Economic Resilience and Vulnerability in the Rural West

Chia-Yun Tsai
Former Graduate Research Assistant

Paul N. Wilson*
Professor

and

Tauhidur Rahman
Associate Professor

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Department of Agricultural and Resource Economics
University of Arizona
Tucson, Arizona, U.S.A.

*Corresponding author: pwilson@email.arizona.edu

Introduction

Given the environmental turbulence of the last fifteen years, policy makers, managers, and scholars have turned their attention towards understanding, promoting and insuring the economic resilience of nations, regions, communities, and organizations. "Environmental" in this context implies the complex system of natural, social, political, and economic forces in the world that impact human livelihoods. "Resilience" is the ability of these agents to recover from or adjust to shocks and/or significant change in their operating environments.[1] "Vulnerability" refers to permanent or semi-permanent characteristics of the unit of analysis that render it more prone to exogenous shocks. Natural disasters, terrorist attacks, economic recession, pandemic disease, civil wars, human error, climate change, and new public policies are a small sample of potential sources of environmental turbulence.[2]

Analyses of the resilience and vulnerability components of environmental turbulence have utilized bio-systems (Brown and Lall 2006; Gallopín 2006), countries (Briguglio et al. 2006), regions (Fieldsend 2013; Pendall, Foster and Cowell 2010), communities (Besser, Recker and Aguitsch 2008; Cutter et al. 2008), cities (Glaeser, Scheinkman and Shleifer 1995; Val and Campanella 2005) and business organizations (Herbane 2010; Worthington, Collins and Hitt 2009) as their unit of analysis. These scholars have explored the relatively permanent factors like location, geography, and history that cannot be easily changed (i.e. vulnerability) with those more flexible variables such as public policies, investments, and community or individual choices that can be changed (i.e. resilience). To date, rural America has not received the analytical attention given to these other units of analysis.

The Great Recession of 2007-2008 provides a natural experiment in exploring the economic resilience of rural counties in the Western United States. With the bursting of the housing bubble and the ensuing chaos in the financial markets, businesses laid off workers, reduced investment, and in some

[1] Bahamra, Dani and Burnard (2011) define resilience as the capability and ability of an element to return to a pre-disturbance state after a disruption.
[2] The concept of resilience first emerges from ecology. Berkes and Folke (1998) and Folke (2006) provide a useful overview of how various disciplines (e.g. engineering, disaster studies, economics) have discovered this issue as worthy of analysis.

cases, these businesses failed. The U.S. labor market lost 8.4 million jobs (Bureau of Labor Statistics 2012). Fiscal and monetary stimuli supported a return to economic, albeit slow, growth in 2010.

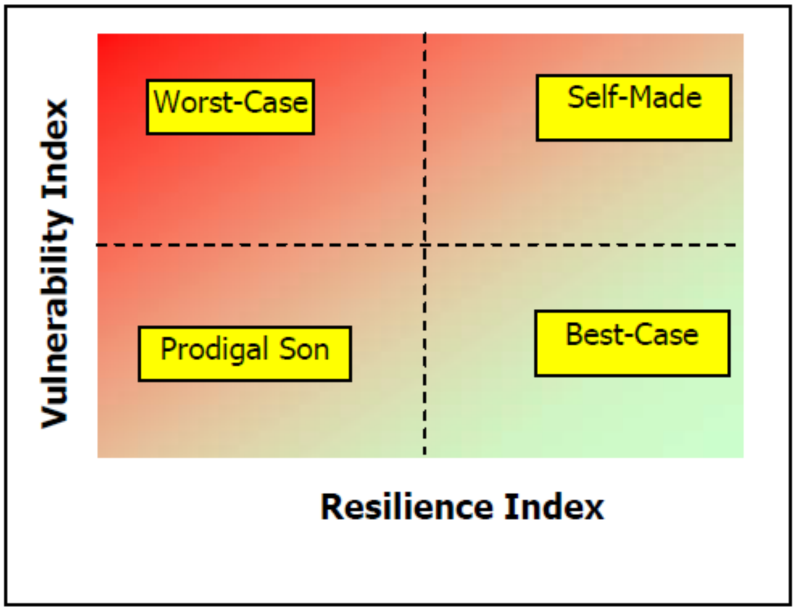
This paper utilizes several analytical frameworks to explore the resilience and vulnerability status of 224 rural counties in eleven Western states during this turbulent period. The next section reviews the conceptual framework and development principles used in the analysis. The data sources and empirical models are specified in the following section. Our results classify the counties in Briguglio's (2004) four-quadrant framework and explore statistical relationships in index and multivariate econometric models, with the intention of understanding the key county-level characteristics that contribute to resilience and vulnerability. We conclude the paper with economic development observations gleaned from this research.

