AN ECONOMIC EFFICIENCY AND RESILENCY STUDY OF UNITED STATES COUNTIES USING FACTOR ANALYSIS AND DATA ENVELOPMENT ANALYSIS WITHIN A COMMUNITY CAPITALS FRAMEWORK

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Steven A. Turi

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Major Professor: Philip Watson, Ph.D.

Authorization to Submit Thesis

This thesis of Steven A. Turi, submitted for the degree of Master of Science with a Major in Applied Economics and titled "An Economic Efficiency and Resiliency Study of United States Counties Using Factor Analysis and Data Envelopment Analysis within a Community Capitals Framework" has been reviewed in final form. Permission, as indicated by the signatures and dates below, is now granted to submit final copies to the College of Graduate Studies for approval.

Major Professor: ____________________________ Date: _____________________
Philip Watson, Ph.D

Committee Members: ____________________________ Date: _____________________
Christopher McIntosh, Ph.D

____________________________ Date: _____________________
Tamara Laninga, Ph.D

Department Administrator: ____________________________ Date: _____________________
Cathy Roheim, Ph.D

Discipline's College Dean: ____________________________ Date: _____________________
Larry Makus, Ph.D

Final Approval and Acceptance

Dean of the College of Graduate Studies: ____________________________ Date: _____________________
Jie Chen, Ph.D

Abstract

This research focuses on developing a single economic efficiency metric to gage the economic development for United States counties. This is done by creating factor scores of variables commonly associated with economic development in the community capitals framework and using data envelopment analysis to create the previously mentioned metric. Our results indicate that highly urbanized counties and predominately rural counties are often the most efficient at converting community capital resources into economic output, but these counties may be vulnerable to exogenous economic shocks. Interestingly, some high capital resource endowment counties, both rural and urban, may have benefited more by having higher economic inefficiency for resource-to-output conversion and be more resilient to such exogenous shocks.

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Dedication

I would like to thank my parents, Ray and Donna Turi, and my brother, Michael Turi, for their constant love and support throughout my entire education career and life. Thank you.

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Chapter 1 - Introduction

The goal of this research was to develop a metric to gage the economic development and economic efficiency of United States counties[1] within a community capitals framework. This was done by treating a county essentially like a production function. Inputs were community capital latent variables[2] created via factor analysis. Economic output was measured as gross domestic product (GDP) per county. The creation of the efficiency metric was done by conducting data envelopment analysis (DEA) that looked at conversion efficiency capital inputs into economic output.

The community capitals framework examines assets held by a community that aid in its socio-economic development. Communities range in different sizes, anywhere from neighborhoods and towns to counties and states, and hold a variety of resources that make that community attractive for immigration, business establishment, and personal expression via cultural, social, and political means. The main community capitals are:

- Physical Capital
- Natural Capital
- Human Capital
- Political Capital
- Cultural Capital
- Social Capital

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[1] This includes ‘county equivalents’. The State of Alaska does not have counties but does possess ‘boroughs’ and ‘census areas’ that divide the state into sectors for data collection purposes. The State of Louisiana is divided into county-equivalent regions known as ‘parishes’.
[2] A ‘latent variable’ is synonymous to a ‘factor’ and a ‘construct’.

Using these community capitals to analyze regional economic development is called ‘community and economic development’ analysis, or CEDs. CEDs do not necessarily measure wealth of a community just in economic terms. (Hancock 1999). While this analysis looked at GDP as an output, it analyzed many of the community capitals as inputs used to create economic output and what variables are influential within these community capitals.

Factor analysis is the mathematical procedure that is used to analyze patterns of correlation between multiple measured, observable variables in order to infer a relationship to a non-observable factor, or latent variable. This research conducted factor analysis on variables linked to regional economic development to create the six community capitals previously mentioned. These factors help explain why different variables are correlated with one another due to some common element that these variables share (Kline, 1994).

Data envelopment analysis (DEA) is a nonparametric analytical tool that uses multiple inputs and outputs to compute a score for efficiency. These scores are then graphed to compare efficiencies of other decision-making units (DMUs), which can represent anything from producers to firms to, in our case, counties. DEA can help DMUs to convert their resources, however meager, into certain, desirable outputs or minimize the usage of inputs (Raab and Kotamraju, 2006). The factor scores for the six community capitals were used in DEA to determine how efficient each county is relative to all the other counties in the nation.

The use of DEA and factor analysis is not foreign to economic development studies as many other researchers have used this tool for their research. However, we believe our research is unique for the inclusion of the community capitals framework into the DEA and factor analysis. By using all three of these components to conduct economic development analysis, the hope is that US county officials will use these result to better understand what they can do to increase their county’s economic output.

Chapter 2 - Data Envelopment Analysis

The crucial tenet of data envelopment analysis (DEA) is technical efficiency[3]. Technical efficiency is the ability of a decision-making unit (DMU) to obtain maximal output from an allocated set of inputs (Coelli, 1996). The graphed efficiency scores, or points, are used to estimate a 'frontier' where the greatest possible amounts of outputs are generated with the most efficient use of inputs. Points that exist on the frontier itself represent the maximum efficiency of resources; all points that are along the frontier itself are equivalent and are Pareto efficient. Points in the interior of frontier are points that face varying degrees of inefficiencies. These frontiers are deterministic, so "any deviations from the frontier are related to inefficiency" (Esmaeili and Omrani, 2007).

DEA has its beginnings in the work of Farrell (1957) with his measurement of technical efficiency. However, it was Charnes, Cooper, and Rhodes (1978) who developed the first DEA model that focused on measuring efficiency through the use of DMUs for constant returns to scale (CRS). CRS implies that the DMUs are able to linearly scale the inputs and outputs without increasing or decreasing efficiency. This is an important assumption of CRS that may be valid in specific cases and tends to lower efficiency scores. Another approach to DEA was created by Banker, Charnes, and Cooper (1984) focused on variable returns to scale (VRS). VRS accounts for both increasing and decreasing returns to scale with economies of scale in mind and allows for less restrictive conditions in order for DMUs to be considered efficient; in other words, VRS tends to raise efficiency scores.

[3] 'Technical efficiency' and 'efficiency' are used interchangeably in this research.

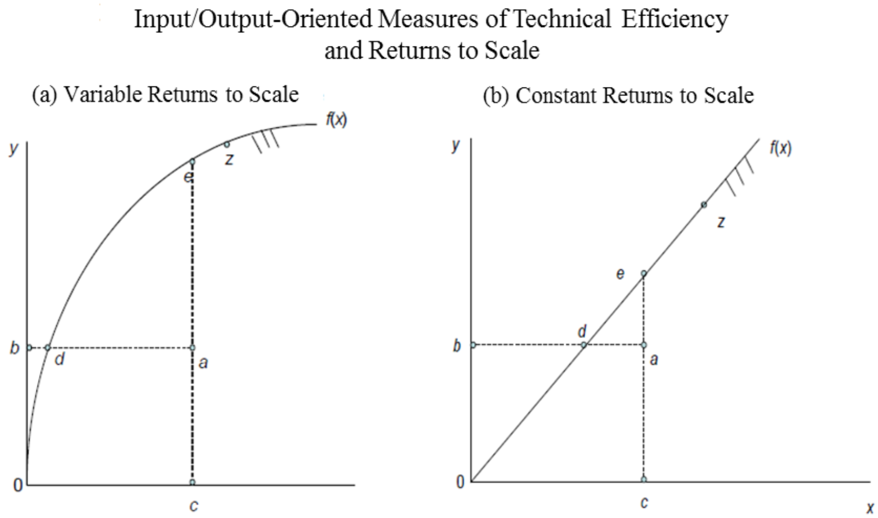

Figure 1 - Input/Output-Oriented Measures of Technical Efficiency and Returns to Scale

