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# Social Impacts of Energy Transition

JASON W. BECKFIELD, D. A. EVRARD, ROBERT J. SAMPSON, AND MARY C. WATERS





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## SOCIAL IMPACTS OF ENERGY TRANSITION\*

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What happens to people and places as communities transition from one form of energy production and consumption to another? How are the unequal impacts distributed across affected populations? How do the populations themselves change through energy transition? How do the basic structures of community life – families, social networks, schools, local organizations, and social norms – shift as energy-producing communities shift away from the production of coal, oil, and gas?

This paper develops an approach to social impacts of energy transition from concepts and measures from analytical and critical approaches to industrialization, social epidemiology, and disasters.<sup>1</sup> The industrial revolution brought about profound transformations of community life, from the nature of social solidarity, to the rise of economic inequalities by income and wealth, to the relational structure of social conflict, to the formation of large urbanized regions, to the rise of the nuclear family, to the institutionalization of large formal bureaucratic structures.<sup>2</sup> Social epidemiology explains disease distribution as a function of social structures like race, gender, and class; and political structures like citizenship rights, collective bargaining institutions, and political incorporation. The sociology of disasters considers the nature, causes, and effects of rapid, macroscopic exogenous shocks, thus offering conceptual and empirical tools for studying a large-scale change like an energy transition.

Foundational to our approach is that macroscopic changes like energy transitions, deindustrialization, and disasters affect people through social structures: we can think of social structure as a prism that refracts change into unequal outcomes depending upon social networks, communities, organizations, race, class, and gender. More deeply, energy transitions can, like disasters, be conceptualized as social processes, though energy transitions probably unfold over a time scale more similar to that of deindustrialization. Either way, the social impacts happen via social processes. For instance, while Hurricane Katrina as an event caused death and destruction, social structures built over the long run in the Gulf Coast – and especially in New Orleans – were a necessary condition for the widespread adverse social impacts of the hurricane.<sup>3</sup> Likewise, longitudinal research on boomtowns in the mountain west of the United States shows that social structures reproduce themselves, after disruptive effects of amplified boom-bust waves.

Today, we find ourselves at a transformative historical juncture as societies shift from fossil-fuel production to decarbonized energy production. Because we know more about what we are transitioning away from than what we are transitioning toward, the social-historical record offers no perfect parallels. And yet, our ongoing energy transition can be conceptualized as a case of macroscopic economic change, and a potential disaster to be averted. Thus, we can learn about

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<sup>1</sup> Sociology as a discipline has tended to ignore energy: “Perhaps this is best exemplified by the fact that it has been more than 27 years since the *Annual Review of Sociology* has published a manuscript on energy, whereas themes of race, gender, inequality, family dynamics, mobility and ageing are featured every two to five years” (Beckley, Thomas M. “Energy and the Rural Sociological Imagination.” *Journal of Rural Social Sciences* 32.2 (2017): 4.

<sup>2</sup> Durkheim, Emile. *The division of labor in society*. Simon and Schuster, 2014 [1893]; Weber, Max. *From Max Weber: essays in sociology*. Routledge, 2013 [1919]; Marx, Karl. *Das Kapital: Kritik der politischen oekonomic*. Vol. 1. O. Meissner, 1872; Cahnman, Werner Jacob, ed. Ferdinand Toennies: A new evaluation. Brill Archive, 1973; Comte, Auguste. *The positive philosophy of Auguste Comte*. Calvin Blanchard, 1855.

<sup>3</sup> Arcaya, Mariana, Ethan J. Raker, and Mary C. Waters. “The Social Consequences of Disasters: Individual and Community Change.” *Annual Review of Sociology* 46 (2020).

the most likely potential social impacts of today's energy transition if we engage with the sociology of economic transformation, and with the sociology of disasters. Complementarily, social epidemiology then offers a number of tools for measuring social impacts, and also shows how population health can itself be a resource for resilience in the face of change, up to a point, and for some people more than others. In what follows, we review the existing research on the social impacts of macroscopic economic changes and disasters, extrapolate some implications for the social impacts of energy transition, and propose how new research can measure such impacts under a deep decarbonization scenario.

Research on the social impacts of deindustrialization and boomtowns gone bust in the United States, the Great Depression of 1929-1939, the transition from Soviet communism to capitalism in the former USSR, and disasters finds that social impacts cluster into the categories of household poverty and inequality, fiscal poverty and inequality, social demography, crime, community (including organizational ecology), and identity. Employment – including the conditions of employment, the returns to employment, and the prospects of unemployment – constitutes the central social mechanism that translates macroscopic economic change into its social impacts, and so we begin our discussion of the evidence there. Employment is also a central mechanism of social impacts of disasters, alongside physical effects on the built environment, especially housing. One takeaway from studies comparing cities, states, regions, nation-states, and disasters is that social impacts depend upon the social resources available to people. Some longitudinal research on boomtowns suggests that social structures may reproduce themselves long after boom-bust cycles, but the short-term consequences of bust – including in the energy sector – are sharp increases deaths, accidents, divorce, violence, and suicide, among other degradations of public health.

Thus, although it may be possible – over the long term – to mitigate or even reverse some negative social impacts of macroscopic disruption, the disasters literature sounds a note of warning about growing inequality in the recovery stage, depending on the distribution of recovery capital.<sup>4</sup> Key insights from the past ten years of disaster research are: (a) recovery of places should not be conflated with recovery of people, (b) short-term effects may differ from long-term effects and depend on baseline conditions, and (c) disaster effects are multidimensional and require complex longitudinal research designs to grasp. All three points should hold as well in the case of energy transition effects.

## Employment

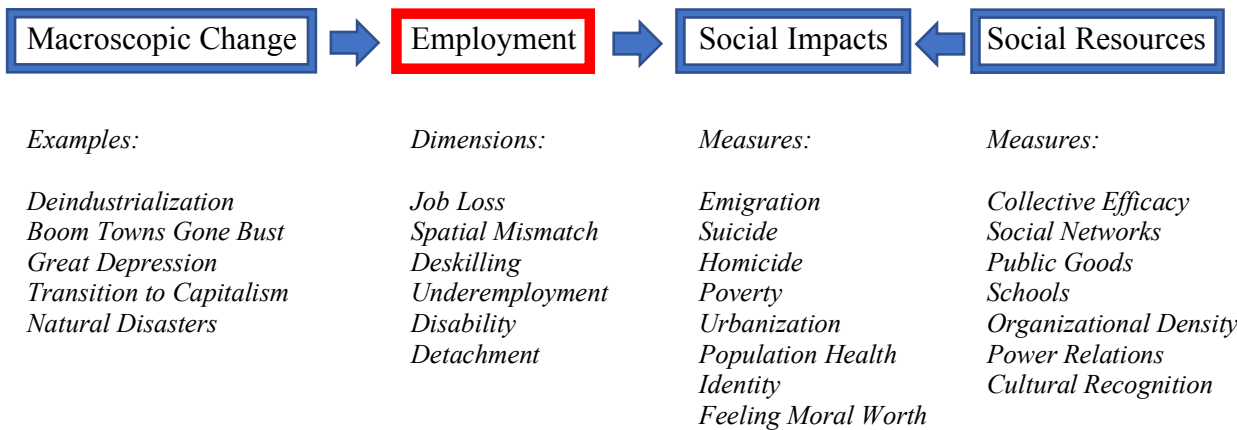
As shown in Figure 1 below, many social impacts of economic transformation hinge on employment. Deindustrialization – the decline of the manufacturing sector and the growth of the service sector – is strongly associated with higher unemployment rates at the national level, and this association has strengthened over time in OECD countries. Contracting sectors of the economy often push unemployment rates higher because they force displaced workers to seek

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<sup>4</sup> Pais JF, Elliott JR. 2008. Places as recovery machines: vulnerability and neighborhood change after major hurricanes. *Soc. Forces* 86(4):1415–53. Gotham KF, Greenberg M. 2014. *Crisis Cities: Disaster and Redevelopment in New York and New Orleans*. Oxford, UK: Oxford Univ. Press.

employment in unfamiliar sectors.<sup>5</sup> It is not dislocation by itself that makes reemployment difficult; instead, the quality of dislocation as measured by the schooling, experience, and industry-specific skills in declining industries play the most important roles. Policy has centered on retraining, but the literature shows mixed effects at best, and no strong evidence that US retraining programs improve the probability that workers will get new jobs, get full-time jobs, get higher pay, receive decent benefits, experience acceptable working conditions, have reasonable commute times, or get new jobs in growing economic sectors.<sup>6</sup>

Figure 1: The Centrality of Work to Understanding the Social Impacts of Energy Transition



In the cases of deindustrialization examined in the literature – much of it inspired by William Julius Wilson’s classics *The Truly Disadvantaged* and *When Work Disappears* – these employment effects are highly racialized, as African American men in particular face longer periods of unemployment, and more difficulty in finding re-employment.<sup>7</sup> When workers do find re-employment, on average they are able to replace only about two-thirds of their previous wages, generating potential long-term scarring effects of unemployment. These scarring effects are stronger for older workers, workers with less formal schooling, women, and African Americans in the United States.<sup>8</sup> At the level of the macroeconomy, employment losses among non-college workers in the middle of the occupational skill distribution were almost entirely countered by employment growth in lower-tail occupations, a downgrading in employment

<sup>5</sup> Kollmeyer, Christopher, and Florian Pichler. “Is Deindustrialization Causing High Unemployment in Affluent Countries? Evidence from 16 OECD Countries, 1970-2003.” *Social Forces* 91, no. 3 (2013): 785–812.

<sup>6</sup> Benedict, Mary Ellen, and Peter VanderHart. “Reemployment differences among dislocated and other workers: how do they adapt to job losses?.” *American Journal of Economics and Sociology* 56.1 (1997): 1-15.

<sup>7</sup> Wilson, William Julius. *The truly disadvantaged: The inner city, the underclass, and public policy*. University of Chicago Press, 2012; Wilson, William Julius. *When work disappears: The world of the new urban poor*. Vintage, 2011.

<sup>8</sup> Young, Cristobal. “Losing a job: The nonpecuniary cost of unemployment in the United States.” *Social Forces* 91.2 (2012): 609-634; Gangl, Markus. “Scar effects of unemployment: An assessment of institutional complementarities.” *American Sociological Review* 71.6 (2006): 986-1013; Farber 1997, 2003, 2005; Kletzer 1998; Podgursky & Swaim 1987; Seitchik 1991.

conditions that is matched by trends in the income distribution toward more inequality.<sup>9</sup> Indeed, displaced workers suffer long-term non-employment rates and highly significant wage and earnings losses as much as over a decade after displacement. Displaced workers also have less job autonomy, job authority and lower occupational income upon reemployment.<sup>10</sup> Long-term scarring effects of three years, six years, ten years, twenty years, and more have also been observed.<sup>11</sup> One particularly important finding is that six years after the typical worker separates from an employer, when it is not due to mass layoff, the worker continues to experience an earnings deficit of 7 percent to 9 percent. When an individual separates due to mass layoff, the earnings losses are sustained six years later at 13 percent to 15 percent. Policies to prevent scarring effects of energy transition via employment are, then, to be prioritized in order to head off longer-term and cumulative negative impacts.

In considering deindustrialization's effects on employment, we must consider the changing quality of employment in addition to its quantity and race/class/gender distribution. It is here where a transition from fossil fuel production to green energy production could actually reverse a long-term trend toward employment dualism and the growth in bad jobs, if the negative scarring effects of displacement can be avoided or ameliorated.

Currently, U.S. employers' use of numerical and functional flexibility strategies – facilitated by deindustrialization and de-unionization – has led to a division between organizational insiders (standard employment relations) and outsiders (who have nonstandard work arrangements). The consequences of working in nonstandard employment relations differ depending on workers' individual and collective control over skills and other valued resources. More provocatively, U.S. employment is taking an increasingly polarized form, with workers either in (a) “good jobs” with high earnings, meaningful opportunities for upward mobility, generous fringe benefits, substantial autonomy and control, and considerable job security, or (b) “bad jobs” distinguished by low wages, few opportunities to get ahead, poor fringe benefits (if any at all), and a high risk of being laid off, fired, or furloughed.<sup>12</sup> Part-time work, and particularly employment in bad part-time jobs, has become increasingly common over time. In 1993, 19% of American workers were part-time, as compared to only 13% in 1957. Moreover, nearly one-third of these part-timers were working part-time involuntarily, a larger share than at any comparable time in the past. The bad jobs are entry-level and dead-end jobs in a secondary labor market. As such, they demand little skill, training, and responsibility, and afford few opportunities for promotion or

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<sup>9</sup> Autor, David, and David Dorn. “This Job Is ‘Getting Old:’ Measuring Changes in Job Opportunities Using Occupational Age Structure.” Working Paper. National Bureau of Economic Research, January 2009.

<https://doi.org/10.3386/w14652>; Alderson, Arthur S., Jason Beckfield, and François Nielsen. “Exactly how has income inequality changed? Patterns of distributional change in core societies.” *International Journal of Comparative Sociology* 46.5-6 (2005): 405-423.

