along the temporal and spatial dimensions; and by articulating how industry is linked to the racial/ethnic dimension of poverty.

Specifically, we examine three general hypotheses. First, we test whether there is spatial variation in the relationship between industrial structure and poverty throughout the period. Second, we test whether the relative strength of the association between industrial structure and poverty changes over time. Third, we test whether the association between industrial structure and poverty differs according to the

racial/ethnic context (while simultaneously accounting for the spatial and temporal dimensions). These hypotheses focus on relationship heterogeneity, as the magnitude of the relationship between poverty and its explanatory variables is anticipated to vary according to time (i.e., stage of development), space (i.e., unevenness of development), and other structural factors (i.e., racial/ethnic composition).

Background

Three main implications can be gleaned from existing poverty research. First, the uneven distribution of structural factors related to poverty likely contributes to the uneven distribution of poverty. Second, the impacts of the structural factors of poverty might vary over time. Third, the impacts of the structural factors of poverty likely vary across space. In short, temporal and spatial dimensions are at play in generating patterns of poverty (Beale & Gibbs 2006; Curtis et al. forthcoming; Friedman & Lichter 1998). Yet no research has empirically assessed the interplay of the spatial and temporal dimensions. We explicitly consider the temporal dimension of poverty to investigate when the effects of industrial structure are strongest as well as changes in the direction of the association. In terms of space, we investigate where distinct patterns in the relationships between poverty and its structural factors emerge. Other structural factors, namely racial/ethnic composition, potentially contribute to the overall temporal and spatial variation through its interactive association with industrial structure.

Statistical methods based on probabilistic modeling, in theory, provide rigorous approaches to analyzing our data and testing our general hypotheses. For example, spatial-temporal regression with possibly spatially and/or temporally varying coefficients helps identify important drivers of poverty rates. However, it remains a challenge in practice to carry out spatial-temporal data analysis because, unlike spatial statistics that have matured over the last three decades (Cressie 1993; Schabenberger & Gotway 2005), spatial-temporal statistics that take into account both space and time are still at an early stage of development and face many challenges. Statistically rigorous methodologies that are computationally and practically feasible for the analysis of spatial-temporal lattice data are seriously lacking. We apply recently developed innovative, rigorous statistical methodologies in spatial-temporal regression and fast computational algorithms that enable practical use (Reyes et al. 2011).

Analytical Approach

We apply newly developed spatial-temporal regression techniques to analyze county-level poverty rates between 1960 and 2010 in the five states of the Upper Midwest: Illinois, Indiana, Michigan, Minnesota, and Wisconsin. Building on our prior research (Curtis et al. forthcoming; Reyes et al. 2011), we focus on the interactive association between local area industry and racial/ethnic composition. The two factors are linked to one another; race/ethnicity can be highly correlated with poverty given exploitative and discriminatory practices that are more deeply rooted or widely practiced among certain industries (Saenz 1997; Snipp 1996).

The data are drawn primarily from the Census of Population (1960, 1970, 1980, 1990, and 2000) and the American Community Survey (2006-2010 5-year estimates scheduled for released in December 2011). Our dependent variable is the reported poverty rate, based on the proportion of the county population living below the poverty threshold. The measure is ideal for our purposes since it is comparable across time. An area's racial/ethnic composition is represented by several variables reflecting the proportionate size of dominant racial/ethnic minority groups in the United States including the African American, Native American, and Hispanic population relative to the total county population, as well as the proportionate size of the non-Hispanic white population. Local-area industrial structure is represented by variables reflecting the proportion of the civilian population 16 years and older per

county that is employed in dominant industries including agriculture, mining, manufacturing, services, FIRE (finance, insurance, and real estate), and other professionals (e.g., science, technology, education).

The spatial-temporal regression model features regression on covariates, spatial autoregression, temporal autoregression, and spatial-temporal interactions. Let y denote the vector of response variables (poverty rates) and X denote the design matrix that comprises of the factors (industry and race/ethnicity). We model the response vector y by a multivariate normal distribution with a mean vector $X\beta$ and a covariance matrix Γ, which is essentially a spatial linear model. In our final analysis, the spatial covariance structure will follow either a conditional or a simultaneous autoregressive model with a flexible class of parameterizations that features spatial-temporal interactions. Model parameter estimation and model selection will be performed via penalized maximum likelihood and a fast computational algorithm developed by Reyes et al. (2011).

This approach enables us to examine the substantive links between local area poverty and industry as well as the interactive influence of racial/ethnic composition while simultaneously accounting for the spatial and temporal processes not captured by the structural factors (industry, race/ethnicity, and their interactive association). Through this approach, we are able to report reasonable estimates of the links between structural factors and poverty (i.e., estimates purged of any bias or inefficiency introduced by dependence in the data) and, related, draw informed theoretical conclusions about the linkages between industrial structure, racial/ethnic composition, and poverty.

In addition, our modeling strategy permits us to draw substantive conclusions about the spatial and temporal dimensions of the poverty-generating process. In terms of the spatial dimension, we report a spatial effect that is independent of the temporal process; thereby permitting us to advance our substantive knowledge about the role of space in the poverty-generating process. In terms of the temporal dimension, we incorporate change points to account for varying strengths in relationships (regression coefficients) over time. Doing so permits us to speak to the "stickiness" in the factors generating local-area poverty.

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