Source: Primont and Domazlicky, 2005

Graphically, we represent technical efficiency with a production possibility frontier in this simple one-input, one-output example (Figure 1). We can calculate the amount of technical efficiency for an input-oriented scenario by looking at the ratio of *bd/ba*, otherwise known as the minimum potential input to the actual or observed input. Taking one minus this ratio gives us the proportion *da/ba*, of which the DMU could reduce its inputs and still produce the same output. For output-oriented analysis, technical efficiency is measured as the ratio of actual or observed output to maximum potential output, or *ca/ce*. This ratio minus 1 is the proportion, equivalent to *ea/ce*, which output could be expanded given the set of inputs. It is also important to note that for *only* the constant returns to scale scenario, the measure of technical efficiency in an input-oriented model is equal to the reciprocal of technical efficiency in an output orient model, or *da/ba* = *ea/ce* (Primont and Domazlicky, 2005). Our particular research will be an input-oriented model for expressing economic efficiency amongst US counties given a set of capital resources, or inputs.

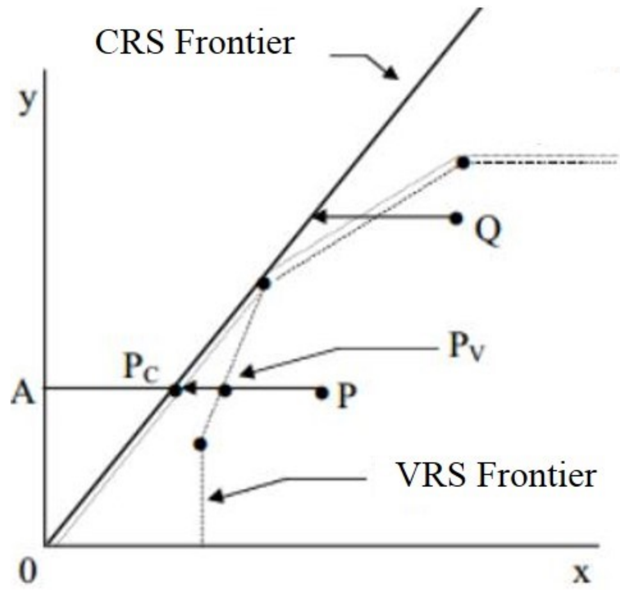

Figure 2 – Constant Returns to Scale Frontiers vs. Variable Returns to Scale Frontiers Source – Coelli, 1996

Similarly, in this figure we see how CRS and VRS are different (Figure 2). Under CRS, points below the CRS frontier would be considered inefficient. Point R would be the only point considered efficient under strict CRS restrictions while points Q and P are considered inefficient. The degree of inefficiency for interior points can be calculated by taking the Euclidean distance between these interior point and the frontier (Yong-bae and Choonjo, 2010). For example, the inefficiency of point P is the distance from point P to point P_c which lies on the CRS frontier. With VRS, we can see more points become efficient as the frontier is redefined to encompass increasing and decreasing returns to scale. Points Q and P are still inefficient, but less so under VRS restrictions. For example, the inefficiency of point P is now the distance from point P to point P_v which lies on the VRS frontier (Coelli, 1996).

DEA has since been used to calculate efficiency in a broad range of fields, however, we will primarily be focusing on literature pertaining to regional planning and development on the state and county level. Raab and Kotamraju (2006) developed a ranking of technological efficiency for all 50 U.S. states using DEA. By looking at four inputs and two outputs commonly associated with the high-tech sector, the researchers used DEA to rank the states in their ability to maximize outputs while minimizing inputs “from the most robustly efficient to the most robustly inefficient”. Raab and Kotamraju focused on research and development investment, venture capital, high-technology workers, and high-technology degrees as inputs and patents per state and value of output for biological and high-tech industries as outputs. DEA is helpful as it allows for the construction of a production possibility frontier ranking states that consume as little input as possible and producing as much output as possible from the given consumption level (Raab and Kotamraju, 2006).

Raab and Lichty (1997) created an input-output model for Minnesota counties using IMPLAN input-output data in order to see how “productivity vary between counties of the urban-transitional-periphery landscape surrounding metropolitan core areas” (Raab and Lichty, 1997). They also stated that resource productivity and efficiency should rise as county size—in terms of population density—increases, otherwise the largest counties would not continue to grow and immigration would stall (Raab and Lichty, 1997). For this reason we expect urban counties to have higher efficiencies than rural counties as more resources are concentrated and available for more people. Certainly there may be some exceptions where counties with high GDP output could be seriously lacking in some capital categories while other, lower GDP output counties may be more evenly balanced with their capitals inputs. Raab and Lichty (1997) focused on five inputs, such as total imports and employee compensation, and four outputs, such as exports and household consumption. From these variables, an efficiency frontier was constructed to show which counties were able to use as little inputs while still producing the most output as possible (Raab and Lichty, 1997).

Kim and Harris (2008) focused on Nevada and Utah counties for an efficiency analysis in a similar approach to Raab and Lichty (1997, 2002), using similar variables. Their hypothesis was based off of Raab and Lichty's (1997) idea about the community efficiency/community growth correlated relationship. However, one key departure was the researchers' argument that a statistical test for returns to scale may be inappropriate for this research because DEA is a non-parametric method. They later described that in most regional growth analyses, constant returns is widely used by using the DEA efficiency estimates and bootstrapping (Kim and Harris, 2008).

Chapter 3 – Factor Analysis

Factor analysis and the creation of latent variables has many advantages. One major advantage of factor analysis is that it can allow us to use variables which are difficult to measure directly (Rethemeyer, 2007). This proves essential to our research because constructs like physical, social, or cultural capital are abstract and hard to assign a quantitative value. However with factor analysis, values can be placed on these latent variables through a ranking system and thus can be measurable via the capitals' manifest variables such the number of airports, the number of labor organizations, or the average temperatures in July within a given county. Factor analysis allows us to develop these constructs that assign quantitative values to sometimes ambiguous qualitative variables.

Factors are calculated from a correlation matrix by accounting for variance and eigenvalues from the correlated variables (Rethmeyer, 2007). The correlation matrix allows comparison between variables to see which variables are most correlated to each other. Variables highly correlated with each other, having values above 0.40, may possibly be a part of the same factor (Rethemeyer, 2007).

	Var1	Var2	Var3	Var4
Var1	1	0.72	0.31	0.26
Var2	0.72	1	0.33	0.31
Var3	0.31	0.33	1	0.69
Var4	0.26	0.31	0.69	1

Figure 3 – An Example of a Correlation Matrix

In the example of a correlation matrix in Figure 3, we see that Variables 1 and 2 are highly correlated to each other with a correlation of 0.72 and likewise Variables 3 and 4 have a correlation of 0.69. Other than these two correlations, the variables do not have much correlation with each other, thus implying that Variables 1 and 2 could be a part of one factor and Variables 3 and 4 are part of another factor.

Each factor accounts for as much variance of the observed variables as possible. The amount of variance accounted for by each factor is known as an eigenvalue, which are equal to the sum of the squared loadings for a given factor (Taylor, 2004). Eigenvalues are important mainly for helping interpret the percentage of total variation in the variables that is explained by the factor. Dividing the eigenvalue by the number of variables being tested gives us the percent of the variance that a particular factor explains (Rethemeyer, 2007).