<sup>10</sup> Brand, Jennie E. “The effects of job displacement on job quality: Findings from the Wisconsin Longitudinal Study.” *Research in Social Stratification and Mobility* 24.3 (2006): 275-298.

<sup>11</sup> Cha, Youngjoo, and Stephen L. Morgan. “Structural Earnings Losses and Between-Industry Mobility of Displaced Workers, 2003–2008.” *Social Science Research* 39, no. 6 (November 2010): 1137–52.

<https://doi.org/10.1016/j.ssresearch.2010.08.002>; von Wachter 2010; Brand & von Wachter 2013, Davis & von Wachter 2012, von Wachter 2010.

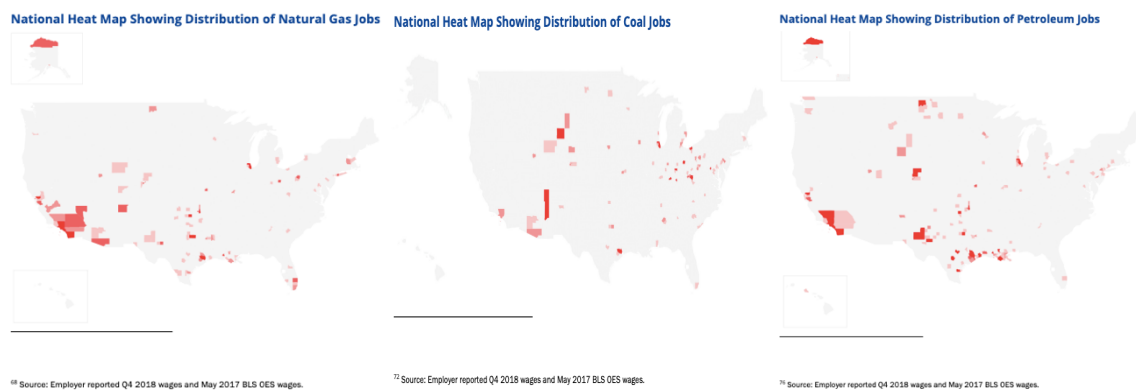
<sup>12</sup> Kalleberg, Arne L. “Flexible Firms and Labor Market Segmentation: Effects of Workplace Restructuring on Jobs and Workers.” *Work and Occupations* 30, no. 2 (May 1, 2003): 154–75.

<https://doi.org/10.1177/0730888403251683>; Kalleberg, Arne, *Good Jobs, Bad Jobs*.

advancement. The bad part-time jobs are poorly paid and generally offer few or no benefits. Turnover in these positions is very high.<sup>13</sup> Thus, while the negative social impacts of deindustrialization on the quality of employment are clear, they can serve as negative lessons in highlighting the importance of workers' control over their skills, non-wage compensation, meaningful opportunities for upward mobility, and high wages.

Given the history of deindustrialization and its ensuing effects on blue-collar workers, it is critical that we grasp the contours of local labor markets within economies dependent upon the energy producing sector. Figure 2 below shows the uneven, regionalized distribution of jobs in the natural gas, coal, and petroleum sectors of energy production in the United States. New Mexico hosts a disproportionate share of natural gas production, while West Virginia and Wyoming host disproportionate shares of coal and petroleum production.

Figure 2. Spatial Distribution of Natural Gas, Coal, and Petroleum Jobs in the United States



Source: USEER (2019)

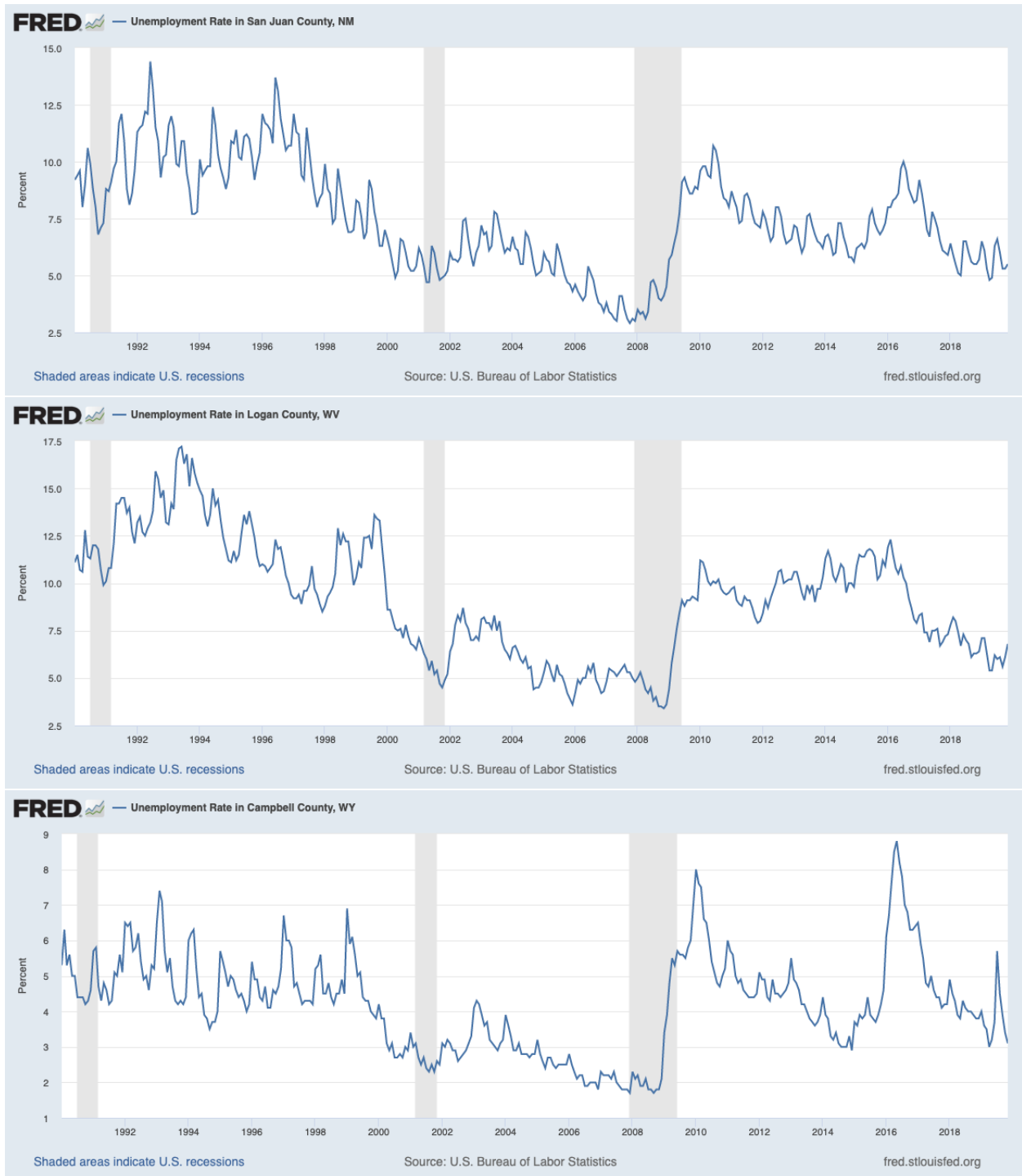
The fossil-fuel energy producing states of New Mexico, West Virginia, and Wyoming are among the most likely target zones of deep decarbonization. About 4.9% of jobs in New Mexico are in the Traditional Fuels sector, vs. 2.3% of jobs nationwide. This compares to 11.8% in Wyoming, and 6.0% in West Virginia. Traditional Fuels are defined by the United States Energy and Employment Report as Fuels, Electric Power Generation, and Transmission, Distribution and Storage. The 40,197 New Mexicans, 42,413 West Virginians, and 33,163 Wyomingites working in this sector are the most vulnerable to dislocation from decarbonization, and their dislocation would have significant social impacts on their communities, which tend to be rural and small in population size. The 2010 US Census estimated the populations of Farmington and Gallup, New Mexico, the largest towns located near the mines in the NW corner of New Mexico, at 45,877 people and 21,678 people. San Juan County, home to Farmington, was the fifth-largest county in New Mexico in 2010 at 130,044 people enumerated by the Census. Logan County, West Virginia, home to much mining activity, had 36,743 inhabitants counted by the 2010 Census.

<sup>13</sup> Half a Job: Bad and Good Part-Time Jobs in a Changing Labor Market. By Chris Tilly. Philadelphia: Temple University Press, 1996.



Campbell County, a prominent mining area in Wyoming, had 46,133 residents in the 2010 Census. In San Juan County, the unemployment rate is currently 5.5%, well above the US average of about 3.5%. In Logan County, the unemployment rate is currently 6.8%. In Campbell County, the current unemployment rate of 3.1% is well below the national average. Figure 3 shows the trend since 1992:

Figure 3. Unemployment in San Juan County, New Mexico; Logan County, West Virginia; and Campbell County, Wyoming



Carbon emissions align imperfectly with fossil fuel production, given the spatial distribution of energy-intensive industrial production. Louisiana combines both in refining large quantities of petroleum, and so in considering which communities would be most likely to experience the

effects of deep decarbonization, we also zoom in on Plaquemines Parish, home to large oil refineries. Michigan and Ohio are also home to areas with large carbon footprints from industrial production, and since these tend to be urbanized, deindustrializing areas they make for interesting comparison cases to Plaquemines Parish, just to the south of New Orleans. In Michigan, we focus on Wayne County, home to Detroit's automobile factories. In Ohio, we focus on Cuyahoga County, home to steel production and other energy-intensive manufacturing.

Figure 4 below shows data on resident population for these areas. Note that the scale of the y-axis differs across the two figures because Plaquemines Parish has a much smaller resident population, though it draws large numbers of employees from the nearby New Orleans metro area. The sharp decline of Plaquemines Parish's resident population in 2005 was caused by Hurricane Katrina.

Figure 4. Resident Population of Focal Counties, 1970-2018

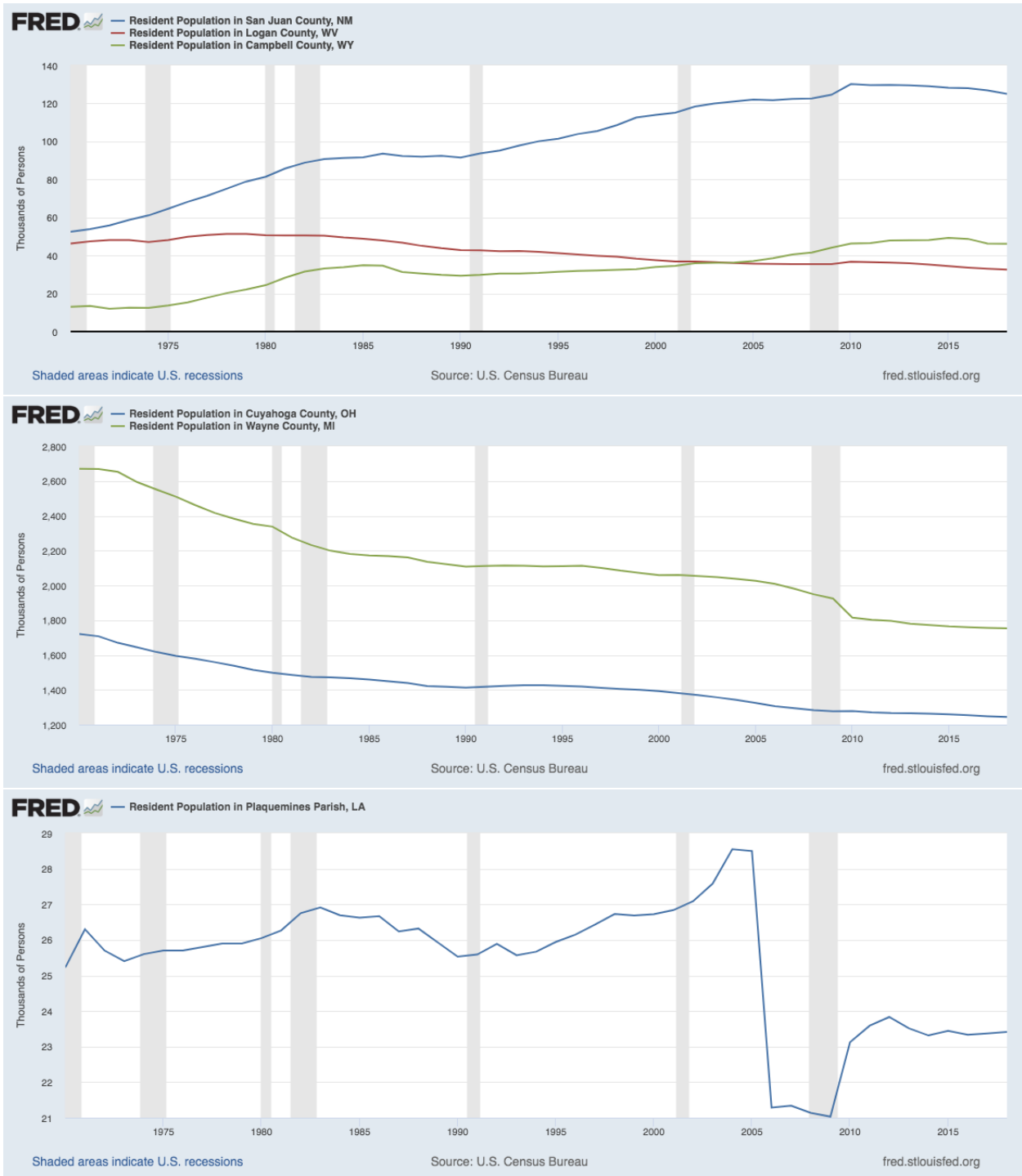
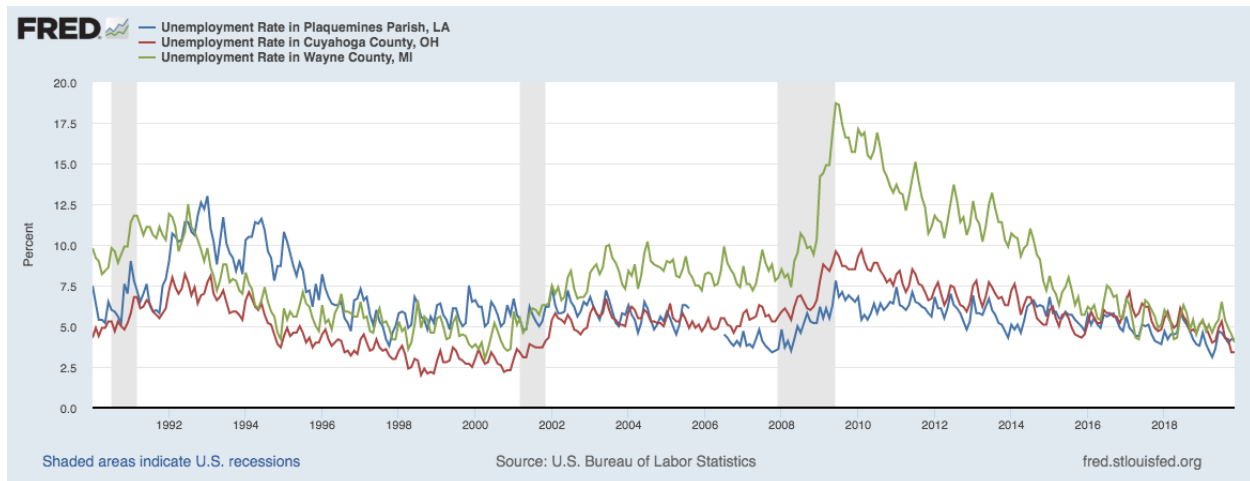