A Conceptual Framework

The Singapore Paradox seeks to explain how a country, vulnerably exposed to external economic shocks, can sustain a high economic growth rate and standard of living. Briguglio (2004), tackles the paradox, by developing a unique classification model built on indices of vulnerability and resilience to explain how countries cope with risk. In this framework, vulnerability is exposure to external shocks from intrinsic features of the economy that are inherent and permanent and not subject to policy or governance. Economic openness, export concentration, and dependence on strategic imports determine economic vulnerability. Economic resilience is the ability to recover from ("shock-absorption") or adjust to ("shock-counteraction") the negative impacts of external shocks. Good governance, sound macroeconomic management, market efficiency, social cohesion, and beneficial environmental management nurture this coping ability.

Utilizing proxies for these determinants of the risk position of a country, Briguglio constructs a resilience index and a vulnerability index to classify countries and to explain the statistical relationship between resilience and vulnerable and economic development. The classification scheme is illustrated in Figure 1. Worst-case countries are inherently vulnerability and adopt policies that exacerbate their vulnerability. Self-made countries adopt policies that enable them to cope with high levels of vulnerability. Prodigal Sons enjoy low levels of vulnerability but adopt poor policies so they struggle to deal with the negative effects of external shocks. Best-case nations experience low inherent vulnerability and have a policy structure that creates a high level of economic resilience.

Figure 1: Briguglio's Four-Panel Model



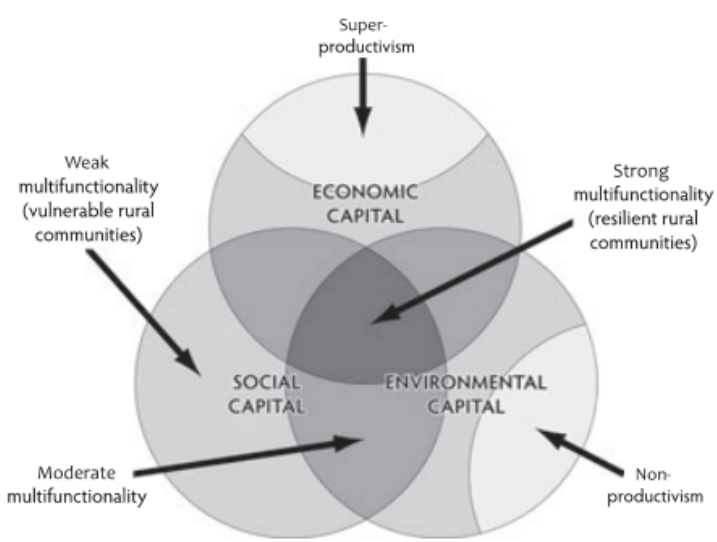
Hill, et al. (2010) partially extend Briguglio's framework in their multivariate analysis by focusing on regional economic resilience and building a resilience index for metropolitan areas.[3] Resilience in this framework is the ability of a metropolitan area to return to the pre-shock employment rate within four years or less. Utilizing a panel data set of 361 metropolitan areas from 1997 to 2007, the authors hypothesize that economic resilience is a function of the composition of the region's economy (e.g. measure of industrial diversification), levels of human capital (e.g. educational attainment), the labor market (e.g. "right-to-work" state), and characteristics of the metropolitan area (e.g. size, age, income equality). Their empirical results show that durable manufacturing, export-based sectors, industry

[3] Augustine et al. (2013) follow a similar methodology, producing similar results, in the their multivariate analysis but expand on their definition of the economic capacity by creating a regional economic capacity index with five components: income equality, economic diversification, business environment, specific export industries, and other factors such as wages per employee and percentage of the metro population living in the central city.

diversity, and "right-to-work" laws increase resilience while relatively low education levels and higher income inequality reduce the ability of metropolitan area to recover from shocks.