Factor analysis looks at the correlations between a variable and a factor. The numeric value for such a comparison is known as a factor loading (Kline, 1994). In one form of the factor analysis model, factor loadings are the coefficients to factors related to a manifest variable. Such a model is represented here:

$$X_m = b_{m1}F_1 + b_{m2}F_2 + \cdots b_{mn}F_n + \ b_nU_n \qquad (1)$$

X_m is a manifest variable, F_n are possible factors used to explain X_m, and b_{mn} are the factor loadings for each of the factors with values between 0 and 1 (Taylor, 2004). U_n are unique variables that affect the variability of one and only one indicator variable at a time (Rethemeyer, 2007). This model behaves much like a regression equation; both look at the levels of influence each independent variable—a factor—has on the dependent variable—manifest variable—via the coefficients of the independent variables—factor loadings.

Much of our factor analysis will look at factor scores. Factor scores look for the level of influence, or weighting, that a manifest variable has on a particular factor. This model behaves much like the previous explained model with the exception that the factor is now the left-hand side variable and the various manifest variables explaining that factor are now on the right-hand side. Such a model is represented here:

$$F_m = b_{m1}X_1 + b_{m2}X_2 + \cdots b_{mn}X_n \tag{2}$$

F_m is one possible factor, X_n are the manifest variables used to explain F_m, and b_{mn} are the factor loadings for each of the manifest variables with values between 0 and 1 (Taylor, 2004). Note that this model does not include unique variables as unique variables are only relevant to manifest variables if they were a dependent variable. We shall be using this model for our factor analysis as it pertains better to our goal of finding a single factor score for a particular capital.

One way to estimate factor scores is to sum all the raw factor loadings corresponding to all items loading on a factor (Comrey and Lee, 1992). Negative factor loadings imply a negative relation to the factor and thus are subtracted rather than added. Average scores for the factors can also be used for comparisons across factors (Grice, 2001). However, this addition method does have some consequences. First, factors are given equal weight regardless of factor loadings. If variables use different metrics, such as length of highway in miles versus museums per capita, ignoring different amounts of variability may result in low accuracy for the factor scores. This can be bypassed by standardizing the variables on different metrics (DiStefano et al, 2009). Note, negative factors scores do not necessarily mean lower quality for the variable being analyzed; it means that value is less than the mean.

Chapter 4 – Community Capitals

4.1 Framework

Community capitals are assets held by a community that aid in its socio-economic development. Communities can range in different sizes, anywhere from neighborhoods and towns to counties and states, and hold a variety of resources that make that community attractive for immigration, business establishment, and personal expression via cultural, social, and political means. Using community capitals to analyze regional economic development is called 'community and economic development' analysis, or CEDs. CEDs do not necessarily measure wealth of a community just in economic terms. (Hancock 1999). While this analysis will be looking at GDP as an output, it will be analyzing many of the community capitals as inputs for economic output. Using community capitals allows us to gage the overall health of the communities' economies and how efficiently each county is using these capital resources. The community capitals are listed as followed:

- Human capital consists of healthy and educated people engaged in building a better community, whether that is through private business or public affairs (Emery and Flora, 2006). It primarily focuses on education attainment levels but this analysis also includes certain health aspects such as the percentage of the population with diabetes or the percentage of those uninsured.
- Natural capital consists of aspects about a community's geography and climate making an area desirable or undesirable for residents (Emery and Flora, 2006). It may also influence the levels of other community capitals. For example, social capital may differ in counties with warm climates where people may be more inclined to participate in outdoor activities versus counties with cold climates where people may participate more in indoor activities.

- Social capital consists of social interactions and organizations within a community that usually act as a 'glue' that binds residents together (Flora et al, 2004; Emery and Flora, 2006). While most social capital, such as volunteer organizations or business associations, is inclusive and positive, some exclusive, negative social capital, such as gangs or 'good ol' boy' clubs, can be detrimental to the entire community even if residents within these exclusive groups receive some sort of unequal benefit.
- Cultural capital consists of artistic and creative contributions by the residents of the community that can build the cultural identity of the community. Cultural capital focuses both on artists and cultural innovators that create new artistic expressions for the community as well as how knowledgeable a community is of the outside world (Emery and Flora, 2006).
- Political capital reflects access to power, organizations, and connections with political influence (Flora et all, 2004; Emery and Flora, 2006). It also consists of the community population's ability to voice their opinions on matters and engage in actions that contribute in improving the well-being of the community.
- Physical capital is comprised of the infrastructure within the community that facilitates the other capitals and aids in the movement and livability of the community's citizens. Such infrastructure focuses on transportation—roads, railroads, airports—residences and housing—single family housing, apartment buildings—and communications—broadband access and speed (Emery and Flora, 2006).

These community capitals do not exist by themselves, but rather overlap one another and form the community's economy. Due to their interconnectedness, community capitals can 'spiral-up' an economy as investments in these capitals enforce and build upon themselves. For example, investments in human and social capitals then directly affect increases in physical and cultural capital. This in turn causes more growth in human and social capital and also facilitates growth in cultural and political capital. Growth in these capitals results in increased economic output and provides revenue for both private parties and governments to use community capitals even more (Emery and Flora, 2006).

However, these community capitals can also led to economic decline should any capital begin to falter. Emery and Flora (2006) described such a situation as a downward spiral which the community declines in all capitals and results in a loss of hope and direction for the community. For example, suppose an economic shock affects a community in a way that results in loss of economic output, or GDP. Jobs are lost and human capital begins to decrease. People begin an exodus from the community resulting in a decrease in social and cultural capital. The community is left to survive on only one or few pillar industries and political capital is reduced to maintaining these industries versus expansion. Due to the loss of population and jobs, tax revenues decrease and physical capital enters into a state of disrepair. Even natural capital is negatively affected as reduced tax revenues mean less spending on enforcing environmental quality standards. Abandoned buildings create blight in these community which further decreases social capital as criminal activity moves into these deserted areas (Emery and Flora, 2006).

4.2 Resiliency

Communities do not control all the conditions that affect them. Circumstances such as land ownership status, industries influencing the local economy, geographic and climatic conditions, and others are either difficult to change or beyond control. However, resilience is not about controlling all the conditions that affect communities, but rather it is about the ability of the individual and the community to respond to change. (Ahmed et al. 2004; Gibbon et al. 2002). For this reason, some counties that are well-endowed in community capitals may actually choose to be inefficient during favorable economic conditions to hedge for any potential changes. The rationale for this is that should some exogenous shock occur, these inefficient counties, which are in effect 'storing' capital resources by not exploiting them, can increase economic efficiency and maintain current levels of economic output (Singh, 1986). Likewise, less-endowed counties have to be efficient with their capital resources during favorable economic conditions just to produce economic output. These counties, both urban and rural, are more susceptible to economic shocks because, unlike their inefficient, well-endowed counterparts, the efficient counties are incapable of 'storing' any capital resources for future use. Because of this, these less-endowed, highly-efficient counties may see their economic output decline in a 'spiraling' down scenario as previously described (Singh, 1986).