Figure 5. Long-term Trends in Unemployment Rates in Three Energy-intensive Areas.



## Household Inequality and Poverty

While deindustrialization in the United States contributed to labor-market inequality between African Americans and whites, it also contributed to the rise in overall income inequality through its impact on declining unions.<sup>14</sup> Wage inequality will grow as a straightforward function of a shift from a more-equal unionized sector (manufacturing, and in some cases fossil-fuel production) to a less-equal non-unionized sector.<sup>15</sup> In addition to this sector-dualism effect, part of this inequality effect of deindustrialization is from the long-term scarring experienced by displaced workers, where their wages are persistently lower than non-displaced workers, and lower than incumbent workers in the new jobs. In many cases, the negative impact of permanent sectoral displacement on worker wages is even stronger over time than the negative effects of short-term unemployment among the non-displaced.<sup>16</sup> Displaced workers are also more likely to be reemployed on a part-time basis or in the lower-wage service sector, raising rates of family poverty.<sup>17</sup>

<sup>14</sup> Western, Bruce, and Jake Rosenfeld. "Unions, Norms, and the Rise in U.S. Wage Inequality." *American Sociological Review* 76, no. 4 (2011): 513–37.

<sup>15</sup> Nielsen, Francois, and Arthur S. Alderson. "The Kuznets curve and the great U-turn: income inequality in US counties, 1970 to 1990." *American Sociological Review* (1997): 12-33; Moller, Stephanie, Arthur S. Alderson, and Francois Nielsen. "Changing patterns of income inequality in US counties, 1970–2000." *American Journal of Sociology* 114.4 (2009): 1037-1101.

<sup>16</sup> Brand 2004, 2006; Podgursky & Swaim 1987; Brand & von Wachter 2013, Davis & von Wachter 2012, von Wachter 2010; Brand 2004; Cha & Morgan 2010; Chan & Stevens 1999, 2001; Couch & Placzek 2010; Couch et al. 2011; Fallick 1996; Farber 2003, 2005; Jacobson et al. 1993; Kletzer 1998; Podgursky & Swaim 1987; Ruhm 1991; Seitchik 1991; Stevens 2014; von Wachter 2010; Chan, Sewin, and Ann Huff Stevens. "Employment and Retirement Following a Late-Career Job Loss." *American Economic Review* 89, no. 2 (May 1999): 211–16.

<https://doi.org/10.1257/aer.89.2.211>; Couch, Kenneth A, and Dana W Placzek. "Earnings Losses of Displaced Workers Revisited." *American Economic Review* 100, no. 1 (March 2010): 572–89. <https://doi.org/10.1257/aer.100.1.572>.

<sup>17</sup> Farber 1993, 2003, 2005; THE EFFECT OF ECONOMIC RESTRUCTURING ON FAMILY POVERTY IN THE INDUSTRIAL HEARTLAND, 1970–1990, Amy Nelson.

While the reasons for these income losses are debated, some focus on both industry-specific decline and the loss of firm- and industry-specific skills.<sup>18</sup> Analyses of wage inequality are consistent with this scenario, in finding substantial industry effects on wage polarization.<sup>19</sup> This could be reason for optimism about the effects of displacement from fossil-fuel production employment, however, given predicted growth in the green energy sector, and opportunities for developing firm- and industry-specific skills in that sector. The conditions of employment in solar, wind, geothermal, and hydroelectric energy production would then shape social impacts; the comparison of open-shop Wyoming and West Virginia to agency-shop New Mexico would be especially interesting in that connection.

The case of deindustrialization in Lake County, Indiana, and its principal city, Gary, offers stark lessons about the social impacts of decline in a local economy dominated by a single industry. In Lake County, as is the case in many Rust Belt cities, the near-disappearance of steel production was followed by significant increases in AFDC reciprocity rates. In this case, the pace of industry loss was important, with rapid displacement bringing both high poverty rates and high fiscal pressure on government. Displaced workers transitioned predominantly to lower paying jobs, meaning that much of the new poverty in Lake County was (and is) working poverty, which places a continuing fiscal strain on local government.<sup>20</sup> Elsewhere, such fiscal strain followed the disappearance of coal jobs.<sup>21</sup> Lake County also experienced rapidly declining property values, with sequelae of (a) constrained geographic mobility (because of the growing differential between one's current home value and one's prospective home value in a place with better employment chances), and (b) decreasing household wealth alongside rising household income poverty.<sup>22</sup>

The bottom line is that in most cities, the deindustrialization of the 1970s and 1980s produced unemployment and under-employment, raised economic inequality, and pushed more families and households into working-poverty.<sup>23</sup> These impacts are even more pronounced in rural areas, where people tend to hold more negative attitudes toward public income supports, and less accurate information about their eligibility for benefits of government programs.<sup>24</sup> This implies that rural communities engaged in fossil-fuel production may raise specific challenges to policymaking intended to soften the blow of energy transition.

Turning to our focal counties, we see the contrast between San Juan County and Logan County, which are both dependent on coal mining, and Campbell County, which is relatively prosperous

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<sup>18</sup> Kalleberg 2000.

<sup>19</sup> Autor + Katz - Changes in the Wage Structure and Earnings Inequality; Card, David. "The Effect of Unions on the Structure of Wages: A Longitudinal Analysis." *Econometrica* 64, no. 4 (1996): 957–79. <https://doi.org/10.2307/2171852>.

<sup>20</sup> David Brady & Michael Wallace, Deindustrialization and AFDC Reciprocity Rates in Lake County (i.e. Gary), Indiana, 1964-93.

<sup>21</sup> "Does the availability of high-wage jobs for low-skilled men affect welfare expenditures? Evidence from shocks to the steel and coal industries."

<sup>22</sup> "Deindustrialization and regional economic transformation," Lloyd Rodwin.

<sup>23</sup> Now is the Time: Places Left Behind in the New Economy, U.S. HUD 1999.

<sup>24</sup> Davis, Grobe, and Weber; Rural–Urban Differences in Childcare Subsidy Use and Employment Stability; Community Effects on Welfare Participation; Thomas A. Hirschl and Mark R. Rank.

from the thriving natural-gas sector. While all six counties have poverty rates markedly higher than the US average, the long-run decline of poverty in Campbell County, and the long-run rise in poverty in Plaquemines Parish, are striking. Also striking are the very high poverty rates in Logan County and Wayne County, each at almost double the national rate. Figure 6 shows the data.

Figure 6. Poverty Rates for Focal Counties



### Fiscal Inequality and Poverty

In declining cities, the spatial concentration of poverty itself has a significant negative effect on the fiscal health of cities in that it increases spending on antipoverty programs and also raises the cost of providing more general public services such as police and fire protection. Because the general service impacts of poverty are typically uncompensated or under-compensated under state and federal policies, poor cities experience significantly higher uncompensated costs and

face growing fiscal pressures.<sup>25</sup> In cities recovering from disasters, poverty traps emerge when the damage to the built environment (akin to damage to a labor market in a place transitioning away from fossil fuel production) exceeds the resources available for reconstruction, even after accounting for the growth effects of reconstruction.<sup>26</sup> Such cities also face declining local capital circulation, negatively impacting public services and property values in a vicious downward cycle.<sup>27</sup> Within shrinking cities, low-income neighborhoods are the first to be hit by decline while, on the urban region scale, socio-spatial inequalities tend to increase. In contexts characterized by such a series of effects, local actors are left with few solutions to reverse decline, due to the fiscal crisis and the lack of financial resources created by urban decline.<sup>28</sup>

For instance, consider the case of New York State, which experienced deindustrialization and rising unemployment in the 1960s and 1970s. Industrial migration activities and local government budgets of New York State from 1962 to 1976 show that in this case, (1) manufacturing decline handicapped the growth of local property tax revenues; (2) when possible, local governments compensated for their lost property tax revenues by raising non-property taxes, which itself has welfare and mobility implications; (3) displaced workers were likely to seek public assistance; and (4) local welfare expenditures did not keep pace with the soaring social service demands.<sup>29</sup>

Of course, local governments are not passive victims of structural change, and they do change their development strategies in response to these macroscopic changes. For example, some relatively autonomous state governments responded to their fiscal dependence on corporate taxes, deindustrialization, and a corporatist “social pact” between capital, labor, and strong central administrations by creating and investing in corporatist employment and development programs. These factors encouraged a long-term entrepreneurial perspective on economic development policy, while business power and electoral competition contributed to short-term “smokestack-chasing” interventions, such as tax incentives and infrastructural investments. In cross-national comparative context, the relatively more politically pluralistic United States governments were more likely to adopt direct intervention at the meso-level.<sup>30</sup>

One indicator of the social service burden of poverty that is widely available is the number of SNAP (Supplemental Nutrition Assistance Program) recipients in a county. Figure 7 shows the available data for our focal counties. In San Juan County, SNAP recipients numbered over 32,000 in 2017, or nearly 25% of the county’s population. This number has hovered around

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<sup>25</sup> Joassart-Marcelli, Pascale M., Juliet A. Musso, and Jennifer R. Wolch. “Fiscal Consequences of Concentrated Poverty in a Metropolitan Region.” *Annals of the Association of American Geographers* 95, no. 2 (2005): 336–56.

<sup>26</sup> Hallegatte, Stéphane, and Patrice Dumas. “Can natural disasters have positive consequences? Investigating the role of embodied technical change.” *Ecological Economics* 68.3 (2009): 777–786.

<sup>27</sup> Haller, William. “Industrial Restructuring and Urban Change in the Pittsburgh Region: Developmental, Ecological, and Socioeconomic Tradeoffs.”

<sup>28</sup> FOL, SYLVIE. “Urban Shrinkage and Socio-Spatial Disparities: Are the Remedies Worse than the Disease?” *Built Environment* (1978-) 38, no. 2 (2012): 259–75.

<sup>29</sup> Wu, Sen-Yuan, and Hyman Korman. “Socioeconomic Impacts of Disinvestment on Communities in New York State.” *The American Journal of Economics and Sociology* 46, no. 3 (1987): 261–71.