Finally, Wilson (2010) develops a conceptual, multifunctionality model of rural community resilience utilizing the concepts of economic, social and environmental capital (Figure 2). Strong multifunctionality implies that all three capitals are equally well developed while moderate and weak multifunctionality recognize only two or one well-developed capital. In Wilson's model economic well being, diversified income streams, and low dependency on external funds are economic capital variables. Some communities are classified as experiencing super-productivism at the expense of other forms of capital. Social capital involves skills training and education, good health and sanitation, an open-minded community, and access to services such as health, education and research industries. Environmental capital includes high levels of biodiversity, good water quality and availability, good soil quality, and sustainable management of the environmental resources in the rural community. Again, some communities can be classified as experiencing non-productivism because of their sole reliance on environmental capital. Wilson concludes that rural communities with high multifunctionality are relatively more resilient to environmental shocks, both internal and external.

Figure 2: Wilson's Multifunctional Framework for Rural Communities



Data and Empirical Models

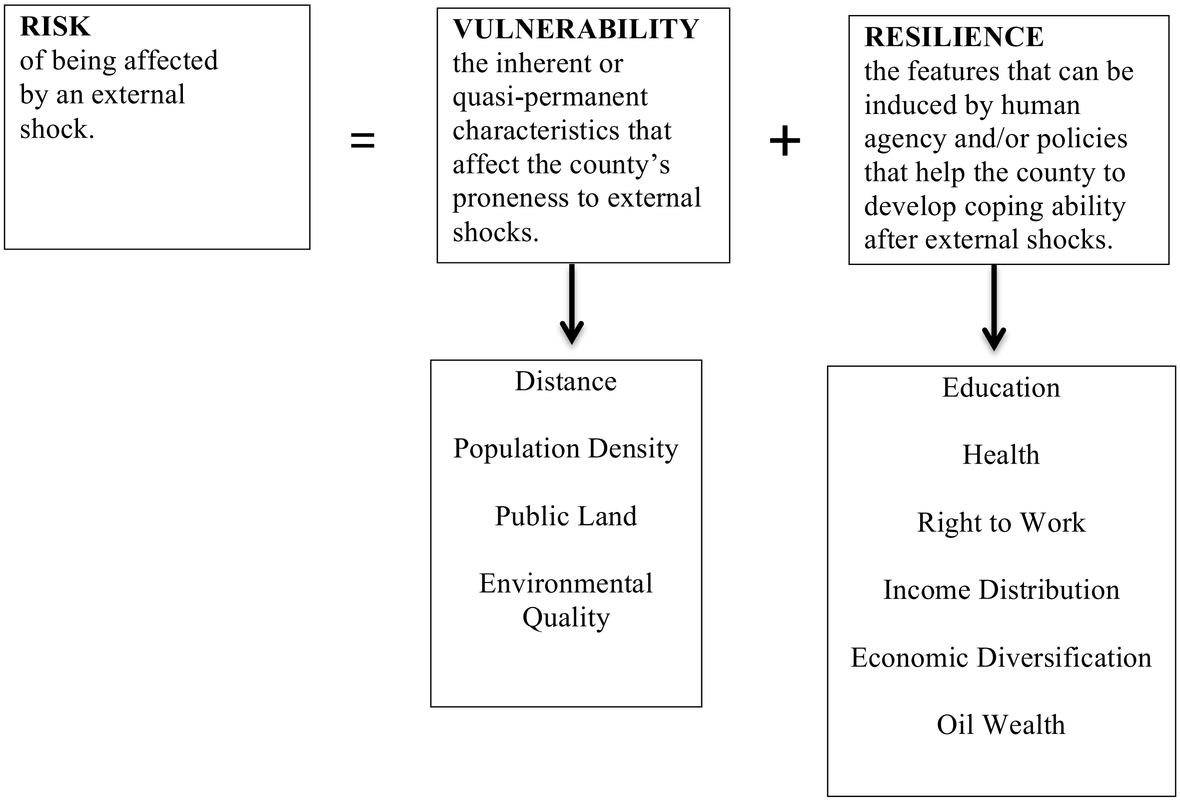
Rural counties in the West are our unit of analysis. Eleven states (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming) with 414 counties were selected following the U.S. Census Bureau's definition of the "West" census region (U.S. Census Bureau 2014). Rural counties (225) were defined as those counties coded a 6-9 in the Rural-Urban Continuum Codes developed by the U.S. Department of Agriculture (USDA 2013). Counties in these code categories have less than 20,000 inhabitants and may or may not be adjacent to a metro area.