Communities need to recognize the inevitability of change and adapt to live with shocks (Folke et al, 2003). Resiliency not only relates to sustaining the current socio-economic systems, but also relates to occasional transformation. Shocks to certain communities can push them beyond levels where minor changes are ineffective; "only total transformation can allow the community to survive" (Magis, 2010). These transformations can allow for new opportunities to emerge and become more resilient in the future. This resilience, not community stability, is what communities need to thrive (Magis, 2010).

Chapter 5 – Methodology

5.1 Data

Data was gathered from a variety of government sources, most notably US Census via American FactFinder, National Atlas, USDA's Natural Amenities Index, and Penn State University's Social Capital Index. Data from non-governmental entities were used as well, including the County Health Rankings and Roadmaps which provided additional data for human capital and the Creative Vitality Index which provided details about cultural capital. Data from IMPLAN was used for GDP per county data. The data variables, in per county terms, for each of the capitals are listed as follows:

<u>HUMAN CAPITAL:</u>

- Percent of population with Associates Degree
- Percent of population with Bachelor's Degree
- Percent of population with Graduate or Professional Degree
- HIV rates per county
- Age-adjusted mortality rates per county
- Percent of population that is diabetic
- Number of mental health providers per county
- Healthcare costs per county
- Percent of population uninsured medically

<u>PHYSICAL CAPITAL:</u>

- Miles of road per total county square miles
- Miles of rail per total county square miles
- Number of airports per county square miles
- Percent of households with broadband speeds of 4 megabytes (mb)
- Number of occupied housing units (houses, apartments, etc.)

POLITICAL CAPITAL:

- Percent vote for 2004
- Response rate for 2005
- Political organizations for 2005
- Homicide rate per 100,000 people for 2013

CULTURAL CAPITAL:

- Employed people in 2000
- Creative people in 2000
- Arts people in 2000
- Creative share of employed population 2000
- Bohemian share of employed population 2000

NATURAL CAPITAL (heavily based from USDA Natural Amenity Index[4]):

- Mean temperatures in January (Z-score)
- Mean amount of sunshine in January (Z-score)
- Mean temperatures in July (Z-score)
- Humidity levels in July (Z-score)
- Topography codes (Z-score)
- Natural log of water area per county (Z-score)

SOCIAL CAPITAL (heavily based from Penn State University's Social Capital Index):

- Aggregation of the following social capital variables:
    - Religious organizations
    - Civic and social associations
    - Business associations
    - Political organizations

[4] The USDA's Natural Amenity Index inexplicably did not include the State of Alaska nor the State of Hawaii in their index. This leaves both states with no data and is why natural capital factor scores for their counties and county equivalents are identical (see Figure 6). This is an issue needing improvement in subsequent research.

  - Professional organizations
  - Labor organizations
  - Bowling centers
  - Physical fitness facilities
  - Public golf courses
  - Sport clubs, managers, and promoters
- Number of Political organizations
- Response rate
- Number of Non profits

One aspect that needs to be addressed is that the data was collected in different years. This was due to data availability as some capitals and variables did not have recent data available. This may impact the accuracy of the analysis and may warrant future research using updated data. Also, the collected data focused on 3,139 counties in the United States. However, there are 3,143 counties in the US and thus four counties and county equivalents were omitted:

- Hoonah–Angoon Census Area, Alaska
- District of Columbia, District of Columbia
- Kalawao County, Hawaii
- Manassas Park, Virginia

Most prominent on this list is the District of Columbia. It was dropped because, while the District of Columbia is crucial for American society, it is not a state county and this research is focused only on state counties. Other counties or county equivalents on this list were dropped because of incomplete data for all capitals. Dropping these three additional counties should not be a significant issue as they mostly had low populations and relatively insignificant economic activity anyways.

Data for the community capitals were matched to corresponding county FIPS codes (Federal Information Processing Standards codes) to provide better tracking and distinguishing of counties. Counties were then divided into regions as described by the U.S. Bureau of Economic Analysis (BEA). This was done because we believe that counties within these regions are more similar to one another in terms of geography, resources, and possible threats. This belief is aligned with Tobler's First Law of Geography stating that "everything is related to everything else, but near things are more related than distant things" (Tobler, 1970). Regionalizing the data will provide better comparisons for county officials due to similarities with other counties in the same region. The BEA regions are described as follows:

- New England: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
- Mideast: Delaware, Maryland, New Jersey, New York, and Pennsylvania
- Great Lakes: Illinois, Indiana, Michigan, Ohio, and Wisconsin
- Plains: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
- Southeast: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia
- Southwest: Arizona, New Mexico, Oklahoma, and Texas
- Rocky Mountain: Colorado, Idaho, Montana, Utah, and Wyoming
- Far West: Alaska, California, Hawaii, Nevada, Oregon, and Washington

5.2 Data Processing and Model:

Once the data was collected, factor scores were calculated using the Structured Equation Modeling (SEM) in STATA. Each capital formed its own factor and composed of variables relating to that capital. Higher values for factor scores imply higher levels of that particular capital operating in a county. Factor scores were then scaled to be positive values only by taking the absolute value of the most negative value of a capital and adding it to all factor scores, thus the value of the most negative factor score became zero after scaling. The reasoning for this scaling is that DEA has issues with calculating for negative numbers. This issue is because DEA is calculating the efficiency of output production given the available resources and thus has problems handling 'negative resources' such as negative factor score values. For the DEA analysis, the scaled factor scores for the capitals are the inputs while GDP per county is the output, thus a six-input, one-output model. DEA results were conducted using DEAP v.2.1, an analytic software developed by Tim Coelli specifically for DEA. The DEA results were conducted using The DEA model used in this research was the VRS model proposed by Banker, Charnes, and Cooper (1984), listed as so:

$$\min_{\theta,\lambda} \theta,$$
$$\text{st} \quad -y_i + Y\lambda \geq 0,$$
$$\theta x_i - X\lambda \geq 0,$$
$$N1'\lambda = 1,$$
$$\lambda \geq 0 \qquad (3)$$

In the VRS model, θ is the efficiency of the i^{th} DMU, minimized to uncover true levels of efficiency subject to input and output constraints. X is a K×N matrix of inputs, where K is the number of inputs and N is the number of DMUs. Y is the M×N output matrix, where M is the number of outputs and N is the number of DMUs. λ is an N×1vector of constants, thus $X\lambda$ and $Y\lambda$ are input and output vectors for the analyzed DMU respectively. y_i is the vector of outputs for the i^{th} DMU. N1 is an N×1 vector of ones which forms a convex frontier enveloping the data points more closely than a CRS model, thus resulting in a VRS data envelopment analysis model (Banker, Charnes, and Cooper, 1984; Coelli, 1996; Anderson, 1996). A VRS model seemed more appropriate for use than CRS due to the reasons previously mentioned in the data envelopment analysis chapter.

Chapter 6 – Empirical Results and Discussion

6.1 Results at a Glance

RANKINGS	RANK: 1=HIGHEST to 8=LOWEST							
REGION	*PHYSICAL*	*NATURAL*	*POLITICAL*	*SOCIAL*	*CULTURAL*	*HUMAN*	*EFFICIENCY*	*AVERAGE RANKINGS*
Far West	7	1	5	6	1	3	4	4
Rocky Mountains	8	2	4	4	7	2	6	5
Southwest	6	3	8	8	5	7	1	6
Plains	5	7	1	1	8	4	2	4
Southeast	3	5	7	7	6	8	3	6
Great Lakes	4	8	3	2	4	6	5	5
Mideast	1	6	6	5	2	5	7	4
New England	2	4	2	3	3	1	8	3

Figure 4 – Rankings of the Average Capital Factor Scores and the Average DEA Efficiency Scores per Region

Figure 4 shows the rankings of average capital factor scores and average DEA efficiency scores with respect to all the regions in the US. The 'Average Rankings' column averages only the capital factor score rankings with respect with all regions. When we look at average DEA efficiency scores, we see that the Southwest region is the most efficient and the New England region the least efficient region. This returns back to Singh's (1986) point of resiliency; we see that resource-affluent regions like New England are the least efficient because they can afford to be inefficient due to the abundance of capital resources. This contrasts with the generally resource-constrained Southwest region which is the most efficient region in the US because it needs to fully utilize its resources just to maintain current economic output levels.