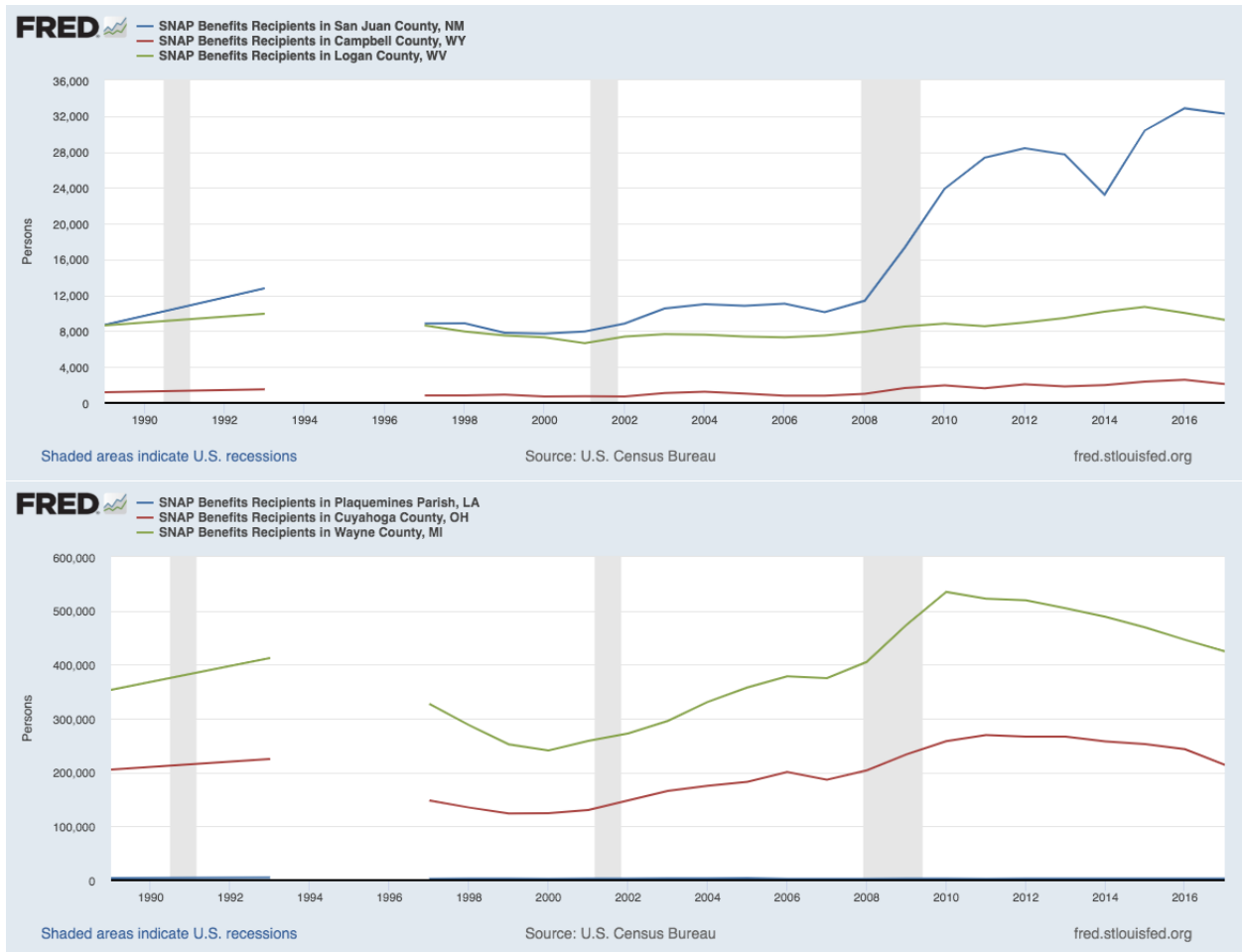
<sup>30</sup> Jenkins, J. Craig, and Kevin T. Leicht. “Direct Intervention by the Subnational State: The Development of Public Venture Capital Programs in the American States.” *Social Problems* 43, no. 3 (1996): 306–26.

<https://doi.org/10.2307/3096980>.



8,000 residents of Logan County (which has had a steady population of about 36,000 since 1989). In contrast, there is very little SNAP recieience in Campbell County, which suggests a high vulnerability to growth in social service needs if deep decarbonization were to displace many workers there. There is also a relatively low level of SNAP benefit receipt in Plaquemines Parish, at just over 3,000 people in 2017, which does not match the county’s high poverty rate.

Figure 7. SNAP Recipients in Focal Counties

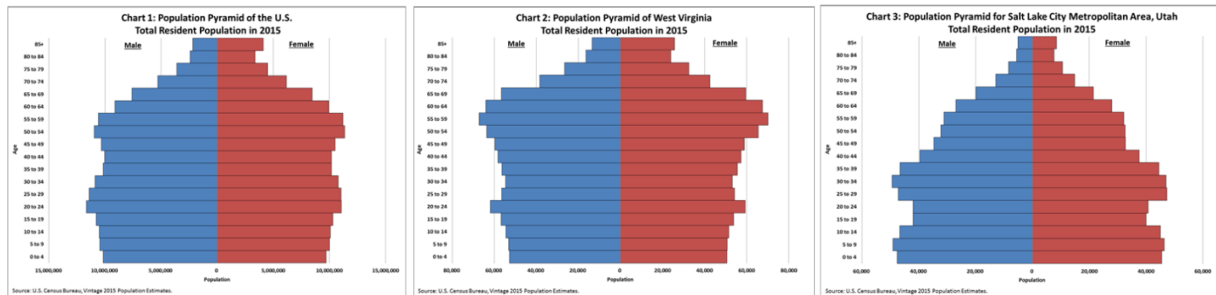


Of course, these burdens must be evaluated relative to the population of the counties in question. Figure 4 above shows the population data. Logan County has seen a long-term decline in total population, going back quite a long time. In contrast, Campbell and San Juan counties have seen population growth, especially over the past thirty years. Cuyahoga and Wayne Counties have seen slow, long-run population declines in response to deindustrialization.

## Social Demography

Populations change as a function of fertility, mortality, immigration, and emigration, and all four of these demographic forces respond to and shape economic transformations like energy transitions, and natural disasters. In Youngstown, Ohio, for instance, following the closure of steel mills, the population declined, led by out-migration of young adults and their children.<sup>31</sup> As young people leave communities, fertility declines, resulting in a feedback loop of absolute declines in the number of children in the population, and relative increases in the elderly population. The age structure shifts from upward-triangle shaped (like the age pyramid for the growing Salt Lake City population, below) to column-like (like the age pyramid for the relatively stable US population, below) to downward-triangle shaped (like the age pyramid for the declining West Virginia population, below). Mortality rates in declining communities also rise, driven by premature mortality among those aged 45-64, higher suicide rates across age groups among white and African American men, and higher mortality rates among the poor and the racially marginalized.<sup>32</sup>

Figure 8. Age Pyramids for the United States, West Virginia, and Salt Lake City Populations, 2015 (Source: US Census Bureau; <https://www.census.gov/newsroom/blogs/random-samplings/2016/06/americas-age-profile-told-through-population-pyramids.html>)



A common assumption is that people will abandon areas following steep losses of employment, but the evidence shows people are less responsive to economic signals than many economic models assume. Despite massive economic changes since the 1980s, the overall rate of internal migration in the United States has continually declined over the same period.<sup>33</sup> Figure 9 below, taken from this study, illustrates that this decline holds across inter-region, interstate, inter-metro-area, and inter-county moves. Research on people affected by Hurricane Katrina suggests

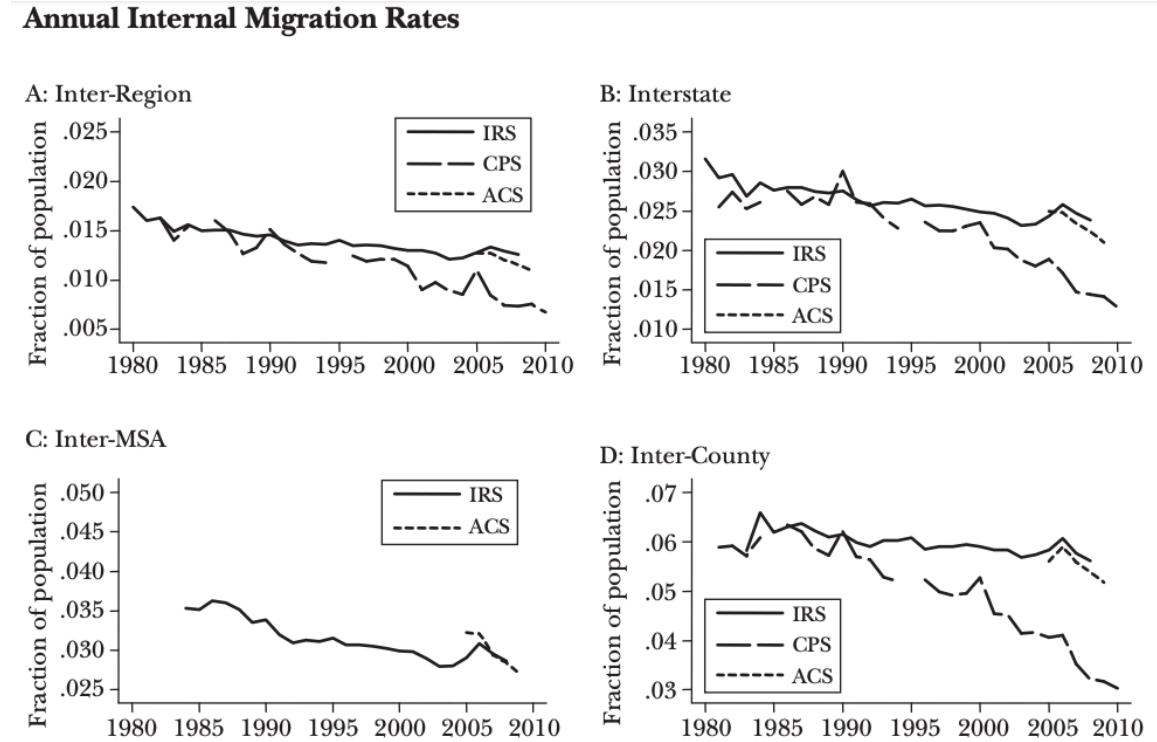
<sup>31</sup> "The cost of urban change to neighborhood schools: the case of Youngstown, Ohio, 1946-1997" Nardy, Margaret T. PhD Thesis, 2017.

<sup>32</sup> Nosrati, Elias, et al. "The association between income and life expectancy revisited: deindustrialization, incarceration and the widening health gap." *International journal of epidemiology* 47.3 (2017): 720-730; Kubrin, Charis E., Tim Wadsworth, and Stephanie DiPietro. "Deindustrialization, disadvantage and suicide among young black males." *Social Forces* 84.3 (2006): 1559-1579; Crime and unemployment; Yang, Bijou; Lester, David.

<sup>33</sup> Molloy, Raven, Christopher L. Smith, and Abigail Wozniak. "Internal migration in the United States." *Journal of Economic perspectives* 25.3 (2011): 173-96.

that moving out of New Orleans was, for many, moving up.<sup>34</sup> We might expect different outcomes for middle-class people forced to relocate from wealthier cities.<sup>35</sup> Such a negative scenario could happen if the energy transition is not well managed.

Figure 9. Internal Migration in the United States Since 1980



Source: Author's calculations based on Internal Revenue Service (IRS), Current Population Survey (CPS), and American Community Survey (ACS) data.

Notes: Current Population Survey and American Community Survey statistics are authors' calculations from microdata excluding residents of group quarters and imputed values of migration. IRS statistics are authors' calculations based on state-level and county-level flows. "MSA" is Metropolitan Statistical Area.

Focusing on counties as the unit of analysis, we again see the centrality of employment to the social demographic effects of economic transitions. Labor-market and socioeconomic well-being variables are the strongest and most consistent determinants of migration differences across counties. In considering the role of migration in shifting the population profile of counties, we must distinguish in-migration (immigration), out-migration (emigration), and net migration. Factors associated with immigration also frequently increase emigration and thus the direction of net migration is typically a function of whether a particular variable is more strongly

<sup>34</sup> Deryugina, Tatyana, Laura Kawano, and Steven Levitt. "The economic impact of hurricane katrina on its victims: evidence from individual tax returns." *American Economic Journal: Applied Economics* 10.2 (2018): 202-33.