The two specifications of the dependent variable are based on the county-level unemployment rate (U.S. Bureau of Labor Statistics Various Years). Since our variable of interest is county-level resilience, the ability to withstand or "bounce back" from the economic shock of the Great Recession, we selected 2007 as our base year and 2010 as the end year for the study. The change in the unemployment rate ($UnEmp_1$, Δ) is calculated as the 2010 unemployment rate minus the 2007 rate. The percentage change in the unemployment rate ($UnEmp_2$, $\%\Delta$) is $UnEmp_1$ divided by the 2007 unemployment rate.

Following Briguglio's analytical framework, vulnerability and resilience indices were constructed for the 225 counties utilizing available secondary data and the experience of the researchers reviewed earlier in this paper. Figure 3 captures the essence of the indexing process. Inherent or permanent characteristics determine the vulnerability index of a county. Hill et al. (2010) argued that the size and population of a region influenced its bounce-back ability after a shock. We selected the population per square mile and hypothesize that the more dense the population the less vulnerable the county (See the specifications, measurements, and sources for all variables in Table 1).[4] Given the relatively high percentage of public lands in Western states, a distinguishing inherent characteristic of the West, we include the percentage of public land in each county as a control variable and hypothesize that the prevalence of public lands will increase vulnerability. As noted earlier, Wilson (2010) emphasized the importance of environmental capital for the ability of rural communities to cope from economic shocks so

[4] The following variables were transformed (1 – measure) to make them compatible with the other variables and with their direction of influence on vulnerability and resilience: Population Density, Environmental Quality, Income Distribution, and Economic Diversification).

Figure 3: Control Variables Within the Index Framework (Adapted from Briguglio, et al. 2006)



we use the USDA's Natural Amenities Scale, an index ranging in values of -2 to 3 that captures the environmental quality of life associated with climate, topography and water (USDA 2012). Finally, as Fieldsend (2013) points out, rural areas are a place of both residence and economic activity. Communities closer to metropolitan areas may become residences for metropolitan workers and reduce the vulnerability of rural counties with fewer employment opportunities. Therefore, we measured the distance between a rural county's county seat to the nearest metropolitan area of over 10,000 people, expecting that the greater distance would increase vulnerability.

Drawing upon the work of Hill et al. (2010) and Augustine et al. (2013) we selected the following variables to measure economic resilience: the percent of the population with at least a high school degree, the percent of the population with health insurance, whether the state is a right-to-work state or not, income inequality (a county-level Gini coefficient), gross crude oil withdrawals, and economic

Table 1: Explanatory Variable Specification

A. Vulnerability

Variable	Unit	Description	Interpretation	Source
Distance	Miles	The distance from the county seat to the nearest metropolitan area. (2014 data)	A longer commuting distance increases economic vulnerability.	U.S. Census Bureau http://www2.census.gov/geo/maps/metroarea/us_wall/Feb2013/cbsa_us_0213_large.gif Google Map https://www.google.com/maps/previw
Population Density	People per square mile	A composite sense of the size and population of each county. (2007 data)	Lower density increases vulnerability.	U.S. Census Bureau http://censtats.census.gov/usa/usa.shtml
Public Land	Percent of all land	Acres of public land in each county divided by total acres in the county. (2007 data)	Greater dependence on public land increases vulnerability	U.S. Department of the Interior http://www.doi.gov/pilt/county-payments.cfm
Environmental Quality	Standarized d scores from -2(worst) to 3(best)	A measure (Natural Amenity Scale) of the physical characteristics of a county that enhance the location as a place to live. (1941-1970 data)	A unattractive/unproductive environment increases vulnerability.	U.S. Department of Agriculture http://www.ers.usda.gov/data-products/natural-amenities-scale.aspx#.U7XQW_ldXD0