From this figure, we see that the New England has the highest average ranking—'3'—of all regions, with consistently high factor scores for all capitals. The Far West, Plains, and Mideast regions all have the second highest average rankings with values of '4' due to usually having one capital with the highest factor scores offsetting other capital factor scores that are on the relative low. The Rocky Mountains and Great Lakes regions have average rankings of '5' for capital factors scores with usually one capital with relatively high factor scores and the rest of the capitals being relatively low in respect with the other regions. Lastly the Southwest and Southeast regions have the lowest average capital factor scores in the nation. Chapters 6.2 and 6.3 will discuss components affecting these rankings for Community Capitals and DEA Results more in detail.

Figures for the summary statistics figures are presented in the Appendix of this research[5]. This was done to centralize all summary statistics in one location of this thesis rather than sporadically inserting figures for these statistics. Averages[6], medians, maximums, minimums, variance, and standard deviation for the capital factor scores and DEA efficiency values were calculated to provide insight on the data analyzed.

6.2 Community Capitals Results

6.2.1 Prelude

The Community Capital Results section will detail each of the six community capitals for each of the eight Bureau of Economic Analysis (BEA) regions in the US. The regions will be described in the following order: Far West, Rocky Mountain, Southwest, Plains, Southeast, Great Lakes, Mideast, and New England. Within each region, the capitals will be described in the following order: physical capital, natural capital, political capital, social capital, cultural capital, and human capital. This section suggests reasons why regions have higher or lower capital factor scores. Figures for capital levels for all capital types can be found in the Appendix. Please refer to the List of Figures and the Appendix for these figures and their corresponding capitals.

[5] Please refer to Page 63 for Figure 7: Summary Statistics of Capital Factor Scores and DEA Efficiency Scores
[6] Averages was used as the basis of the Average Rankings figure, Figure 4

6.2.2 Far West Region

Because of the area's ruggedness and remoteness, the Far West region has low factor scores in physical capital with fewer airports, roadways, and rail. The Far West's population is spread over a large land area, much of it devoted to large scale agriculture or simply vacant land due to geographic features like deserts and mountains. The western US has less roadways and rail in terms of count, but the roadways and rail it does have span for hundreds of miles. With population spread over the western U.S., commuter rail is not as popular but freight lines hauling natural resources originating from this area are likely a contributing factor. Notable exceptions to the area's low factor score are major population centers like Portland and Los Angeles. Counties near these cities have much higher population densities and thus have greater need for roadways, rail, broadband access, and housing. These highly populated counties thus score similarly with their eastern U.S. counterparts.

However, the Far West scores high in natural capital. One reason for this is that the humidity variable is negatively scaled, thus while many Midwestern and Southeastern counties with high humidity will be have their factor scores negatively affected, Far West counties have little humidity and thus do not see this reduction to their score. This helps Far West counties even though summer temperatures are generally higher in the western states versus the eastern states. Some of the Far Western states, notably California and Nevada also have more sunshine as opposed to other states, further boosting some Far West county factor scores. Water area, notably the Pacific Ocean, is also influential on the factor scores by creating temperate climates that do not get too hot or too cold. Temperatures in the Pacific Northwest are relatively low, but not exceptionally cold due to the Pacific Ocean retaining heat. Weather in California likewise does not become too hot due to the ocean absorbing much of the solar energy and providing cooling breezes. One issue with this natural capital score, however, is the absence of data for Alaska and Hawaii.

The Far West performs moderately in political capital, mainly due to low homicide rates throughout most of the region. Some rural counties, such as those in eastern Oregon, and wealthy counties, such as those containing San Francisco and San Jose, have some of the highest factor scores for political capital. In addition, wealthy counties may also have more political organizations as wealthy citizens are more likely to donate to political causes than lower income citizens. We see this pattern mainly in some urban counties with the notable exception of those counties in Southern California. Los Angeles County, while having high levels of wealth and political organizations, also has high levels of homicides which negates much of these positive attributes. This is likely the reason we see the Los Angeles area being one of the lowest scoring counties in political capital. Also affecting political capital mainly in southern California could be the presence of non-U.S. residents who cannot legally participate in the political process and thus further lowering factor scores.

Social capital appears to follow the same pattern of political capital in the Far West, with higher factor scores in the north and low factor scores in the south. While some elements of social capital, predominately business, labor, and professional organizations, tend to concentrate in urban counties, this is not a direct correlation and does not necessarily boost factor scores in those counties. In fact, one of the most curious observations is Los Angeles County which despite hosting the second largest city in the US actually has the lowest factor score for social capital in the entire nation. Meanwhile, counties near Seattle and Portland perform much better despite having fewer of these organizations.

The Far West in its entirety seems to perform well in cultural capital with high factor scores throughout the region. In fact, the Far West, besides the Mideast and New England regions, has some of the highest scores in the nation. Many cities in the region such as Los Angeles, Portland, and Seattle are cultural hubs for various artists, musicians, painters, and others. Rural counties also seem to do relatively well, showing that cultural expression is not exclusive to urban counties. Alaska is a particular case with high cultural capital scores even with low population levels in remote regions of the state. One theory for this high cultural representation in Alaska is that the state has high levels of Native American populations that are exceptionally expressive through traditional art, crafts, and other creative outlets.

Human capital is well represented in the Far West, again concentrated primarily in urban areas but also present in some rural areas as well. Some rural counties may be performing well due to high levels of human capital brought on by land-grant universities within their county and thus even rural counties may have high education attainment levels. Other notable areas include those around Seattle and the San Francisco/San Jose region, home to Silicon Valley where premier universities collaborate with local high-tech industries to create high-valued economic output. When considering health in the region, the Far West is one of the highest scoring regions in the US. This can contributed to a couple of factors. One factor is that with high education attainment levels, people can afford better preventative health options such as specialty diets and gym memberships as well as other health care options that may be unaffordable to other people in other regions. The other factor in line with preventative health is the region is well renown in its outdoor recreation, so activities such as hiking and biking are not only entertaining to people living in these counties but also keep people healthy via exercise. All the states in this region are well-known for state and federal parks that encourage such physical exercise in order to explore the beauty of the park lands.

6.2.3 Rocky Mountains Region

For physical capital in the Rocky Mountains region, we see a similar pattern as in the Far West with the population is spread over a much larger land area and geographic features like deserts and mountains inhibiting the expansion of road and railways. Freight lines and highways are the primary roadways in the Rocky Mountains. Notable counties with high factor scores are major population centers like Salt Lake City, Denver, and moderate population centers like Boise, Idaho. Counties containing or near these cities have higher population densities and thus have greater need for roadways, rail, broadband access, and housing. However, it seems that immediately bordering these high physical capital scoring counties are counties with exceptionally low factor scores. This shows that these high scoring urban counties are few and isolated in by more numerous rural and rugged counties.