<sup>35</sup> Arcaya et al., 2020 (cited above).

associated with immigration or emigration.<sup>36</sup> For instance, a study of the Great Depression of 1929-39 found that in-migration prompted some residents to move away and others to lose weeks of work or access to relief jobs. For every 10 arrivals, the authors estimated that 1.9 residents moved out, 2.1 were prevented from finding a relief job, and 1.9 shifted from full-time to part-time work.<sup>37</sup> In the United States, later periods of urban decline in the 1970s and 1980s were associated with selective migration, with the most qualified and the youngest leaving first. As a result, the most vulnerable populations (the poorest, the oldest and those with less schooling or no formal qualifications) were left behind to experience deterioration in their standard of living.<sup>38</sup>

In addition to mortality and migration, the social demography of economic transformation also investigates the family as a social institution that mediates and moderates social impacts. Using ethnographic and qualitative interview data, one study of social impacts of the transition away from forest mill work in rural California explores how labor market transformations affect gender norms and family life in a rural community historically tied to a single industry. The communities of energy transition in West Virginia, Wyoming, and New Mexico can also be characterized as predominantly single-industry places that may face labor market shifts in energy transition, and so this study warrants a close look. It argues that the gender strategies pursued by couples heavily impact their relationships and families as they experience changes in the nature of employment. Flexibility with regard to gender norms is key to creating stable relationships in a context of labor market change that threatens the existing gender order, the male-breadwinner norm that is still very strong in much of the United States. For couples strongly tied to traditional breadwinner/homemaker gender roles, men's diminished positions on the labor market create marital and family tensions. In contrast, when men are able to refocus their conceptions of masculinity on more attainable goals such as active parenting experience less strife and more marital satisfaction.<sup>39</sup> Such social strain can also have economic knock-on effects, given the centrality of family and wider social networks for finding new jobs after displacement.<sup>40</sup>

Lastly, closely tied to mortality are measures of morbidity, or non-fatal ill health or lack of wellbeing. Leading explanations for why job loss and unemployment negatively impact social-psychological well-being include lowered self-esteem, self-acceptance, self-confidence, morale, life satisfaction, sense of purpose, and sense of control; heightened apathy, idleness, isolation, and the breakdown of social support; and a loss of the positive derivatives of participating in a work environment, such as skill use, time structure, economic security, interpersonal socialization, and valued societal position.<sup>41</sup> In the socioecological model of post-disaster recovery, good mental health, good physical health, and social role functioning all serve as

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<sup>36</sup> Rayer, Stefan, and David L. Brown. "Geographic diversity of inter-county migration in the United States, 1980–1995." *Population Research and Policy Review* 20.3 (2001): 229-252.

<sup>37</sup> "The Effect of Internal Migration on Local Labor Markets: American Cities during the Great Depression."

<sup>38</sup> Fol, 2012.

<sup>39</sup> Sherman, Jennifer. "Bend to avoid breaking: Job loss, gender norms, and family stability in rural America." *Social Problems* 56.4 (2009): 599-620.

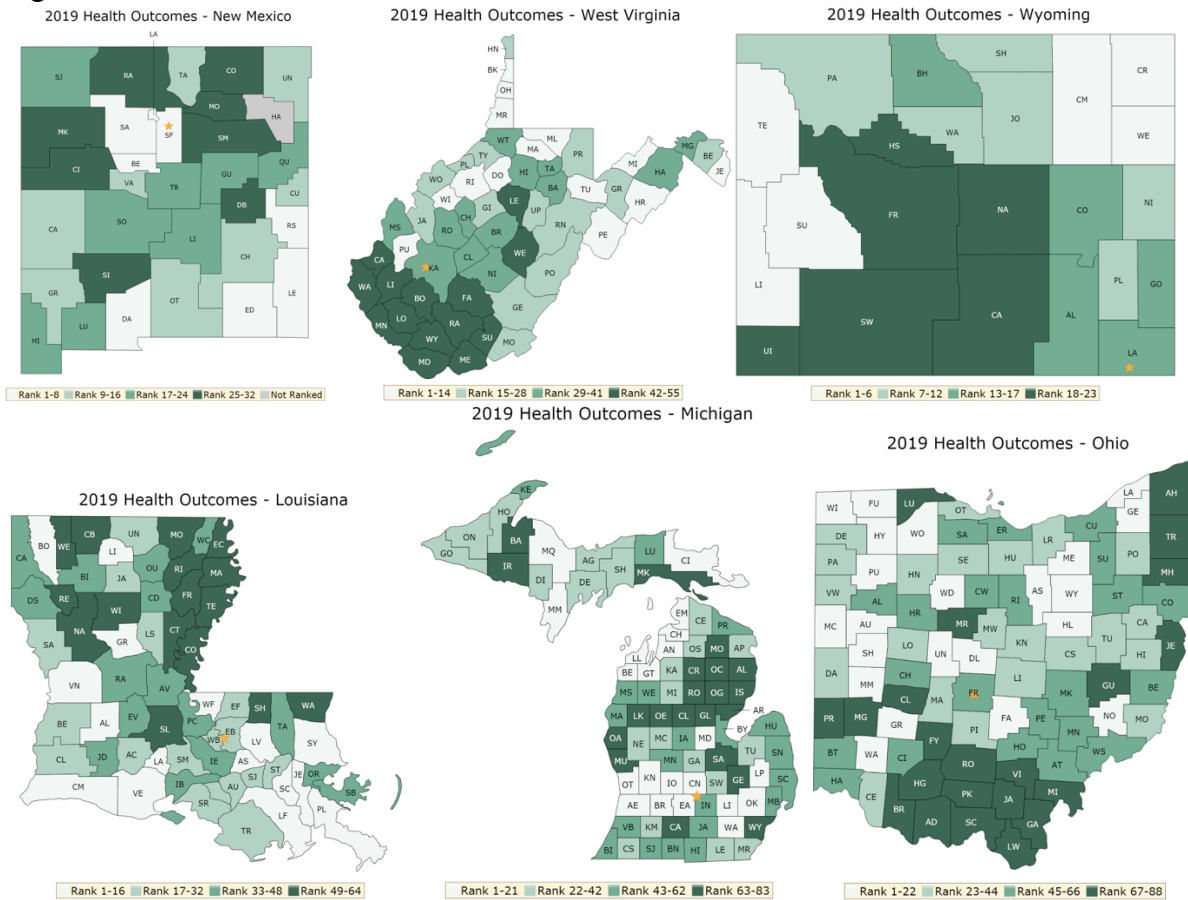
<sup>40</sup> Gush, Karon, James Scott, and Heather Laurie. *Job loss and social capital: The role of family, friends and wider support networks*. No. 2015-07. ISER Working Paper Series, 2015.

<sup>41</sup> Darity & Goldsmith 1996, Jahoda 1982, Jahoda et al. 1971 (1933), McKee-Ryan et al. 2005.

individual-level measures of recovery.<sup>42</sup> This suggests once again the promise of health metrics as indicators of “success” in the energy transition.

Figure 10 shows health rankings of all counties in Louisiana, Michigan, Ohio, New Mexico, West Virginia, and Wyoming, based on several common health indicators used by the Robert Wood Johnson Foundation’s *County Health Rankings* project.

Figure 10. Health Outcomes in Focal Counties and States



San Juan County, the northwesternmost in New Mexico and marked SJ, ranks mid-pack within the state. Logan County, in southwestern West Virginia and marked LO, ranks toward the bottom within the state. Campbell County, in the northeastern quadrant of Wyoming, ranks among the healthiest counties in that state. These data suggest quite different starting points for these counties, as they potentially embark on decarbonization projects.

Turning to the sites of energy-intensive industrial production, Plaquemines Parish has one of the better population health profiles in Louisiana, though it should be noted that in absolute terms,

<sup>42</sup> Abramson, David M., et al. "Measuring individual disaster recovery: A socioecological framework." *Disaster medicine and public health preparedness* 4.51 (2010): S46-S54.

the state has long had some of the worst health outcomes in the United States. In Michigan, Wayne County ranks in the bottom group; and Cuyahoga County, home to the Cleveland Clinic, ranks below mid-pack among Ohio counties.

## Crime

Homicide rates of economically dislocated communities in the United States have remained significantly higher than those which have not, and considerably above national averages.<sup>43</sup> Deindustrialization of the urban core in US cities such as Chicago and Detroit, in combination with racial residential segregation and the concentration of poverty, also results in higher crime rates, though this effect is much weaker in communities with stronger collective efficacy, as discussed below.<sup>44</sup> The deindustrialization-and-crime literature tends to focus on employment in general rather than energy-sector-specific employment. An exception is a study of the former mining town of Lupeni, Romania, which found that unemployment and poverty resulted in severe social problems that have grown each year since mines were closed in the early 1990s. For instance, in 2008, in the city of Lupeni, the number of crimes was 70% higher than in the rest of the country, the most frequent of these being theft, assault, or domestic violence.<sup>45</sup>

## Community

Collective resources that endure at the community level – even as the composition of the population changes – mediate the social impacts of macroscopic changes such as deindustrialization. For instance, longitudinal data from the Project on Human Development in Chicago Neighborhoods shows that even large-scale job displacement from the move of manufacturing out of the city has highly variable effects across the city, conditional largely on the collective efficacy of the local community where people live.<sup>46</sup>

Collective efficacy means “social cohesion among neighbors combined with their willingness to intervene on behalf of the common good.” Social cohesion comes from networks among people, and those networks are formed in and through local organizations such as churches, schools, cafes, daycares, pools, community centers, social clubs, and other places where people live their lives outside of work.<sup>47</sup> The term “social infrastructure” makes such public or semi-public places analogous to the more familiar energy infrastructure and transportation infrastructure, in that all three share a materiality in the built environment.<sup>48</sup> One can see and touch social infrastructure, just like one can see and touch pipelines and bridges. An organization census is one approach to studying social infrastructure, as is observational ethnographic research. In the

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<sup>43</sup> Matthews, R., Maume, M., & Miller, W. (2001). Deindustrialization, Economic Distress, and Homicide Rates in Midsized Rustbelt Cities. *Homicide Studies*, 5(2), 83-113.

<sup>44</sup> Sampson, Robert J., Stephen W. Raudenbush, and Felton Earls. "Neighborhoods and violent crime: A multilevel study of collective efficacy." *Science* 277.5328 (1997): 918-924.

<sup>45</sup> CONSTANTINESCU, ILINCA PĂUN. "Shrinking Cities in Romania: Former Mining Cities in Valea Jiului." *Built Environment* 38, no. 2 (2012): 214–28.

<sup>46</sup> Sampson et al. (1997).

<sup>47</sup> Sampson, Robert J. *Great American city: Chicago and the enduring neighborhood effect*. University of Chicago Press, 2012.

<sup>48</sup> Klinenberg, Eric. *Palaces for the people: How social infrastructure can help fight inequality, polarization, and the decline of civic life*. Broadway Books, 2018.

literature on the social impacts of macroscopic transformations like deindustrialization, the decline of local schools represents one lagging indicator of decline, following job displacement, emigration, and the loss of young people.<sup>49</sup>

Willingness to act for the common good, however, can be observed only indirectly. In the Chicago study, researchers implemented a lost-letters experiment, wherein properly addressed and stamped letters were systematically dropped on sidewalks near mail drops.<sup>50</sup> The researchers then used the rate of people picking up the letters and mailing them as one indicator of the community's willingness to act for the common good. Another approach is the unobtrusive, systematic observation of public spaces, as in one study that video-recorded and later coded public space in street by street, block by block fashion, like Google Street View long before there was Google Street View. Such an approach creates a very rich catalog of community order and disorder, themselves functions of collective efficacy.<sup>51</sup>

There is some evidence that job displacement undermines social cohesion. For instance, in one study displaced workers showed significant and long-term lower probabilities of involvement in various modes of social participation, including church groups, youth and community groups, charitable organizations, and informal social gatherings with friends.<sup>52</sup> Thus, in a study of the social impacts of energy transition, we would want to understand both the social infrastructure as a set of opportunities for social cohesion, as well as the social conditions for legitimate participation. It would be important to observe under what conditions and in what capacities people participate in community life.

## Identity

Difficult to measure but crucial for a range of outcomes like social cohesion is identity. In the United States, the meaning of one's self is closely tied to one's job, as anyone who has asked or answered the modal introductory question, "what do you do?" In the US, what you do aligns closely with who you are. The function of the organization that employs a person is meaningful to the individual as the purpose of the work constitutes identity. There is an important relationship between meaningful work and the moral worth of institutions and individuals.<sup>53</sup> Losing a job is a significant threat to identity, and as such is experienced as supremely stressful. Social-psychological research shows that the loss of a job presents a source of acute stress associated with the immediate disruption to a major social role, as well as chronic stress resulting from continuing economic, social, and psychological strain.<sup>54</sup> Displaced workers report higher levels of depressive symptoms, somatization, anxiety, and the loss of psychosocial assets,

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<sup>49</sup> Nardy, 2017; Deindustrialization and the Financial Support of Public Education, Donald Spayd, Charles Dye; DISPROPORTIONATE BURDEN: Consolidation and Educational Equity in the City Schools of Warren, Ohio, 1978-2011, Leah Schmidt, Thomas Welsh; Deindustrialization and Urban Schools, Pamela J. Bettis;

<sup>50</sup> Milgram, Stanley, Leon Mann, and Susan Harter. "The lost-letter technique: A tool of social research." *Public Opinion Quarterly* 29.3 (1965): 437.

<sup>51</sup> Sampson, Robert J., and Stephen W. Raudenbush. "Systematic social observation of public spaces: A new look at disorder in urban neighborhoods." *American journal of sociology* 105.3 (1999): 603-651.

<sup>52</sup> Brand & Burgard (2008).

<sup>53</sup> Meaningful Work and Moral Worth; Christopher Michaelson.