B. Resilience

Education	Percentage	Percentage of the population with at least a high school degree. (2006-2010 data)	A more highly educated population increases resilience.	U.S. Census Bureau http://censtats.censu.gov/usa/usa.shtml
Health	Percentage	The number of people enrolled in health insurance divided by county population. (2007 data)	A health “safety net” provides more resilience for the county.	U.S. Census Bureau http://censtats.census.gov/usa/usa.shtml

Table 1 continued

Variable	Unit	Description	Interpretation	Source
Right to Work	1=Not 0=Yes	Dummy variable indicating the state has a right-to-work law or not. (2014 data)	As noted by Hill, et al. and others, right to work flexibility increases resilience.	U.S. Census Bureau http://censtats.census.gov/usa/usa.shtml
Income Distribution	Gini Index ranging from 0 to 1	Indicates the degree of income inequality with a larger Gini value representing higher income inequality. (2008-2012 data)	A more even distribution of income increases county resilience.	U.S. Census Bureau American Community Survey (ACS) http://www.census.gov/acs/www/
Economic Diversification	Herfindahl-Hirschman Index (HHI)	Represents the degree of industrial diversity of four sectors (agriculture, government, manufacturing, and services) (2007 data)	A more diverse economy increases economic resilience.	U.S. Census Bureau http://censtats.census.gov/usa/usa.shtml
Oil Wealth	Barrels	Annual gross withdrawals of crude oil. (2007 data)	Income from natural resource exploitation increases resilience.	U.S. Department of Agriculture http://www.ers.usda.gov/data-products/county-level-oil-and-gas-production-in-the-us.aspx#.U4PT8vldXD0

diversification. For economic diversification we utilized the Herfindahl-Hirschman Index (HHI) to calculate the HHI for the degree of economic concentration in each county. The percentage of people working in agriculture, government, manufacturing, and services provided the data for calculating the HHI. We hypothesized that higher education levels, more people covered by health insurance, a right-to-work state, energy income, an equal distribution of income, and a more diversified economy would improve economic resilience.

Index Model

To create the vulnerability (VI) and resilience (RI) indexes, all variables (except for the natural amenity scale) were standardized by:

$$XS_{ij} = X_{ij}/Max_j$$

where XS_{ij} is the standardized observation i of variable j; X_{ij} is the value of observation i of variable j; and Max_j is the maximum value of variable j. In the case of the environmental capital variable ranging in values from -2 to 3, the standardized values were created by applying the following formula:

$$XS_{ij} = (X_{ij} – Min_j)/(Max_j – Min_j)$$

where Min_j is the minimum value of variable j. All values for each county now take on a range of 0 to 1. The county VI and RI values were computed by taking a simple average of the individual variable values.[5] Utilizing ordinary least squares, we estimate the following equations: $UnEmp_{1\text{ or }2}$ = f(VI, RI).

Multivariate Index Model

Keeping with the objective to construct an index model to explain county-level differences in their ability to respond to economic shocks, a multivariate index model was formulated to utilize the vulnerability and resilience variables as independent variables. These control variables in standardized form are used to estimate the following two equations: $UnEmp_{1\text{ or }2}$ = f(distance, population density, % of public land, environmental quality, level of education, health coverage, distribution of income, right to

[5] See Briguglio (2004, 2006) for the justification of using a simple average. Choosing variable weights stretches our theoretical and empirical knowledge.

