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POST-RECESSION JOBS RECOVERY: A STATE-LEVEL SPATIAL ANALYSIS

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ABSTRACT

Employment recovery performance across states - gauged as the level of employment in 2014 as a fraction of employment levels in 2008 - varied considerably. The difference between the maximum (North Dakota) and the minimum (Nevada) States' amounted to approximately seven standard deviations. What are the possible determinants of the asymmetry in performance? Despite an abundance of theoretical and empirical work in this area little is available by way of specific guidance in model formulation. Accordingly, various economic and political state policy variables reflecting formal and informal institutions as well as quality-of-life variables are examined as possible explanatory variables for the observed differences. This results in a large set of prospective explanatory variables in combination with a small sample size, an instance of what is known in the literature as a small-n, large-p problem. Bayesian Model Averaging is used to overcome both the high-dimension low sample-size limitations as well as the resulting model uncertainty. Another consideration that may have a bearing on this inquiry is the regional agglomeration and dispersion forces that have increasingly led to employment clusters that often straddle several states. Thus, it is possible that employment recovery performance has a spatial spillover dimension to it. Again, a proper gauging of variables responsible for employment performance, should readily account for possible spatial spillovers. A reduced set of explanatory variables that account for the observed differences in employment recovery performance is found; there is no evidence of spatial spillovers.

INTRODUCTION AND OVERVIEW

The recovery has been kinder to some states. By 2014 many states had reached and substantially exceeded their pre-recession employment levels. Many others lagged. The ratio of employment levels in 2014 to employment levels in 2008 provides a measure of each state's success in employment recovery. Based on this metric the observed variation in performance was considerable. The employment performance difference between the maximum (North Dakota) and the minimum (Nevada) amounted to approximately seven standard deviations in 2014.

What prolonged the recovery? Variables affecting firms and agents' structure of incentives are likely to have a bearing on employment decisions. A formidable body of

economic literature has persuasively shown that there exists a link between a region's or state's policies and the success of its economic agents (Brown, Hayes, & Taylor, 2003) (Taylor & Brown, 2006). More specifically, that the payoffs to economic activity are set by the institutional environment; these are rules that "change dramatically from one time and place to another." (Baumol, 1990). Thus, the duration of the recovery period, the time it takes a state to regain its pre-recession levels of employment is influenced by the operational effectiveness of its economic institutions.

Stronger, higher quality government policies (or institutions) are capable of ensuring higher levels of productive entrepreneurship, innovation, economic growth, productivity of resource use. They also contribute to less rent-seeking and influence-peddling. In fact, considerable empirical research within, and across countries, supports the proposed claim of an association between the quality of institutions and economic performance (Bowen & De Clerq, 2008) (Sobel, 2008) (Bluhm, de Crombrugghe, & Szirmai, 2013) (Hall & Sobel, 2008). Thus, states with higher-quality government institutions are more likely to fare better in their job-recovery efforts.

Informal institutions have an equally compelling claim on employment success.[1] Rules that govern the ease and interaction of a polities' citizenry in the democratic process, as well as factors influencing quality of life variables also constitute features likely to distinguish regional performance (Brown, Hayes, & Taylor, 2003). Economic behavior is susceptible to the trust-enhancing properties of social networks or the increased appeal of quality of life variables. Quality of life variables - amenities, health, safety considerations as well as social networks and the level and availability of social capital, all considered informal institutions invariably impact employment levels.

Problematically, too many variables can be considered as representing a formal or an informal institution, and thereby a concern for empirical model specification. This ex-ante difficulty in selecting the right set of regressors results in vexing model uncertainty. Sources of model uncertainty arise when the research is (a) uncertain about the structure of the model; (b) uncertain about the estimates of the model parameters, even if the structure of the model is known; and, (c) unexplained random variation in observed variables even when we know the structure of the model and the values of the parameters (Chatfield, 1995). Moreover, selecting the appropriate predictive variable set is derivative to the difficulties surrounding how theoretical concepts are to be measured in the first place. In addition, and by definition, a cross-section examination of U.S. states' performance is necessarily limited to fifty data points, and more likely, to forty-eight data points when examining contiguous states. The resulting small-n, large-p problem follows from this hard constraint necessarily curtailing the degrees-of-freedom available to a researcher.