<sup>54</sup> Pearlin et al. 1981.

including healthy self-identity.<sup>55</sup> In the study of mine closures in Romania, for instance, the transition from holding a “miner” identity to an “unemployed” identity made people apathetic and unable to respond to industrial crisis or arrive at a common understanding of how to overcome decline.<sup>56</sup> On the other hand, a potential buffering effect of widespread job loss on individual wellbeing has also been observed.<sup>57</sup> The state of the art research on this topic suggests that the wider moral climate – whether people perceive job loss as an indicator of moral worth – is decisive in ameliorating or exacerbating the impacts of widespread unemployment.<sup>58</sup>

The identity aspects of job loss include the inability to maintain a clear sense of personal identity (close to the classical sociological concept of anomie, or normlessness), lost feelings of control and mastery, and a stigmatized status involve different social and psychological mechanisms. Whether a life event has an enduring mental health impact depends on the degree to which the individual is able to resolve the consequences of the event. When a negative life event such as a job loss is successfully resolved, it has no enduring effects on mental health. On the other hand, when the consequences are not resolved, the individual continues to experience poor mental health.<sup>59</sup> For those who have to accept a less prestigious job, stigma (spoiled identity) may be difficult to overcome. Loss of income and status may lead to a devaluing of work and career goals to maintain a sense of identity. Others may cope with threats to personal identity by reframing their sense of self, pursuing a simpler life, retiring, or seeking other sources of life satisfaction. Finally, even if reemployment is successfully achieved, the individual's sense of mastery and control may be shaken if the new job is markedly less secure, so again we see the importance of the quality of the job beyond the quantity of jobs available.<sup>60</sup>

To understand the barriers to a successful energy transition, a helpful approach is the “science of loss,” which investigates:

- 1) what people value highly, how things come to be valued, and how values vary over space and time; 2) the climatic and social drivers of undesirable changes that put at risk things that people value; and 3) should losses arise, the means and extent to which suffering can in turn be minimized.<sup>61</sup>

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<sup>55</sup> Brand et al. 2008; Burgard et al. 2007; Catalano et al. 2011; Dooley et al. 1996, 2000; Darity & Goldsmith 1996; Gallo et al. 2000, 2006a; Hamilton et al. 1990; Jahoda 1981, 1982; Jahoda et al. 1971 (1933); Kasl & Jones 2000; Kessler et al. 1988, 1989; Leana & Feldman 1992; McKee-Ryan et al. 2005; Miller & Hoppe 1994; Paul & Moser 2009; Pearlin et al. 1981; Turner 1995; Warr & Jackson 1985.

<sup>56</sup> Constantinescu, Ilinca Păun. “Shrinking Cities in Romania: Former Mining Cities in Valea Jiului.” *Built Environment* 38, no. 2 (2012): 214–28.

<sup>57</sup> Brand et al. 2008; Charles & Stephens 2004; Clark 2003, 2010; Miller & Hoppe 1994;

<sup>58</sup> Sharone, Ofer. *Flawed system/flawed self: Job searching and unemployment experiences*. University of Chicago Press, 2013.

<sup>59</sup> Turner, R. J., & Avison, W. R. (1992). Innovations in the measurement of life stress: Crisis theory and the significance of event resolution. *Journal of Health and Social Behavior*, 33, 36-50.

<sup>60</sup> Price, Richard H., Daniel S. Friedland, and Anuram D. Vinokur. "Job loss: Hard times and eroded identity." *Perspectives on loss: A sourcebook* (1998): 303-316; Price, Richard H., Jin Nam Choi, and Amiram D. Vinokur. "Links in the chain of adversity following job loss: how financial strain and loss of personal control lead to depression, impaired functioning, and poor health." *Journal of occupational health psychology* 7.4 (2002): 302.

<sup>61</sup> Barnett, J., Tschakert, P., Head, L. and Adger, W. N. (2016) A science of loss. *Nature Climate Change* 6(11), 976-978.



Such an approach could extend well beyond social identity, to a broader consideration of how the cultural meanings of energy transition matter to people. After all, energy transition happens in social context, and so energy transition as a social process will depend on what energy production means to the communities that have large and long-term social stakes.

### Studying the Social Impacts of Energy Transition

We summarized the potential social impacts of energy transition in Figure 1 above. The quality and quantity of employment is at the center of the schematic, reflecting the centrality of employment in the literature on social impacts of macroscopic external perturbations. Also critical to what social impacts are realized from unemployment and under-employment are community resources such as collective efficacy, social networks, public goods such as welfare supports, schools, nongovernmental organizations like churches and social clubs, and the power and recognition people feel in positive social identity. The social impacts of energy transition may well differ across urban vs. rural areas, as one rural sociologist notes:

The social impacts of current and forthcoming energy transitions, whether unconventional oil and gas development, renewable and/or distributed energy systems, will be profound for rural places and rural people.<sup>62</sup>

We have noted the parallels between a disruptive energy transition and a natural or technological disaster. As we consider the measurement of social impacts, we can generalize the socioecological model of post-disaster recovery to identify several of the most promising measures of the impact of these social processes on people living in energy-producing communities.

The socioecological model focuses on the effects of housing damage or loss. If we replace disaster exposure with energy transition, and housing with employment, the applicability of the model to the case of energy transition becomes clear. Figure 11 shows the original model (Abramson et al. 2010). Figure 12 shows the model as modified to understand energy transition.

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<sup>62</sup> Beckley, Thomas M. 2017. "Energy and the Rural Sociological Imagination." *Journal of Rural Social Sciences*, 32(2), pp. 69–97.

Figure 11. Socioecological Model of Postdisaster Recovery (Abramson et al. 2010)

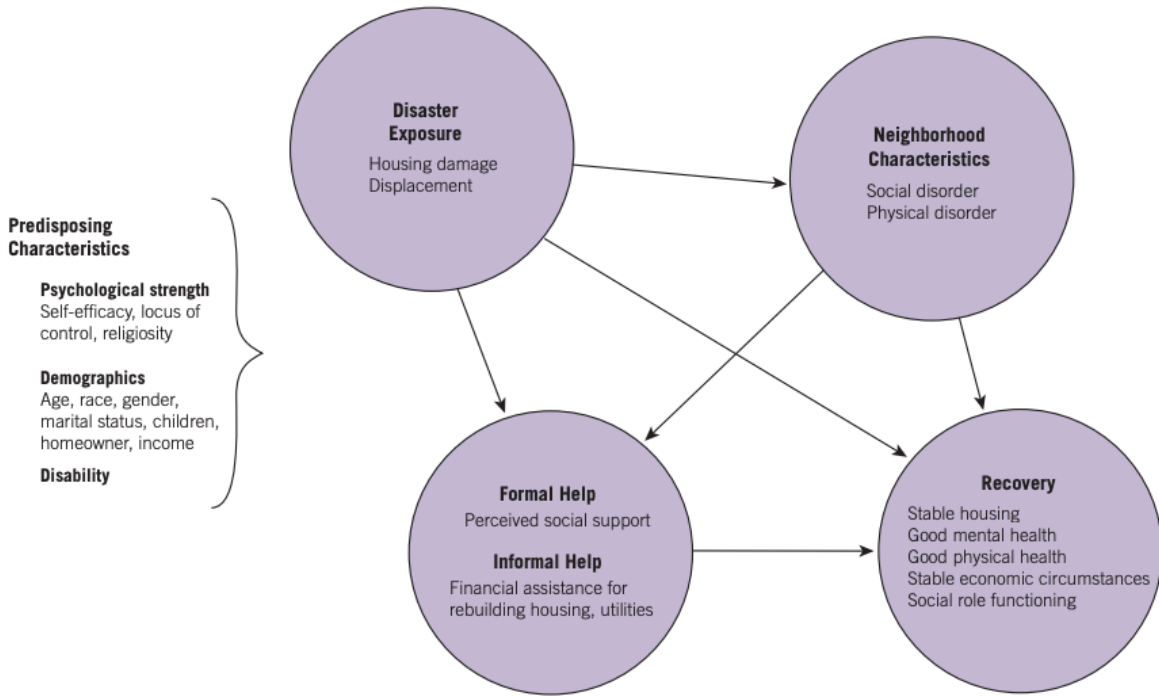
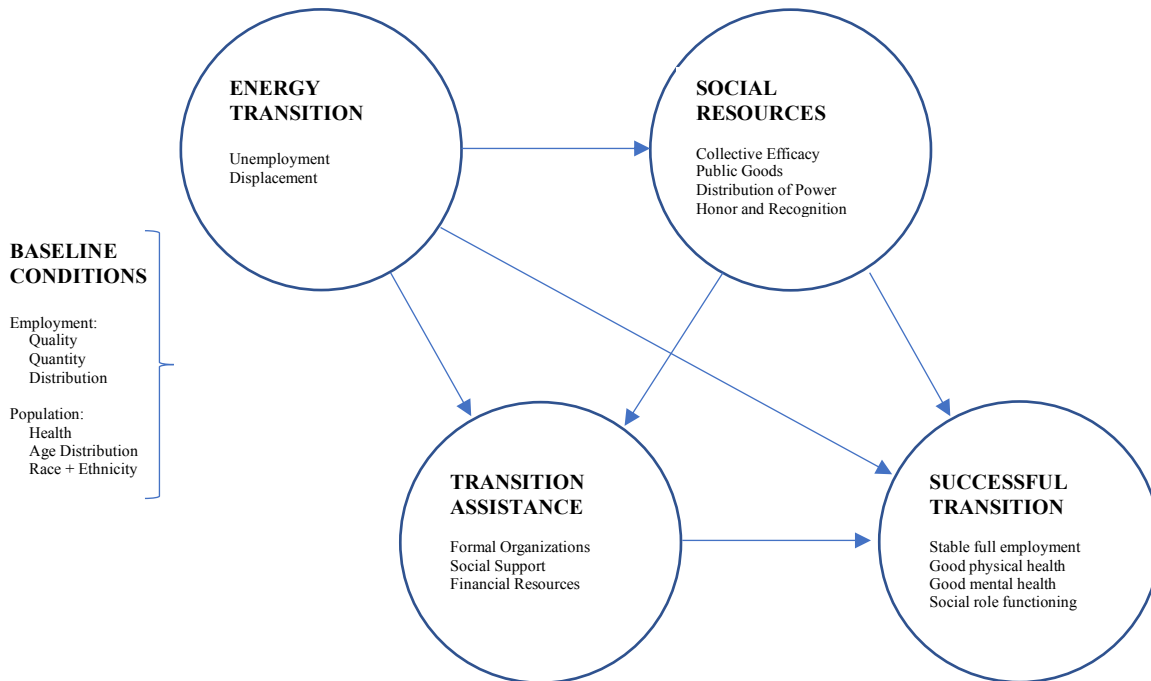


Figure 12. Socioecological Model of Successful Energy Transition



We propose that in studying the social impacts of energy transition, it will be essential to establish baseline measures of employment quantity, quality, and race/class/gender distribution; physical and psychological well-being and race/class/gender distribution; and community resources, including collective efficacy and social identity. Crucial for the success of such an ambitious research project would be the inclusion of local communities from the design stage onward, following best practices of community-based participatory research in public health. Partnering with scholars and other members of energy-producing communities, perhaps following a model of community-based participatory research, would be necessary.

Case selection is also essential, and the comparison of energy-producing communities to communities focused on other economic sectors would be helpful in identifying the effects of energy transition. Matching pairs of communities based on secondary data from the 2010 US Census would be straightforward to implement. For instance, baseline secondary quantitative evidence could be collected on some of the candidate variables listed in Figure 13. Data on three of the most-studied measures, population loss, poverty, and employment, are shown for West Virginia in Appendices A-C. A full catalog of social impacts measures appears as Appendix D.