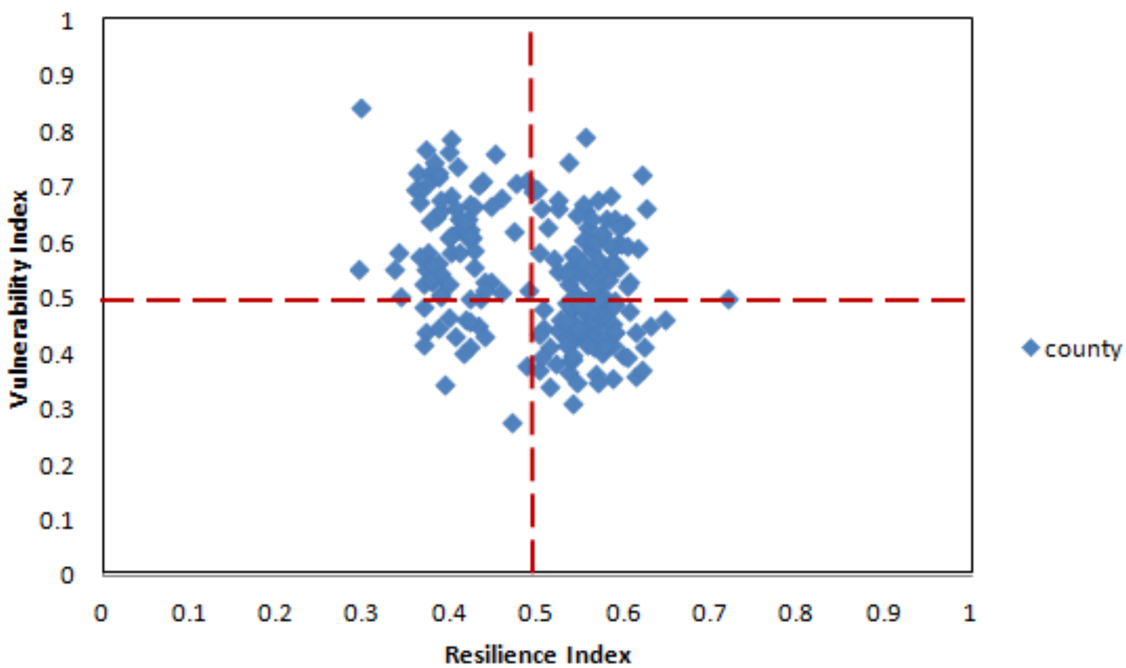
work, oil income, economic diversity). This formulation provides a more in-depth understanding of the specific factors contributing to economic strength and recovery.

Results

Four Quadrant Classifications

We constructed two indexes, RI and VI, for each of the 225 rural counties in the West. Figure 4 illustrates the scatter plot of these counties utilizing Briguglio's four-quadrant model. The county-level measures are largely grouped around the midpoint value of 0.5 for both vulnerability and resilience. There are fewer Prodigal Son counties than counties in the other three classifications, followed in increasing number by Worst Case, Self-Made and Best Case counties. A majority of the counties have pursued resilient strategies under varying levels of vulnerability. High levels of vulnerability, as measured in this paper, do not guarantee a high-risk economic environment for many counties.

Figure 4: Scatter Plot of Rural Western Counties



Tables 2 and 3 present the index scores for a selected group of most/least vulnerable and resilient counties, respectively. The counties with the highest vulnerability have county seats that are a greater distance to a metropolitan area, a larger percentage of public land, and a natural environment less suitable for people. Interestingly, the 2007 unemployment rate (average) for the five most- and five least-vulnerable counties is the same. The least vulnerable counties were able, on a relative basis, to weather the shock or bounce back by 2010. The highest resilience counties have more people with at least a high school education, more citizens with health insurance, more oil wealth, and no right-to-work law. This last tentative result does not support Hill et al.'s findings that metropolitan regions in right-to-work states are more resilient to economic shocks. Again, the average unemployment rate in both the least and most resilient counties is nearly equal but as expected, the 2010 unemployment rate varies greatly.

Table 2: Select Data for Most and Least Vulnerable Counties

County	VI	Distance (Miles)	% Public Land	Environmental Quality Score	Unemployment Rate (2007) %	Unemployment Rate (2010) %
A. Most Vulnerable						
Teton, WY	0.84	278	99	0.63	2.2	8.3
Hinsdale, CO	0.79	174	95	0.74	2.9	4.5
Mineral, NV	0.79	250	81	0.65	6.5	14
Lander, NV	0.77	218	95	0.51	3.4	7.1
White Pine, NV	0.77	241	92	0.47	3.8	8.9
B. Least Vulnerable						
Los Alamos, NM	.28	41	52	0.47	2	3.3
San Juan, WA	.31	75	2	0.56	3.4	7.2
Adams, WA	.34	87	2	0.17	5.9	9.9
Payette, ID	.35	35	25	0.38	4.1	9.1
Morgan, CO	.35	59	≈0	0.36	3.4	6.9