There is an increased understanding of the regional influence of agglomeration and dispersion forces on economic performance (Moretti, 2012) (Faggian, Olfert, & Partridge, 2012). As a result, it is necessary to examine whether observed values of realized employment outcomes for particular states are independent from observed values in neighboring states. In fact, recognizing this spatial dependence has enhanced analytical insights drawn from empirical studies of inter-state economic performance. Bologna, for instance, finds evidence linking the rate of entrepreneurship and institutional quality (Bologna, 2014).[2] Stansel et al., and Bologna, et al., report a positive correlation between US metropolitan area-level income and institutional quality (Stansel, Torra, & McMahon, 2016) (Bologna, Lacombe, & Young, 2016); Sobel and Hall find positive links between institutional quality and entrepreneurship (Hall & Sobel, 2008). Cole finds a relationship

between entrepreneurship and unemployment for the mid-Atlantic region of the United States (Cole, 2017).

Looking at the relationship between institutions and post-recession employment performance accounting for the issues raised above promises to distinguish the results obtained here. In this paper, these gaps in the literature are examined simultaneously. The outcome is an explanation for the observed disparity in post-recovery employment performance based on the most important elements of informal institutions in addition to the more conventional political, economic ones; that is to say, formal institutions. And because employment performance is unevenly distributed across space the outcome incorporates regional interactions.

The tool for this spatial model selection problem is Bayesian model averaging. Bayesian model averaging is popular across a wide range of disciplines as a variable-reduction method used to pierce the model uncertainty problem in empirical work arising from too many potential regressors (Steel, 2017) (Hoeting, Madigan, Raftery, & Volinsky, 1999).

The main contributions of this paper are the following: (i) by recognizing the problem of model uncertainty it extends the understanding of the relevant factors explaining variation in post-recession employment performance; (ii) it recognizes the possible spatial dependence in performance outcomes; and, (iii) it provides insight into states' resiliency in recovering from the effects of a recession.

The remainder of this paper proceeds as follows. The methodology and previous research delineating this work is presented in Section 2. The empirical methodology utilized, the variables and data used in the model and a discussion over their applicability and relevance is in Section 3. Results and their interpretation follows in Section 4. Section 5 acknowledges limitations of the study and contains concluding thoughts.

AN OVERVIEW OF THE LITERATURE

There exist several lines of well-established, distinct, albeit inter-related commentary linking institutions and economic performance – especially economic growth. Although our focus in not on growth per se, sound employment performance typically accompanies economic growth. Thus, the literature on growth and employment, the literature on economic performance, the literature on the relevance of institutions on economic growth provide grounding for this study.

The incentives and constraints set by culture, religion and social norms understood to be informal institutions inevitably impact economic activity, economic organizations in directions that contribute to output growth (North 1990, 2005) (Baumol, 2002). Social capital, "those features of social organizations, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions" retains a place of pride in the literature on informal institutions (Putnam et al. 1993). Social capital is considered a beneficial attribute, one that enhances economic performance. First, trust among actors reduces information and transaction costs (Fukuyama 1995). Second, trust and involvement in the social community enable the achievement of collective action through cooperation, solidarity and public-spiritedness (Putnam et al. 1993). Third, the social infrastructure and network relations associated with formation and nurture of high levels of social capital make it easier to mobilize local resources. This is particularly true for knowledge that circulates more easily when actors are embedded in flexible social networks.