There is a definite west-east continental US divide for natural capital factor scores situated on the Rocky Mountains region. Counties in the Rocky Mountains scored exceptionally high in natural capital like the counties in the Far West. Again, a main driver in this factor is the lack of relative humidity in the region and thus the Rocky Mountain's factor scores are not penalized as harshly, even with high summer temperatures. Again, many of these counties, notably in Colorado, states also generally have more sunshine as opposed to other counties, further helping the region's factor scores. Unlike the Far West, the Rocky Mountains do not have any substantially large bodies of water, with the exception of the Great Salt Lake, and thus temperatures in the region can range to temperatures well above 90 degrees in the summer and temperatures well below freezing in the winters. Also, with the physical presence of the Rocky Mountains, snow accumulation is much more of an influential factor that can lower winter temperatures and thus negative affect natural capital scores.

Political capital is relatively high for the Rocky Mountains, with many rural counties primarily in Montana and Wyoming scoring high. For Montana, this may be due to the presence of Native American reservations with political activity due to their special sovereignty status with the federal government. For Wyoming, the highest levels of political capital occur in the northwestern corner of the state, home to Yellowstone National Park where federal involvement may be causing these factor scores. Colorado, a swing state in presidential elections, also has high values of political capital, especially in the Denver area. Another contributing factor is the region's relatively low homicide rate, boosting political capital scores.

Social capital appears to follow the same pattern of political capital in the Rocky Mountains and has a general random distribution. Again, we see some rural Montana counties with high social capital scores which may be due to close-knit Native American tribes. Wyoming also has high scoring counties in the Yellowstone National Park region. Reasons for this and other rural, rugged counties' higher scores could be social clubs and organizations involved with outdoor recreation, like hiking or skiing clubs. Once more, some urban counties we expected to see higher scores from had similar scores with less populated counties. For example, Denver, despite having a much higher population and physically being a larger city, has relatively the same factor score as Boise, Idaho, which, while also an urban area, is much smaller than Denver. This may show that some counties are better utilizing their civic centers, social clubs and other social capital much better than larger counties that have many more of these centers and clubs. This theme of 'more is not always better' is an interesting concept that may warrant future research and understanding.

The Rocky Mountains are adequate for their cultural capital. Unlike the Far West, the Rocky Mountains are not especially regarded as major cultural expression hubs. Some urban counties have high levels of cultural capital; one notable example is the Red Rocks Amphitheatre near Denver which attracts world-renown musicians. Other urban areas, while not having world-renown cultural attractions, still may at least cater to local artists and musicians looking for viewership only within the region. Scale of cultural expression, such as the difference between a major motion picture and a local play, is not accounted for in this analysis and would be difficult to quantify. Thus, this analysis only looks at the number of artists employed and working in each county. But this region also has pockets of very low cultural capital scores. These regions may be more rural and thus the need or demand for cultural expression may not be viewed as important.

Human capital performs well in Rocky Mountains due its education levels and its very active, healthy population that is largely involved in outdoor recreation. Again, major land-grant universities are prevalent here along with other higher education institutions, leading to the region having some of the highest human capital scores in the region. Colorado performs very well with its numerous universities as well as its active population biking and hiking as forms of entertainment and exercise. Utah also seems to perform well both in urban areas like Salt Lake City and rural counties featuring major outdoor recreation destinations like Moab contain both Arches and Canyonlands National Parks. Idaho seems to have some of the lowest scores in the region with high human capital concentrations mainly in the eastern part of the state and not much else. While high education attainment levels seem to be prevalent, scores minimizing disease rates and mortality may be most influential in this region due to the popularity of outdoor recreation.

6.2.4 Southwest Region

Physical capital in the Southwest has some of lowest values in the country, mainly due to vast plots of desert and vacant land with little to no population. There is visible divide that falls upon the middle of Oklahoma and Texas, with counties east of this divide having much higher levels of physical than counties lying to the west of the divide which have very low scores of physical capital. Even urban western counties contain cities such as Phoenix and Albuquerque have relatively poor physical capital scores compared to eastern counties with cities such as Dallas or even rural eastern Texas counties. With the majority of the region being rural, demand for housing and broadband is low, further lowering the factor scores for physical capital. Most of the rural counties are devoted to agriculture with substantial plots of land are not being developed for physical capital but rather for crop and livestock production, especially in northwestern Texas. For other states, it may not be feasible both economically and physically to construct extensive networks of physical capital in desert counties.

In contrast, the Southwest have high scores for natural capital. There is a similar division in the region as physical capital but now in the opposite direction: Arizona and New Mexico have some of the highest levels of natural capital in the nation while eastern Texas and Oklahoma have average values. This is primarily due to high humidity in Texas and Oklahoma versus low to practically non-existent humidity in Arizona and New Mexico. Winter temperatures in Arizona and New Mexico are also some of the highest in the country which further benefits the natural capital score. This is evident with the high number of 'snow birds'; the people who live temporarily in Arizona and New Mexico to escape the cold winters of their home states. Water area, in the form of the Gulf of Mexico, does have some influence in the natural factor scores for coastal Texas. Counties along the coast have slightly higher factor scores due to the climate effects of large bodies of water. However, these counties compare similarly with some interior Texas counties so the effect of living near the Gulf of Mexico may not be as beneficial as other bodies of water.

The Southwest has some of the lowest levels of political capital in the nation, possibly due to the amount of non-U.S. citizens that are unable to participate via voting in the political process. This lowers the voting participation in the region and thus lowers the political capital scores. Another reason for low political capital scores could be due to these states being solidly supportive of a single party, Republicans, and thus it may not worth investing too much in the number of political organizations. Furthermore, homicide rates are relatively high in the region, with the majority of the crimes occurring in Arizona, New Mexico, and Coastal Texas near Houston. Reasons for the homicide rates include poverty among new U.S. immigrants and workers from Mexico as well as the high number of drug crimes in the area.

Social capital mirrors the political capital in the Southwest and thus is also some of the lowest in the country. Most of the highest social capital factor scores occur in rural Texas and are higher than some major urban areas such as Dallas and Houston. Arizona and New Mexico have low scores overall with the exception of Los Alamos County in New Mexico which has one the highest social capital factor scores in the region. The reasons for the poor scores in social capital could range from either too little social capital available for everyone to use or too much social capital that some investments are simply not being used. We are leaning more towards too little social capital due to the generally known individualist mentality of Texas and the rest of the region. This mentality may be inhibiting social capital growth because civic centers and social clubs are less effective when the population in general is more focused on individual needs versus group needs.

Cultural capital for the Southwest has some higher factor scores and is spread throughout the region relatively even. Counties within in Arizona, New Mexico, and

Oklahoma have the higher factor scores in the region while Texas is a mix of high cultural capital scores followed by counties with very low factor scores. A reason for some of the higher cultural capital scores could be due to the ethnic diversity of the region. Arizona and New Mexico have large proportions of the population that are Hispanic and Native American and may express their culture through arts, crafts and shows. Oklahoma could have similar reasons due to their relatively large Native American population. Some urban areas have relatively high factor scores for cultural capital, but they are not the highest in the region. Urban centers like Dallas and Houston provide opportunities for some cultural expression by artists and musicians, but the opportunities may not be as extensive as other regions in the US.