Table 3: Select Data for Least and Most Resilient Counties

County	RI	Health Coverage %	Education Beyond High School %	Right-to Work State	Unemployment Rate (2007) %	Unemployment Rate (2010) %
A. Least Resilient						
Apache, AZ	0.30	12	72	Yes	8.5	17
Teton, WY	0.30	9	95	Yes	2.2	8.3
Wasatch, UT	0.33	9	91	Yes	2.6	9.9
Blaine, ID	0.34	10	91	Yes	2.3	8.8
Clark, ID	0.34	11	69	Yes	2.2	8.4
B. Most Resilient						
Richland, MT	.72	18	85	No	2.3	3.4
Fallon, MT	.65	20	88	No	1.9	2.7
Sherman, OR	.63	26	90	No	4.9	9.9
Curry, OR	.62	31	92	No	6.6	12.8
Harding, NM	.62	28	90	No	2.6	4.7

Index Model

Briguglio and others utilized the index model to analyze the role of resilience and vulnerability on the economic performance of small nation states. Our analysis takes a similar model to explore the role of resilience and vulnerability on rural Western counties' ability to withstand or recover from an economic shock. We hypothesized that variables contributing to the resilience of a local economy, when indexed, would have a statistically significant impact on stabilizing economic wellbeing. Likewise, the variables creating vulnerability in the county would work detrimentally to the ability of the county to bounce back from an economic shock.

Table 4 presents the OLS results of the Briguglio-like model. For both specifications of the dependent variable, change in unemployment ($UnEmp_1$) and the percent change in unemployment ($UnEmp_2$), the index variables for resilience (RI) and vulnerability (VI) are statistically significant at the 1% level and have the hypothesized signs. County-level vulnerability increases the change in unemployment while county resilience decreases the change in unemployment. For the $UnEmp_1$, VI and RI capture 18% of the variability while for $UnEmp_2$ the indices explain 33% of the variability in this cross-sectional data set. Two robustness tests (not reported here) were run on this model. One test only used VI as an independent variable while the second added state controls (10 state dummies). In both cases, the results of the index model are supported.

Table 4: Index Model Regression Results

Variable	**$UnEmp_1$ (Δ)**		**$UnEmp_2$ (Percent Δ)**	
	Estimator	**Pr > |t|**	**Estimator**	**Pr > |t|**
Intercept	3.7935***	0.0050	2.2613***	<.0001
VI	6.7352***	<.0001	1.3841***	<.0001
RI	-5.5246***	0.0019	-3.5953***	<.0001
Adjusted R^2	0.1808		0.3344	
N: 225				

*<Note>*** indicate 1% significant ** indicate 5% significant * indicate 10% significant*

Multivariate Model

Finally, this multivariate formulation takes the components of the VI and RI and treats them as independent variables in explaining $UnEmp_1$ and $UnEmp_2$. The values for these variables are their index values, not the original measures. The results (Table 5) provide additional insight into the key factors contributing to our understanding of vulnerability and resilience, and the capacity of a county to respond to an economic shock. In the case of the $UnEmp_1$ specification both the percent of public land and environmental quality contribute positively to vulnerability and to the change in the unemployment rate. County managers in rural counties view the percent of public land in their counties as detrimental to economic development because this land is tied up, generally, in lower income producing activities. In addition, although much of the rural areas in the West are beautiful (e.g. mountains), topography, climate, etc. (environmental quality) may discourage human settlement and contribute to higher vulnerability and greater changes in unemployment due to an economic shock. Significant resilient variables are Education Level (-), right-to-work state (-), and oil wealth (-). Higher education levels, the absence of a right-to-work law, and oil wealth reduce $UnEmp_1$. As noted earlier, the negative sign on right-to-work state implies that those rural counties in states without right-to-work laws are more, not less, capable of withstanding economic shocks.