But social capital-cum-social networks, are not unequivocally positive or procompetitive. Social networks may equally easily hinder economic growth by enabling anticompetitive practices and facilitating the pursuit of rent-seeking activities. Groups such as lobbies, interest groups, professional associations *inter alia*, necessarily constitute networks. But they constitute a net cost to society preferring to fight over the distribution of existing output rather than commit resources to the production of new wealth. (Knack and Keefer 1997; Coates and Heckman 2003; Yamamura 2011). Similarly, the close links and attachments characterizing professional and social networks can facilitate cartel enforcement and persistence (Rodriguez & Menon, 2010)

A clear understanding of the forces underscoring employment agglomeration invites speculation as to level of spatial dependence in employment performance levels across states. Allowing for the possibility of these employment spillovers is important and interesting for at least two reasons. First, uncontrolled-for spatial dependence can result in inconsistent or otherwise biased estimates of the relationship between employment performance and institutional quality (Corrado & Fingleton, 2012). Second, there are compelling reasons to believe that changes in a state's formal and informal institutions can affect employment levels in neighboring states. For example, a reduction in a state's commercial effective tax rates may increase commercial activity in at least two ways. It may draw customers away from neighboring states. The resulting growth may increase employment; and it may invite startup activity seeking to capitalize in a more attractive business environment – again, resulting in enhance employment growth. A similar narrative can be associated with lower income tax rates. A reduction in income taxes by one state can lead to increases in disposable income that are partially spent at businesses in neighboring states, where employment growth is likely to follow the increased business activity. Obviously, unfavorable spillovers also have employment consequences. Business unfriendly developments or fiscal mismanagement by a state government may push businesses to relocate – reducing employment.

S uccinctly, the presence of spatial dependence whereby proximate observations may in part be used to predict each other tends to reduce the amount of information contained in the data if the empirical modeling approach fails to account for inter-state spillovers. The spatial dependence allowed for is in geographic space. A geographic definition of a state's "neighbors" also ensures that the weight matrix employed in our estimations is exogenous. Put differently it is independent of the variation in the proposed explanatory variable: employment performance.

EMPIRICAL METHODOLOGY

How exactly are formal and informal institutions gauged? The distance from concept to metric imposes considerable difficulties. Theoretical prescriptions are necessarily broad and more often than not incapable of proffering the guidance required for empirical work. Left unrestricted, the prospective lists of relevant metrics increases quite rapidly. The resulting "laundry list" of control variables forms a formidable technical obstacle: the sample size is substantially smaller than the number of covariates. This is known in the literature as the small-n, large-p problem reflecting the high dimension low sample size problem. For the most part, the problem is addressed via methods that reduce the number of proposed covariates via variable selection algorithms or by projecting onto a lower dimension. Examples of the latter are regression step-wise methods whereas principal component is an example of the former.

Bayesian model averaging replaces the reliance on seemingly ad-hoc empirical model variable selection methods and overcomes the limitations of conventional variable reduction methods – especially when confronting problems of a small-n, large-p nature. More specifically, Bayesian Model Averaging provides a coherent mechanism to identify the final specification of the model in the presence of model uncertainty. For a set of reasonable models (M_1, M_2,... M_k) for estimating parameter estimates θ from a given data set y, Bayesian model averaging constructs the posterior density of θ, given the data. In this sense, the resulting parameter estimates are not conditional on any specific model (M_i). More formally, at the outset prior probabilities $P(M_i)$ are specified for all models under consideration and prior densities are specified for all parameters under consideration. The resulting posterior density for each parameter of interest is a weighted average of the conditional posterior densities where the weights are the posterior probabilities of each model. The model ultimately selected is the single model with the highest posterior probability. The identified model is subsequently examined for spatial dependence.

Neglecting the possibility of spatial auto-correlation and spatial heterogeneity can cause biased interpretations of the associations between predictor and dependent variables (Arbia, 2014; Le Gallo, 2014). The most frequently cited forms of spatial dependency are spatial lag and spatial error (Anselin et al.1996; Chi 2010). Spatial lag refers to situations where the employment performance of a particular state might be affected by its neighboring-state employment performance or by neighboring-state realizations of the examined predictor variables. Spatial error refers to spatially correlated model residuals attributed often to spatial heterogeneity plausibly attributable to explanatory or unexplained variable spillovers across regions (Anselin et al. 1996; Chi 2010, Wu and Gopinath 2008; Sobel and King 2008; Ferguson et al. 2007).