Human capital is also mixed in the Southwest with Arizona and New Mexico having relatively higher rates while Oklahoma and Texas have some low values for human capital. New Mexico has the highest values in the region, partly due to its education institutions and opportunities with government entities such as the Los Alamos National Laboratory. Texas and Oklahoma have a substantial number of counties that perform poorly in human capital. Texas' sheer size may make it difficult for the state to provide the proper education attainment opportunities throughout the state. Another reason for the low human capital factor scores could be due to the non-U.S. immigrants from Mexico and abroad who may not have high education attainment levels. These immigrants may not pursue higher education because of the demands of their low-skill, low-pay occupations. Health is also an issue with higher rates of mortality and diseases such as diabetes affecting the area. One curious issue affecting areas like Phoenix are the presence of the previously mentioned 'snow birds' who are mainly retired, elderly people who generally have more medical conditions. Eastern Texas and Oklahoma tend to share some similar traits with the Southeast region of the US which is known for its health problems and low education attainment levels.

6.2.5 Plains Region

Physical capital in the Plains region is moderate as we are beginning to straddle the western-eastern US divide with the east having much more physical capital development. We not only see urban areas but see that they are slowly becoming less isolated by rural counties and being located relatively closer to one another. Another possible factor increasing physical capital scores could be inter-regional transit of people and freight, notably to the major transit hub of Chicago in the Great Lakes region. Because of the city's closeness and influence, rail and roadways may be more prevalent than if Chicago did not exist. Meanwhile, rural counties devoted to agriculture tend to have lower physical capital scores as substantial plots of land are not being developed for physical capital but rather for crop and livestock production. High quantity of housing and broadband are likely not as demanded by these rural populations.

For natural capital, the Plains have some of the lowest scores in the nation. This is primarily due to high humidity in the hot summers and some of the coldest winters in the country. The Plains, especially the Dakotas and Minnesota, are well known for their snow levels contributing to cold winters. Due to the negative scaling of cold winters and humidity, the natural capital factor scores are severely punished. The region also receives little sun during the winter, further hurting the region's score. Water area is marginal in the Plains. While the region may have lakes, notably in Minnesota, they hardly contribute to the local climates unlike the oceans or Great Lakes.

However, political capital is highly concentrated in the Plains region and has some of the highest political capital scores in the nation. Iowa is an interesting case where the majority of the state is ranked high in political capital. While homicide rates are low, Iowa is home to the Iowa Caucuses for presidential candidates and thus the state has high numbers of political organizations and voting participation leading to high factor scores. Iowa behaves similarly to

Colorado politically, but Iowa has much more political capital and more intimate involvement in the presidential elections that Colorado. On a related note, political capital may be higher in this region than most other regions because states in this region tend to be more swing states that are not dominated by any one political party as opposed to some states in the Rocky Mountains which are solidly Republican or some states in the Far West that are solidly Democratic. There may be more political organizations and involvement due to the close nature of these elections. The western part of South Dakota may also have high levels of political capital due to the presence of Mount Rushmore National Monument.

Social capital appears to follow the same pattern of political capital in the Plains and again we see some of the highest values in the nation. Counties, both urban and rural, are using their civic centers and organizations efficiently and effectively. One theory influencing these high social capital values could be the low-scoring natural capital and climate mentioned earlier. Due to cold winters and humid summers, people may be more likely to seek indoor activities possibly involving other people, such as bowling or religious institutions or social clubs. This inclement climate may help develop strong social bonds between people. Another factor possible related to the previous statement is the general notion of 'Midwestern hospitality' where residents of the Plains are generally viewed as more courteous and friendly than other people in different regions. This factor may be difficult to test for, but could at the least warrant future investigation of whether 'Midwestern hospitality' is present and whether it has a statistically significant effect on social capital in the region.

Cultural capital is more diverse in the Plains than other capitals, with an apparent divide in the middle of the region separating higher cultural capital factor scores of Iowa, Minnesota, and Missouri from low cultural capital scores of the Dakotas, Kansas, and Nebraska. One reason for this split could simply be the population difference. The Dakotas are some of the least populated states in the country and thus the percentage of creative people living in the Dakotas may be some of the lowest in the nation. Similarly with some counties in the Rocky Mountain region, counties in Kansas and Nebraska tend to be rural and have low populations, thus cultural expression may not be as highly valued as in other parts of the country. Meanwhile in states like Minnesota and Missouri with major cities such as Minneapolis/St. Paul and St. Louis, cultural capital may be more vibrant due to available avenues for musicians and artists to express themselves in these major cultural hubs.

Human capital is generally highly scored in the Plains, having concentrations of high factor scores in the north near Minnesota as opposed to Missouri which may share some characteristics of the low-scoring Southeast region. Education attainment levels are high primarily in urban counties and northern Plains counties. These education attainment levels are primarily concentrated in counties near the cities of Minneapolis/St. Paul and St. Louis. Some rural counties in Nebraska and Kansas may have higher human capital factor scores due to land-grant universities. Health wise, northern Plains counties have higher health ratings that states such as Kansas or Missouri. Minnesota is known for its superior health care system and easy access to top quality hospitals and clinics. Minnesota and the Dakotas have relatively low rates of disease and mortality; the main exception is to some Native American reservations that have higher than normal mortality rates associated with poverty and alcoholism. As we go south, especially in rural Missouri, we begin to see higher rates of disease and mortality. Some of this is associated with poverty levels in these counties and the inability to prevent or treat these health issues. Missouri is an interesting state that while in the generally more prosperous Plains region, tends to share many characteristics with its least fortunate neighboring region, the Southeast.

6.2.6 Southeast Region

The Southeast has mixed physical capital scores with most trending high. Lower factor scores tend to occur in Mississippi, Alabama, and the western portion of Tennessee. High factor scores tend to occur just east of the Alabama-Georgia state line in Georgia, eastern Tennessee, Kentucky, and Virginia. Florida scores lower in physical capital in its southern section versus its northern section, likely due to the presence of the Everglades. The region does have relatively high levels of manufacturing and thus has an extensive network of road and railways. Manufacturing, along with a sizeable service industry, also creates jobs that increase demand for housing and broadband. The region owes its success to a mix of private-public employers. Low minimum wages may draw corporations to relocate to the region due to reduced operating costs. Meanwhile, some counties in the Tennessee Valley (eastern Tennessee, North Alabama) may owe their success to the presence of the Tennessee Valley Authority, which provides affordable electricity to the region drawing in manufacturing plants and thus help spur rail and road development.

With the exception of Florida and some counties along the Appalachian Mountain range, the Southeastern region has relatively poor scores for natural capital. The primary suspect in the low factor scores is humidity, which the region has some of the highest levels in the nation. With humidity and summer temperatures negatively scaled, the region on a whole performs poorly in natural capital factor scores. Florida has high scores mainly due to its year-round sunshine and warm temperatures in winter, a trait that has endowed the state with 'snow-birds' similar to that of Arizona. Some counties along the Appalachian Mountain range may have higher factor scores due to lower summer temperatures and marginally less humidity. However, these mountain counties stretching from Tennessee to West Virginia may be penalized by lower winter temperatures.

Political capital in the Southeast is some of the lowest levels in the US. This is mainly due to the region having the highest homicide rates in the nation. Much of the region has low-income and low upward social mobility which is often correlated with high rates of crime and homicides. Both urban and rural counties have low political capital factor scores, showing that factors influencing the low scores are not isolated to any particular type of county. Voter turnout is some of the lowest in the nation as well. This could be due to lack of political participation by low-income individuals who may defer voting in order to earn additional income on election days. The region is also tends to show strong support the Republican Party and voter participation, especially for other parties, may be low. Florida appears to have the most counties with higher scores in the region, but still has low political capital when compared to the rest of the nation.