Figure 13. Candidate Measures of Social Impacts, by Unit of Analysis

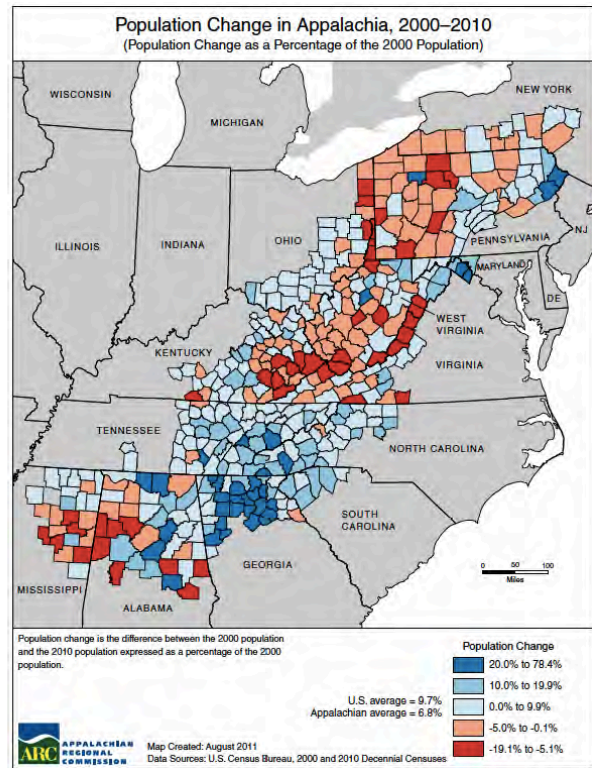
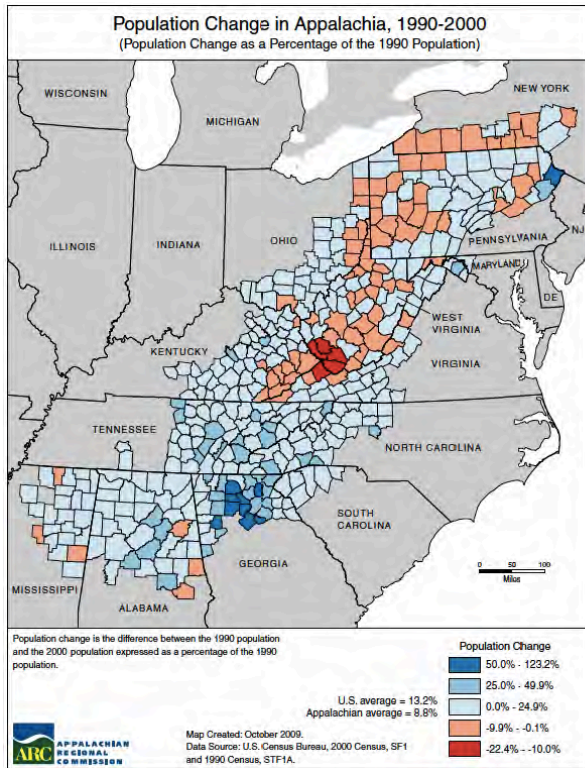
<ul style="list-style-type: none"> <li>• Communities               <ul style="list-style-type: none"> <li>○ Population</li> <li>○ Integration</li> <li>○ Inequalities</li> <li>○ Resources</li> <li>○ Collective Efficacy</li> <li>○ Power</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Emigration, Age structure, Population loss</li> <li>Social organizations, Welfare organizations</li> <li>Racial disparities, Concentrated disadvantage</li> <li>State and local tax revenue, Government expenditures</li> <li>Lost letters, Systematic social observation, Organization census</li> <li>Voting, Unions, Incorporation</li> </ul>
<ul style="list-style-type: none"> <li>• Organizations               <ul style="list-style-type: none"> <li>○ Networks</li> <li>○ Resources</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Social foci (schools, parks, employers, churches), Isolation, Core discussion networks</li> <li>Food pantries, Homeless shelters, Re-entry organizations, Labor unions</li> </ul>
<ul style="list-style-type: none"> <li>• Families               <ul style="list-style-type: none"> <li>○ Reproduction</li> <li>○ Migration</li> <li>○ Resources</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Fertility rate, Infant mortality rate, Marriage rate, Divorce rate</li> <li>Emigration, Remittances, Locked-in-place</li> <li>Poverty, Foreclosures, Debt</li> </ul>
<ul style="list-style-type: none"> <li>• Individuals               <ul style="list-style-type: none"> <li>○ Identity</li> <li>○ Anomie</li> <li>○ Stigma</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Employment, Dignity, Male breadwinner norm</li> <li>Suicide, Homicide, Property crime, Street crime, Institutional de-legitimation</li> <li>Scarring effects of unemployment, Addiction, Overdose, Recognition</li> </ul>

*Note: The most-studied measures are in blue, relatively easily obtained measures are in red, and measures in black would most likely require original data collection. Several measures are available from the US Census, but intercensal data between 2010, 2020, and 2030 would not be available from Census products such as the American Community Survey because of the small size of energy-producing communities.*

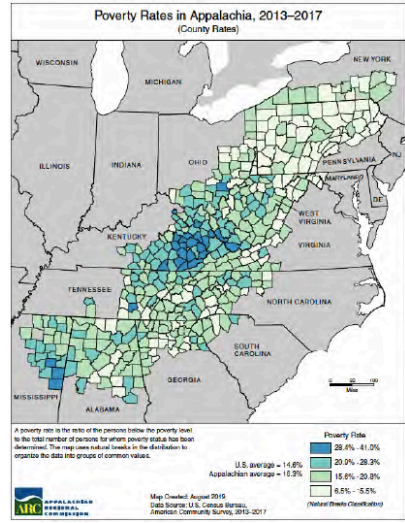
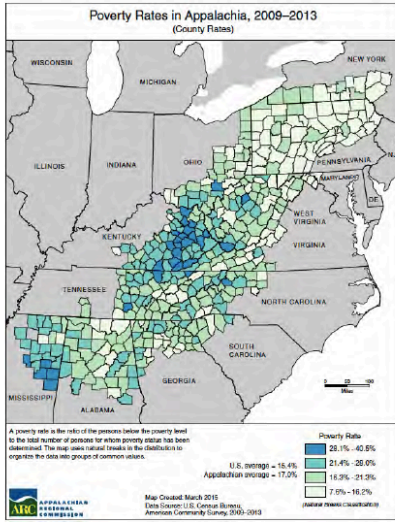
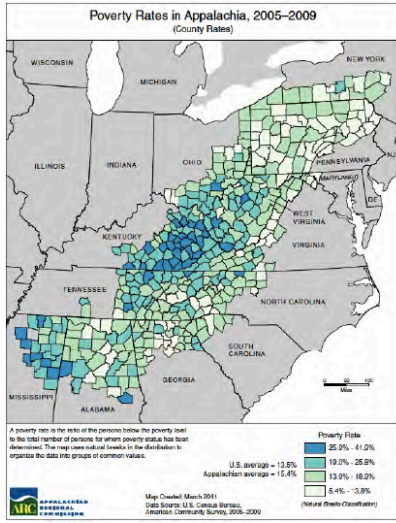
State-of-the-art research on social impacts integrates qualitative and quantitative methods. Such mixed-methods research balances ethnographic depth in understanding the meaning of community life, personal identity, and local social processes with quantitative techniques for causal inference, estimation, and the statistical simulation of control. Fielding baseline ethnographies, systematic social observation, and surveys, designed in collaboration with local experts, is the next step. To understand the complex culture of energy-producing communities, photovoice methods could also be used; since these can be done remotely, such an approach has advantages in a time of pandemic.<sup>63</sup> The results of such study would then constitute preliminary data and baseline comparative data for a larger longitudinal study, which would require substantial support from funders. To best understand the social impacts of energy transition, original data collection will be necessary, and original data collection is extremely expensive. Such an investment is essential to understanding how people will experience and lead the inherently social process of deep decarbonization, should that path be chosen.

<sup>63</sup> Bell, Shannon Elizabeth. 2016. *Fighting King Coal*. MIT Press.

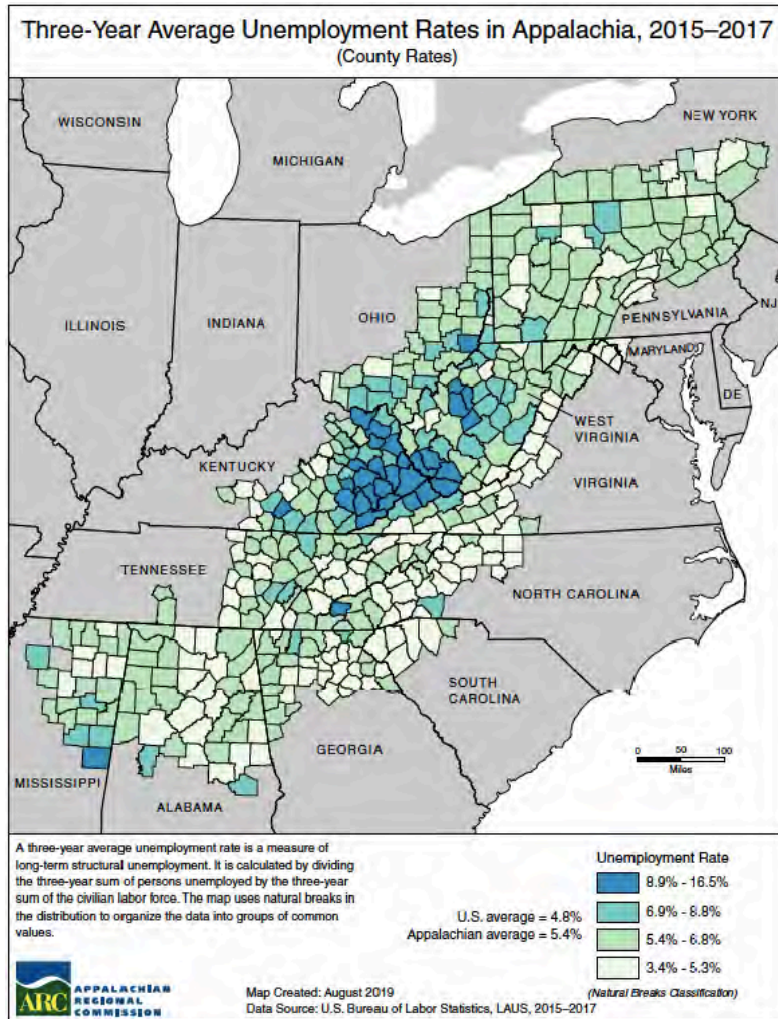
# Appendix A. Population Loss in Appalachia, 1990-2010



# Appendix B. Poverty in Appalachia, 2005-2017



Appendix C. Long-Term Unemployment in Appalachia, 2015-2017



## Appendix D. Measures and Methods

### Potential measures of social/community well-being

- Number and spatial distribution of groceries
- Satisfaction with public works/infrastructure maintenance projects
- Teacher retention rates
- Density of nonprofit organizations
- Algorithmic work labor market (i.e. is there a sufficient market for app-based work)
- Presence of childcare centers with nonstandard operating hours
- Community proximity to fossil fuel extraction waste dumps
- Ratio of nonpermanent to permanent housing

Smith, Michael D., Richard S. Krannich, and Lori M. Hunter. "Growth, Decline, Stability, and Disruption: A Longitudinal Analysis of Social Well-Being in Four Western Rural Communities\*." *Rural Sociology* 66, no. 3 (October 22, 2009): 425–50.

<https://doi.org/10.1111/j.1549-0831.2001.tb00075.x>.

- Data collected during four rounds of community surveys undertaken in each of the four study areas.
- In the first phase of data collection, surveys were administered at three points during the 1980s (1982, 1984, 1986), when three of the areas were experiencing substantial economic and demographic shifts associated with regional development of energy resources.
- In 1995, conducted a follow-up survey using similar data collection and measurement procedures to identify changes in various dimensions of social well-being that might have occurred over the decade following the boom growth era.
  - Administered self-completion questionnaires to a probability sample of adult residents in each study community at each data collection point.
  - Used water or electric utility records to develop comprehensive sampling frames of residential units
    - supplemental visual enumeration and mapping procedures ensured inclusion of units in mobile home parks and other multifamily housing areas where some units were not metered individually by the local utility companies
  - Questionnaires were distributed and collected via personalized drop-off/pick-up procedures using trained field workers;
    - this technique consistently has resulted in relatively high response rates
  - For the 1982, 1984, and 1986 surveys, the questionnaires were distributed to self-designated household heads, although another adult member of the household could act as a proxy if necessary.
  - For the 1995 survey we used a similar procedure, but response was requested from a randomly selected adult in each of the sampled households.
- Measures used for social well-being
  - Perceived social integration index
  - Perceived community friendliness
  - Borrowing/trading with neighbors
  - Task support from neighbors



- Helpfulness of neighbors in event of a personal crisis
- Trust in other local residents
- Importance of locking doors
- Safety walking alone after dark
- Fear of crime
- Community satisfaction

Raudenbush, Stephen W., and Robert Sampson. "Systematic Social Observation of Public Spaces: A New Look at Disorder in Urban Neighborhoods." *American Journal of Sociology* 105, no. 3 (1999): 603–51. <https://doi.org/10.1086/210356>.

### **Design**

- Observers trained at the national opinion research center
  - Drove an SUV @ 5mph down every street in 196 census tracts
    - 343 neighborhood clusters representing combinations of all 865 Chicago census tracts
      - Tracks selected from a stratified probability sample to maximize variability by race/ethnicity and SES
        - Tracks stratified by 7 categories of race/ethnic mix and SES
    - The NORC team fielded a driver, videographer, and 2 observers
      - As the vehicle drove, a video camera on each side of the vehicle captured activities and physical features of each side of the block simultaneously
        - Since viewing and coding recordings was expensive, they selected a random subsample and coded
          - 126 variables were coded
            - Including detailed information on physical conditions, housing characteristics, businesses, and social interactions
        - The two observers recorded observations into a log and spoke into the videotape audio when relevant
          - Data in logs focused on land use, traffic, the physical condition of buildings, and evidence of physical disorder
- Geographic unit of recorded observation within sampled NC's = face blocks (the block segment on one side of the street)
  - Each intersection received a unique identification code
    - Allowed adjacent block faces to be pieced together to form higher levels of aggregation
- Face blocks observed 7 a.m. to 7 p.m.