Building on the model-selection process described above, a series of preliminary tests for heterogeneity and normality suggest that spatial error correlation is unlikely; thus, the focus remains primarily on spatial lag models. Specifically, past the initial ordinary least squares (OLS), the focus turns towards a Generalized Spatial Two-Stage Least Squares model (GS2SLS). The GS2SLS accounts for both the problem of endogeneity of Wy and the problem of spatial correlation among the stochastic disturbances. It is a combination of 2SLS (Two-Stage Least-Squares) methodology with a GMM estimator to estimate the Spatial AutoRegressive with additional AutoRegressive error structure (SARAR) model. This general SARAR model nests within several special spatial structures.

The spatial models were run using a first-order queen contiguity spatial weights matrix to define the neighborhood structure. Queen contiguity considers neighbors of a particular state or polygon to be any other state that shares a common boundary or single point of contact in any direction (Anselin et al. 1996; Voss et al. 2006). For this reason, only the 48 contiguous states within the continental USA were utilized.

More formally, the general spatial model is as follows:

$$y_i = + \lambda Wy + X_i\beta + u \qquad (1)$$

$$u = \rho Wu + \varepsilon_i \qquad (2)$$

Where y_i is the ratio of state i's employment performance in 2014 relative to its employment performance in 2008; X_i is a vector of independent and control variables

identified via Bayesian Model Averaging; β is a vector of coefficients for X_i; λ and ρ are spatial error parameters; W is a spatial weight matrix for the error term; and ε_i is an error term that is independent and identically distributed.

The parameter estimate, λ, is the coefficient on the spatially lagged dependent variable. This variable measures the extent to which institutional quality in neighboring states influences employment performance in a particular state. The parameter, ρ, is the coefficient on the spatially lagged error term.

Variables, Data Treatment and Data Sources

The dependent variable gauging recovery performance is the ratio of realized employment level in 2014 relative to employment levels in 2008. A total of 25 control variables are specified at the outset. Although their interrelatedness limits coherent classification these variables can be conceptually considered either as formal and informal institutions with priors as to their impact on employment performance. Table 5 provides summary statistics of the control variables. Anticipating the territorial contiguity conditions required for the spatial analysis below, data for Hawaii and Alaska are removed from the 50 state data set.

The EFNA Index, published in the Fraser Institute's Economic Freedom of North America (EFNA) is composed of three different categories: (1) the size of government; (2) takings and discriminatory taxation; and (3) labor market freedom and it is intended to provide relative comparisons among the U.S. states. This index has been frequently used as a proxy for the quality of a state's government primarily because it combines numerous economic variables over which a state government has discretionary control (Stansel, Torra, & McMahon, 2016). The EFNA Index has been found to be positively associated with a variety of measures including the per-capita size of the economy, economy-growth as well as various measures of entrepreneurial activity (Stansel, Torra, & McMahon, 2016) (Bologna, 2014) (Bologna, Lacombe, & Young, 2016).

Despite their seeming intuitive simplicity, composite indicators such as the EFNA Index have been criticized for numerous reasons, especially for their construction methodology and their usefulness. Some critics and commentators fault aggregate indicators for selecting constituent variables that serve a predetermined ideological or political outcome. Critics raise technical objections: specifically they advance the argument that some predictor variables chosen are in reality "outcome" variables thus rendering any seeming information conveyed by the index entirely spurious. Critics also claim that the Indexes poorly track their intended or proffered outcome (Artz, Duncan, Hall, & Orazem, 2016; Kolko, Neumark, & Cuellar-Mejia, 2013; Paruolo, Saisana, & Saltelli, 2012; Gladwell, 2011; Motoyama & Hui, 2013; Fisher, 2013). Accordingly, rather than using the index itself, the constituent variables in the 2014 EFNA index as used as independent predictors of employment performance. This unbundling dispels concerns over the ex-ante and self-serving selection of explanatory variables and relinquishes the selection task to a Bayesian Model Averaging process.