Table 5: Multivariate Model Regression Results

Variable	$UnEmp_1$ (Δ)		$UnEmp_2$ (Percent Δ)	
	Estimator	**Pr > |t|**	**Estimator**	**Pr > |t|**
Intercept	6.5330	0.0123	0.1781	0.8064
Vulnerability Variables				
Distance	-0.8097	0.2940	0.1939	0.3702
Public Land	1.5792	0.0028	0.1448	0.3248
Environmental Quality	6.6577	<.0001	1.2394	<.0001
Population Density	-0.8253	0.5898	-0.1057	0.8055
Resilience Variables				
Health	0.9164	0.2568	-0.8703	0.0002
Education	-7.1065	0.0014	-0.7242	0.2399
Income Distribution	2.8787	0.1723	1.3534	0.0227
Right-to-work	-1.0006	0.0011	-0.5560	<.0001
Oil Wealth	-2.5266	0.0687	-0.3537	0.3623
Economic Diversification	1.5376	0.3128	0.4279	0.3166
Adjusted R^2	0.4120		0.4563	
N: 225				

The $UnEmp_2$ specification produces similar but slightly different results. Environmental quality assumes the overwhelmingly dominant role among the vulnerability variables, with a poorer quality living environment constraining the bounce back in the unemployment rate. With regard to the resilience variables, greater health care coverage, less unequal distribution of income, and again, not being in a right-to-work state mitigate the negative impact of higher unemployment rates associated with an economic shock. The result for income distribution was not expected. The statistically significant positive sign implies that counties with greater unequal distribution of income are more, not less, capable of absorbing and responding to economic shocks. Both models explain over 40% of the variability in unemployment rate changes.

As in the index model, robustness tests (not reported here) were performed on the multivariate model to confirm the results. One model was estimated with only the vulnerability variables, another with only the resilience variables, a third model without public land, and the fourth model without environmental quality. Models 3 and 4 were estimated to explore the sensitivity of the results given the relatively high correlation (.46) between public land and environmental quality. All these formulations produced results consistent with the multivariate model presented above. The full model has the highest adjusted R^2 of all the models in the robustness check.

A Concluding Synthesis

Briguglio's resilience/vulnerability framework for analyzing the strategic risk position of geopolitical regions (countries, counties, metropolitan areas) proved to be a useful conceptual model for exploring the economic vulnerability of rural Western counties. In our fieldwork conversations with several rural county managers, the vulnerability and resilience components of their day-to-day reality provided a valuable springboard for discussion. We recommend that future research on this topic utilize a mixed method approach where in-depth discussions with county-level leaders leads to more measureable variables for the econometric models. Our budget and time constraints did not allow us to expand either the qualitative or quantitative parts of our analysis. Nevertheless, this novel approach for exploring rural development deserves further attention in the academy.

The index model, as specified in the paper, produced strong, compatible results with development theory. Some counties are more vulnerable to economic shocks than others due to inherent physical characteristics that are not easily changed by human agency or public policy. Likewise, some counties who may or may not be vulnerable make resilience-enhancing decisions that put in place conditions that mitigate economic shocks. The positive sign on the VI and the negative sign on the RI were our hypothesized values based on our created indices.

In the multivariate formulation we were impressed by the relative importance of the physical environment. Environmental quality (Natural Amenity Score) and the presence of public land in the county were important contributors to vulnerability and the mitigation of economic shocks. Although a rural area may be aesthetically beautiful (in the summer), its appropriateness for human habitation may be limited. Naturally endowed rural areas, according to our analysis, can be more vulnerable to economic shocks than other rural regions that do not rely on tourism. Likewise, counties with a high percentage of public land are vulnerable to economic shocks because the area is dependent on lower-value economic activities (e.g. grazing).

Hill et al. (2010) may have found that metropolitan areas in right-to-work states were more resilient to economic shocks but our research does not produce a similar finding for counties in the rural West. Counties in non-right-to-work states are more resilient to economic shocks than their right-to-work rural and urban counterparts. Firm-level flexibility in downsizing and upsizing the employee base does not carry the same level of economic importance in rural areas. This relationship was highly significant in both multivariate models.

Finally, although the health care and education variables proved to be statistically significant in the multivariate formulations, our expectations for distance, population density, income distribution and economic diversification failed to materialize. Generally these variables were statistically insignificant in explaining change in unemployment in the multivariate formulations. But in the case of income distribution in the $UnEmp_2$ formulation, the variable was statistically significant and had the "wrong" sign. These results lead us to conclude that more work needs to be done on identifying (1) the key factors that create vulnerability for rural counties and (2) those important more manageable variables that produce resilience for county residents.

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