### **Measures**

- Data behaved as a dichotomous scale
  - Coded 1 = presence and 0= absence
- 2 scales
  - Physical disorder
    - 10 items → absence of presence of:
      - Cigarettes or cigars in street/gutter

- Garbage/litter on street/sidewalk
  - Empty beer bottles in the street
  - Tagging graffiti
  - Graffiti painted over
  - Gang graffiti
  - Abandoned cars
  - Condoms on sidewalk
  - Needles/syringes on sidewalk
  - Political graffiti
  - \*\*\* 6 taken from observer logs, 4 from videotapes
- Social disorder
  - 6 items
    - Drinking alcohol in public
    - Peer group with gang indicators
    - Public intoxication
    - Adults fighting or arguing in hostile manner
    - Selling drugs
    - Prostitutes
- \*\*\* Physical scale as a better as ecological measure\*\*\*
- Components of measurement error
  - Inconsistencies within a face-block
  - Face-block variation
  - Temporal variation
    - However, considerable amount of temporal variation in the time of observation within each census tract
- Operationalize neighborhood using the 196 census tracts
  - Research has argued for the smallest level of aggregation possible in measuring observed disorder (Perkins et al 1992; Taylor 1997)
    - Smallest level of aggregation possible in measuring observed disorder
      - Due to variability block-to-block within larger ecological units
    - By dropping to tract level, they doubled neighborhood degrees of freedom
    - Census tracts provide additional information necessary to address multicollinearity among ecological variables
- INDEPENDENT DATA
  - Households within the 196 census tracts were selected according to a multistage probability sample
    - Within each household, a randomly selected adult was interviewed concerning conditions and social relationships in the local neighborhood
      - Examine
        - Disorder
          - Multi-item scale

- How much a problem residents rated the presence in the neighborhood of social incivilities
      - A big problem, somewhat of a problem, not a problem
  - Predatory crime
    - Measured by respondents reports of whether they or any member of the household had experienced within the past 6 months
      - A violent victimization in the neighborhood
      - A household burglary or theft
  - Shared expectations for informal social control
    - Asked about the likelihood (very likely, likely, neither, unlikely, very unlikely) that their neighbors could be counted on to take action if:
      - Children were skipping school and hanging out on a street corner
      - Children were spray painting graffiti on a local building
      - Children were showing disrespect to an adult
      - A fight broke out in front of their house
      - The fire station closest to home was threatened with budget cuts
  - Social cohesion
    - Asked how strongly they agreed, on a 1 to 5 scale, that
      - “people around here are willing to help their neighbors”
      - “this is a close-knit neighborhood”
      - “People in this neighborhood can be trusted”
      - “people in this neighborhood generally don’t get along with each other”
      - “People in this neighborhood do not share the same values”
- Ecological variations in crime
  - Geocoded from police department and aggregated to the census tract of occurrence
    - Incidents of
      - Homicide
        - Raw count of homicide using a negative binomial regression
      - Robbery
        - Also analyzed log robbery rate per 100,000 persons
      - Burglary
        - Also analyzed log burglary rate per 100,000 persons

- 3 Indexes of neighborhood structural deviation created from census data @ tract level
  - Concentrated disadvantage
    - An economically disadvantage factor in racially segregated neighborhoods
      - Dominated by high loading for
        - Poverty
        - Public assistance
        - Unemployment
        - Female-headed households
  - Concentrated immigration
    - % latino
    - % foreign-born
    - Density of children
  - Residential stability
    - % living in the same house as five years earlier
    - % of owner-occupied homes
- Controls
  - Ecological characteristics reflect opportunities for crime and bear on the ability of residents to engage in guardianship
    - Density
      - Control for the number of persons per square kilometer in the tract
        - Using census data
      - Land use
      - The proportion of face blocks in the tract that contain mixed residential and commercial activity
        - Shown to be a correlate of crime and disorder (Wikstrom 1991; Taylor 1995)
        - Also relevant for collective efficacy

Robert Sampson *The Great American City*

Lost Letter Experiment

- Meant to tap the general propensity of communities to exhibit altruistic behavior over time, thereby promoting altruistic norms
  - More than 3,300 letters dropped
  - Addressed to a person on the 6<sup>th</sup> floor of a building in Cambridge
  - Fictitious names of companies and signatures were added for extra measure incase envelopes were opened
  - Letters were stamped and addressed in bold type behind water-resistant cellophane
  - Dropped during the day
    - On the sidewalk
    - Near mailboxes
    - Near a parked car door
    - Near a business

- Repeated this systematically across blocks in each strategically selected community
  - Rich/poor, White/minority, mixed income/mixed race
- Higher return rates in areas where organizations are dense and lower return rates where poverty is high as well as areas of moral/legal cynicism
- Lost letters first analyzed as a simultaneous function of
  - 21 situational predictors
    - Time, month, housing conditions, etc.
  - Neighborhood-level predictors
    - Concentrated disadvantage
    - Ethnic/immigrant diversity
    - Residential stability
    - Population density
  - Organizational predictors
    - Nonprofit organizations
    - businesses

Matthews, R., Maume, M., & Miller, W. (2001). Deindustrialization, Economic Distress, and Homicide Rates in Midsized Rustbelt Cities. *Homicide Studies*, 5(2), 83-113

1. Measure:

- a. Independent: homicide (offence statistics in the Uniform Crime Reports [FBI])
- b. 4 dependent:
  - i. Socioeconomic deprivation as a measure of economic distress
    - 1. Created an index composed of highly intercorrelated indicators
      - a. Poverty as the % of residents below the federal poverty level
      - b. % black residents
      - c. Single mother households
    - 2. Unemployment
    - 3. City elasticity (based on Ruck 1993)
      - a. A composite of city expansion/contraction and population density between 1950-90
    - 4. Population change
      - a. Subtracting estimated population in 1995 from its 1980 population
- c. Multivariate analysis of homicide rates using least squares dummy variable regression
  - Yang, Bijou, and David Lester. "Crime and Unemployment." *Journal of Socio-Economics* 23, no. 1 (1994): 215–222. [https://doi.org/10.1016/1053-5357\(94\)90028-0](https://doi.org/10.1016/1053-5357(94)90028-0).
    - 1. Five socioeconomic variables as predictors of homicide and suicide rates
      - a. Unemployment rate
      - b. GNP per capita
      - c. Female participation in the labor force
      - d. Divorce rate

- e. % Roman Catholic
- 2. Ordinary least squares method and Hildreth-Lu search procedure to estimate regression coefficients

Kollmeyer, Christopher, and Florian Pichler. "Is Deindustrialization Causing High Unemployment in Affluent Countries? Evidence from 16 OECD Countries, 1970-2003." *Social Forces* 91, no. 3 (2013): 785–812.

1. Two-way fixed-effects regression models
2. Dependent Variable
  - a. OECD harmonized unemployment rate
3. Independent variables (OECD Measures)
  - a. Employment in industrial sector
    - i. Manufacturing employment
    - ii. Mining employment (used in this case as a control)
  - b. Labor market rigidities
    - i. Variable tax wedge
      - i. The tax burden associated with the use of labor
        - a. Income tax from workers, payroll taxes paid by firms and labor, any other forms of taxation on labor
        - b. Taxes are assessed as a rate
      - ii. Variable employment protection legislation
        - a. The strictness of statutes regulating hiring and firing
          - i. Ranges from 0-5; Higher scores=higher protection
      - iii. Unemployment benefits
    - c. Corporatist bargaining structures
      - i. Wage bargaining
        - a. Transnational and temporal differences in the centralization and coordination of wage setting procedures
        - b. Coded in dummy format
      - ii. Union density
  - Brady, David, and Michael Wallace. "Deindustrialization and Poverty: Manufacturing Decline and AFDC Reciprocity in Lake County, Indiana 1964-93," n.d., 39.
  1. Historical case study approach with a multivariate time series analysis
    - a. Dependent variable:
      - i. The % of the county's population that is receiving AFDC
    - b. Independent variables
      - i. Percent change in total employment and payroll
        1. Measure changes in total private sector employment
      - ii. % change in manufacturing employment and payroll
      - iii. % change in service employment and payroll
      - iv. % change in steel employment and payroll
      - v. % change in nonsteel manuf. employment and payroll
        1. Number of employees= level/extent of employment
        2. First quarter payroll= quality of employment

- vi. U.S. AFDC reciprocity rates
  - 1. Used as a quasi-lagged endogenous variable
- Reemployment Differences among Dislocated and Other Workers. How Do They Adapt to Job Losses?
  - 1. Data derived from the Panel Study of Income Dynamics
    - i. Data limited to those who experienced some type of unemployment within the given year
    - ii. Different groups of unemployed
    - iii. Dislocated/plant closings; dislocated/job termination; quits; entrants;
  - 2. Percentage change in annual employment was determined based upon industry, then the rate of change was calculated into three categories
  - 3. Declining; stable; growth
  - iii. Utilized a multinomial logit regression to explore the relationship between labor market outcomes and worker type
    - a. Independent variables chosen: Measures of human capital investment (education, tenure, experience); personal characteristics that may affect labor market outcomes (age, union affiliation, asset income, marriage status, regional location)

Koppel, Ross, and Alice Hoffman. "Dislocation Policies in the USA: What Should We Be Doing?" *The Annals of the American Academy of Political and Social Science* 544 (1996): 111–26.

- i. 500 interviews with workers from 2 sites of dislocation
  - a. 7 questions about the worth of training for getting a job
    - i. "does post-layoff training or education help dislocated workers find jobs?". For those who took training, "did the training help them find a job?" as a measure of the perceptions of the impact of the training
    - ii. "Did training help workers find full-time as opposed to part-time work?"
    - iii. "did those who enrolled in post-layoff training or education get jobs that pay adequately compared to their previous jobs?"
    - iv. "did post-layoff training or education help dislocated workers get new jobs with decent benefits?"
    - v. "Does post-layoff training or education help dislocated workers get new jobs with acceptable working conditions?"
    - vi. "Does post-layoff training or education help dislocated workers get new jobs that do not require dramatically longer commutes than were required by the old jobs?"
    - vii. Asked respondents to evaluate the outlook for the jobs they had found after the layoffs

NELSON, AMY L. "THE EFFECT OF ECONOMIC RESTRUCTURING ON FAMILY POVERTY IN THE INDUSTRIAL HEARTLAND, 1970—1990." *Sociological Focus* 31, no. 2 (1998): 201–16.

1. Dependent Variable: % poor families as indicator of community/economic wellbeing and social conditions; change in the # of poor families
2. Independent variables: % / change labor force in industry, % / change labor force in services, unemployment rate

Haller, William. "Industrial Restructuring and Urban Change in the Pittsburgh Region: Developmental, Ecological, and Socioeconomic Trade-Offs." *Ecology and Society* 10, no. 1 (2005): art13. <https://doi.org/10.5751/ES-01261-100113>.

- Two methods, both using census tracts as units of analysis, examine the relationship between regional restructuring and underclass growth
  1. The first is a tabular presentation of the relevant descriptive statistics showing the intercensal shifts in employment structure by industry and occupation, and the shifts in underclass indicators for the same periods.
  2. The second is a series of eight ordinary least squares (OLS) multiple regression models testing whether the intercensal employment shifts in durable manufacturing industries and blue-collar occupations were significantly related to increases in a structural underclass
- Typical measures were utilized in this study
  - Change in % of males not in labor force
  - Change in % of population under poverty line
  - % in industry in period B subtracted from % in industry in period A.
- Hirschl, Thomas A., and Mark R. Rank. "Community Effects on Welfare Participation." *Sociological Forum* 14, no. 1 (1999): 155–74.
- 3 questions utilizing PSID data
- (1) are there comparable aggregate relationships between population density and poverty level, and the likelihood of welfare participation?
  1. Examined cross tabulations of participation in food stamp program by poverty level and population density
- (2) do these relationships persist in a multivariate context?
- (3) can these effects (if effects are found) be understood in terms of differences in knowledge about eligibility criteria and adverse attitudes toward food stamps?
- examine cross-tabulations among nonparticipants between prior reasons for nonparticipation and population density and poverty level, and test for statistical significance

Jenkins, J. Craig, and Kevin T. Leicht. "Direct Intervention by the Subnational State: The Development of Public Venture Capital Programs in the American States." *Social Problems* 43, no. 3 (1996): 306–26. <https://doi.org/10.2307/3096980>.

- Fiscal dependence on corporate profits measured by the proportion of direct state revenue derived from corporate income taxes



- Business power measured by concentration of industrial employment and the concentration of industrial assets
  - Mean asset concentration = total corporate assets/ total establishments (U.S. Statistical abstract)
  - Mean employment concentration = establishments with 1000+ employees/total establishments (U.S. Statistical abstract)

Joassart-Marcelli, Pascale M., Juliet A. Musso, and Jennifer R. Wolch. "Fiscal Consequences of Concentrated Poverty in a Metropolitan Region." *Annals of the Association of American Geographers* 95, no. 2 (2005): 336–56.

- Measure of fiscal capacity computed using a representative tax burden approach
  - City fiscal capacity is estimated by multiplying a city's aggregate household income by a representative tax rate derived from averaging tax rates across all cities in the region (Ladd and Yinger 1989).
    - Tax rate itself is typically estimated as the ratio of city revenues to aggregate household income



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