Informal institutions structure the scope of interactions among a state's citizens. They are the practices, mores and customs that characterize a human workforce. Informal institutions and quality of life variables condition employment decision. Several variables reflect the consideration we give to the amenities and quality of life variables that surround us: Life Expectancy, Mortality Rates, Air Pollution, Life Expectancy, Life Satisfaction, Broadband Access, Homicide Rates, Rooms per Person, and Traffic Congestion. For

example, Traffic Congestion measured as the "annual delay per auto commuter" (in hours) is the extra time vehicles spend traveling at congested speeds rather than free-flow speeds. This delay typically occurs during peak periods and is measured for private vehicles. This metric provides a sense of the effects of congestion, capturing aspects of the intensity, the duration and the extent of the congestion problem and its impact on our quality of life.

In addition to quality of life variables and amenities, individuals today are not only eager to develop their natural potential as human beings but recognize that their flourishing requires interaction with the other members of the community (Granovetter, 1985). Most people join a community, follow its rules, and benefit from its ability to reputational controls and enhance trust. These civic institutions are captured in three variables: start-up density, voter-turnout, and social-network support. Human capital is an important determinant of employment success. A trained workforce is likely to enhance employment. Thus, the proportion of the citizenry that boast advanced education is included to account for human capital. Last, disposable personal income per capita is included to control for a workforce's productivity. The definitions and sources of all variables can be found in Tables 1-4 in the Appendix.

RESULTS

The first reported results are those derived from the Bayesian model-averaging intended to address concerns over model uncertainty. Results are displayed in Appendix Table 6. The BMA procedure sifts through all the possible models to choose a single best subset of predictors. This result provides likelihoods as to the most parsimonious subset of variables and the most informative using BIC for predictive performance (Hoeting, Madigan, Raftery, & Volinsky, 1999).

The model selection process distinguishes a subset of 5 predictor variables: a states' mortality rate, its life expectancy, its entrepreneurial startup density, property tax rates and the minimum wage. These variables are distinguished by bold font, in the table above. This reduced set of variables is examined for evidence of spatial interaction.

At the outset, despite the optimized subset the prospects of endogeneity, lurking variables, omitted variables, and especially spatial dependence may impair the required independence between explanatory variables and the error term. Breusch-Pagan and Jarque-Bera test results are provided below. Breusch-Pagan tests whether the variance of the errors from a regression is dependent on the value of the independent variable. Jarque-Bera in turn, tests for non-normality of the residuals.

Studentized Breusch-Pagan test:
BP = 20, df = 5, p-value = 0.0006
Jarque Bera Test:
X-squared = 30, df = 2, p-value = 0.000004

There is evidence of both heteroskedasticity and non-normality of the residuals. This test result raises concerns over the structure of residuals. Indeed, spatial dependence exists when there are unobservable geographic correlations within either the dependent variable, the independent variables, or the regression error term, and this can render OLS to be either biased and inconsistent or inefficient.

Moran I test statistic for the hypothesis of spatial correlation of the residuals of an ordinary least squares regression of the reduced model are shown below. Rejection of the

null in the Moran test, indicates the presence of employment agglomerations that traverse state boundaries. In fact, due to both inter-state competition for jobs and the recent new economy tendencies of regional agglomerations it is certainly reasonable to speculate that employment performance will change throughout space. The zero-sum nature of inter-state competition suggests that the observed spatial correlation should be positive.

Moran I statistic standard deviate = 0.4, p-value = 0.4
alternative hypothesis: greater
sample estimates:

Observed Moran I	Expectation	Variance
-0.0212	-0.0556	0.0082

It is not positive: the Moran test shows that there is evidence of negative but not statistically significant spatial correlation in the regression residuals. However, not rejecting (or even rejecting) Moran's statistic provides no guidance as to the specification of an alternative. The Lagrange Multiplier test statistics provide no evidence in favor of the more likely alternative: a spatial lag model.

Lagrange multiplier diagnostics for spatial dependence

LMerr = 0.04, df = 1, p-value = 0.8
LMlag = 0.1, df = 1, p-value = 0.7
RLMerr = 0.03, df = 1, p-value = 0.9
RLMlag = 0.1, df = 1, p-value = 0.7
SARMA = 0.2, df = 2, p-value = 0.9

In sum, there is no evidence of spatial externalities. Results suggest no neighborhood spillovers in employment performance. In other words, whereas changes in some variables classified as formal and formal institutions do have an impact on a state's employment performance, there is no statistical evidence of one state cumulatively affecting any other region, and no corresponding feedback effects.

CONCLUSION AND IMPLICATIONS

In this paper, several variables representing formal or informal institutions and quality-of-life variables are examined as possible predictors of post-recession employment recovery. This inquiry reflects the understanding that in addition to the quality of a state's governing apparatus, a state's informal institutions and its quality of life considerations equally influence economic decision-making, including employment.

And so did the quality of state formal and informal institutions contribute to employment performance following the great recession? The answer is a cautious yes. Three of the five variables are economic variables (entrepreneurial startup density, property tax rates and the minimum wage) over which the state's and local legislatures have discretion, the other two are quality-of-life (mortality rate, life expectancy) indicators.

Importantly, because of the increased prevalence of regional agglomeration tendencies and employment clusters that often straddle two or more states, the analysis sought to incorporate the possible spillover effects that employment performance might have into the estimation of the marginal coefficients of the explanatory variables. However,

there is no empirical evidence of spatial spillover in the employment performance variable, indicating no discernible impact from neighborhood states.

The results obtained via Bayesian Model Averaging seemingly offer some support for the claim that the quality of state government matters. A states' ability to marshal its entrepreneurial talent, in combination with its level of property taxes and its minimum wage levels are vital influences of the states' employment performance. The detrimental effect of taxes is consistent with prior studies despite some findings that the relationship between state tax environment and a state's total employment is a weak one (Fatehin, 2017).

It is a somewhat more tasking to explain the influence on employment performance of the two quality-of-life indicators: the mortality rate and life expectancy. It is possible that their presence is a reflection of the dynamics of baby-boomer decision-making. Impaired retirement portfolios, depressed housing prices, and needed benefits may have encouraged many retired boomers to remain or rejoin the workforce, or extend their retirement horizon (Gustman, Steinmeier, & Tabatabai, 2010). This conjecture may be worthy of examination.

The findings here have consequences for the current trend among policymakers to cultivate specific industrial entities, regional clusters and disburse financial and fiscal incentives all in the name of increasing employment. Rather, it appears that the capacity of each state to foster employment appears to turn on its management of its citizen's tax burden, the minimum wage it sets and on its ability to ascribe resources to forging and supporting entrepreneurship.

ENDNOTES

1. The literature discusses "soft" institutions: ideas, social and cultural norms, rules and routine practices; and it discusses informal institutions: socially shared rules, usually unwritten, that are created, communicated and enforced outside of official channels. These terms are used synonymously here. Within this taxonomy are included the rules that govern social networks and the civic norms that influence voter turnout.
2. Hall, et al. find no evidence of spatial dependence in entrepreneurial activity (Hall, Lacombe, & Pokharel, 2016).

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APPENDIX

Figure1

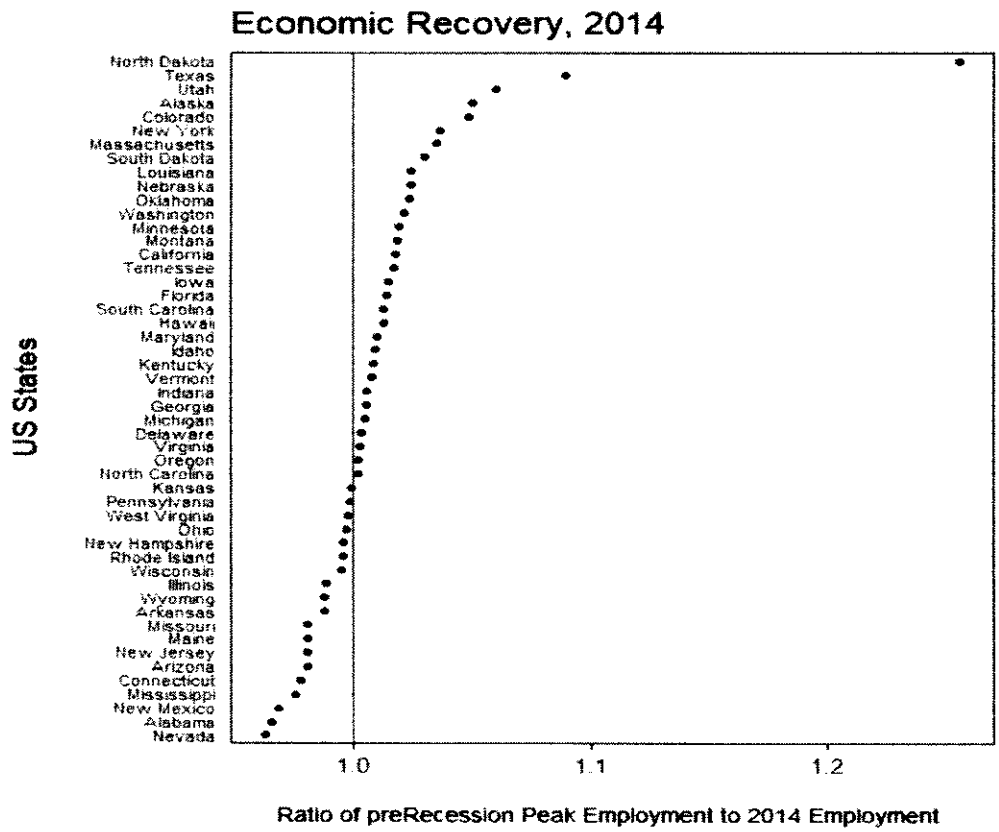

Figure 1 depicts the realized differences in employment performance by state as of 2014. The performance measure is the ratio of employment in 2014 to employment levels in 2008. The vertical red line – identifying the proportion of 2014 employment equal to pre-recession employment distinguishes the states that have recovered, from the laggards. Those to the left of the red line continue to struggle to catch-up.

Table 1 Variable Definitions

Variable	Definition
Air Pollution	Average level of PM2.5 in the region experienced by the population
Annual Commuter Delay (hrs)	Mean Annual Commuter Delay in hours
Broadband Access	Share of households with Broadband Access
Disposable Personal Inc per Cap	Household disposable income per capita
Employment Performance	Employment percentage of working age population (2008/2014)
FRASE Index	The federal regulation and state enterprise index
Government Employees (% of Total Employment)	General Consumption Expenditures by Government as a % of Income
Government Spending (% of Income)	General Consumption Expenditures by Government as a % of Income
Homicide Rate (%)	Number of homicides per 100 000 people
Income, Payroll Tax Revenue (% of Income)	Income & Payroll Tax Revenue as a % of Income
Insurance & Retirement (% of Income)	Insurance and Retirement Payments as a % of Income
Life Expectancy	Life expectancy at birth
Life Satisfaction	Self-assessment of life satisfaction. Scale from 0 to 10
Minimum Wage Legislation	(Minimum-wage X 2080/per-capita income)
Mortality Rate (%)	Rates per 100,000 population; based on postcensal populations as of July 1, 2011

Table 2
Variable Definitions, cont.

Variable	Definition
Property Tax Rev (% of Income)	Property Tax and Other Taxes as a % of Income
Rooms per Person	Rooms per person (Ratio)
Sales Tax Rev (% of Income)	Sales Tax Revenue as a % of Income
Secondary Education (%)	Labor force with at least secondary education as % total labor force
Social Network Support	Percentage of people who have friends or relative to rely on in case of need
Startup Density	The number of new employer businesses normalized by total business population
Top Marginal Income Tax Rate	Top Marginal Income Tax Rate and the Income Threshold at Which it Applies
Transfers & Subsidies (% of Income)	Transfers & Subsidies as a % of Income
Union Density	Union Density
Voter Turnout (%)	Voter turnout (percentage of voters)