Social capital in the Southeastern region is also among the lowest in the nation. This region has some of the highest numbers of religious organizations in the country. This is not surprising given that the Southeast region is well-known for its association with religion, often known as ‘the Bible Belt’ of America. However, even with these high values for number of religious organizations, the region still scores relatively poorly in social capital. The reasons for the poor scores in social capital are likely due to little social capital available for everyone to use. While religious organizations are popular in the region, the relative overall lack of other capital sources such as business associations and non-profit organizations seems to have penalized the Southeast region’s social capital factor scores.

The Southeast region does score well in cultural capital in general, with counties in Florida, the Carolinas, and Tennessee scoring particularly high. Counties containing cultural hubs such as Nashville, New Orleans, Atlanta, and Miami are well-renowned for their contributions to the music and entertainment industries. Many of these cities and counties in the region are known for being birthplaces for musical forms, such as blues, jazz, rockabilly, and country music. Counties throughout states like Alabama, Mississippi, the Carolinas, West Virginia, and Virginia which may not have the previously mentioned cultural hubs still score relatively high with large populations of artists and musicians. Some counties in the Southeast region may have low cultural capital scores due to being rural and having low populations, thus cultural expression may not be as highly valued as in other parts of the country.

Human capital in the Southeast region is by far the lowest in the entire nation. Counties in the region consistently have some of the lowest education attainment levels, regardless of rural or urban status. Low education levels for the region may be detrimental to the economy as high-skill, high-paying occupations may be out of the reach of most people in the region. While the region does have a relatively large manufacturing base, many of these jobs are low-skill, low-paying jobs. Furthermore, the region also has some of the worst health scores in the nation, having some of the highest rates for age-adjusted mortality, diabetes, HIV cases, and lack of health insurance. Reasons for the poor health of the people in the region could arise from lack of education attainment and lack of high-paying jobs as people may not have the funds to treat these health ailments. More so, some low-skill, low-pay jobs may occur in unhealthy work environments, such as coal mines in West Virginia, which further contribute to high levels of health ailments and high health care costs.

6.2.7 Great Lakes Region

It should not be surprising to see how high the Great Lakes scores in physical capital. The region is well-known for being a major manufacturing base for various industries, most notably automobiles and steelworks. With such manufacturing presence, the demand for roads and railways is high and thus the region scores well on these fronts. Traditionally, these industries have employeed thousands of workers and thus demand for housing and, recently, broadband is also high. However, this region also contains a vast portion of the 'Rust Belt', where the once powerful industrial sector is beginning to wane, leading to population lost and less demand for some of these physical capital variables. The region still is a major manufacturing sector, just not as large as it has historically been.

The Great Lakes region, however, does have some of the lowest scores for natural capital in the nation. The Great Lakes has moderately warm summers, but its factor score is hurt by high levels of humidity. One of the biggest factors negatively influencing the natural capital factor score is the region's bitterly cold, snowy winters that rival the northern portion of the Plains region. Part of this could be due to the Great Lakes winter phenomenon of 'lake effect snow' when cold air moves over expanses of warm lake water and picks up water vapor that then freezes and falls as snows once the water-saturated cold air travels across land. Counties in the region are often subjected to lake-effect snow and bitterly cold winters (NOAA, 2013) which also leads to low levels of sunshine in the region, further decreasing the natural capital factor score.

The Great Lakes region does have relatively high levels of political. Most of the region has a mix of high and low scoring counties, but there is a concentration of political capital in Wisconsin that it interesting. Reasons for this could be the relatively low homicide rates in the state as well as the state having political influence as swing state in presidential elections. Ohio is also considered one of these swing states, but only has a handful of high-scoring political capital counties, notably in the western Ohio and Cleveland areas. One reason for this mix of high and low scoring counties could be the region's relatively high homicide rate, lowering political capital scores. Counties containing cities such as Chicago and Gary, Indiana, while having significant political influence, may have low scores due to these cities' reputation for high homicide rates.

Social Capital in the Great Lakes is moderate. Part of this may be due to high membership in labor organizations, such as labor unions, that are often associated with industrial, manufacturing sectors. Business and professional associations also have high membership due to the same reason. Counties in Wisconsin have higher social capital rates than those in the rest of the region. Some of these Wisconsin counties may share some similarities to the Plains region, thus expressing some 'spill-over' effect from the Plains region. Again, a reason for the relatively low social capital scores could be the declining populations in these Rust Belt counties, resulting in less utilization of social capital facilities such as civic centers.

Cultural capital in the Great Lakes region is relatively high as a whole. Counties containing cultural hubs such as Chicago and Detroit are well known for their contributions to the music and entertainment industries. Other concentrations include those in southern-central Ohio (Columbus-area), central Indiana (Indianapolis-area) and central Illinois (Springfield-area). Some of these secondary concentrations may be due to being located in counties containing major universities, such as Ohio State University in Columbus, where there may be a sizable amount of young artists and other cultural professionals. Again, some counties in the region may have low cultural capital scores due to being rural and low populations, thus cultural expression may not be as highly valued.

Human capital in the Great Lakes region is mixed, with high factor scores in the Wisconsin area but lower factor scores as we move east and south. Part of this trend may be due to influences from other regions, with Wisconsin-area counties having high scores because they are located near the Plains region and Ohio, Michigan, and Indiana counties having lower scores because they are located relatively near the Southeastern region. One major reason may be the lack of high education attainment levels in the Ohio, Michigan, and Indiana areas. Education attainment levels may be low in these states because these states have been historically associated with manufacturing jobs that are often low-skill, low-paying occupations. We also see this region having some high levels of health issues, notably diabetes and age-adjusted mortality. Some of this, especially age-adjusted mortality, may be attributed to detrimental environmental conditions in many of these manufacturing and industrial occupations. Troubling is increasing health care costs in a region seeing loss of employment as manufacturing jobs are being transferred globally.

6.2.8 Mideast Region

The Mideast region by far has the highest levels and concentrations of physical capital in the nation. While the nation may not have the manufacturing clout of the Great Lakes, the Mideast does still has more than its fair share of industry. Many of these Mideast industries focus on commodities such as steel but there is also substantial presense of biotechnical and other technology industries. Much of the high concentration of physical capital is attributed to the extensive network of road and railways to facilitate the dense population. Major interstate and highway artieries snake through the region while a vast network of commuter rail provides public transport for millions of regional inhabitants. Housing and broadband is also exists in high quantity and availability, with broadband access having some of the highest levels in the nation in the Mideast region. The region as a whole scores high in all these physical capital variables and thus has a high factor score.

The Mideast region scores average for natural capital. Much of this deals with humidity levels and lack of sun during the winter months. The region does get a boost in natural capital due to the extensive coast line that moderates temperatures and boosting water area. Due to the Atlantic Ocean, natural capital scores tend not to penalized too much as temperatures rarely trend to the extremes. Counties that are more inland, such as those in upstate New York and western Pennslyvania, tend to have lower natural capital scores. A major reason is that counties in these areas tend to be hampered bitterly cold, snowy winters and lake effect snow conditions shared by Great Lakes region counties. Counties containg cities such as Buffalo, Rochester, and Erie are notable examples.

Political capital factor scores in the Mideast region are relatively average to below average. Despite affluent, major metropolitan centers like New York and Philadelphia having large numbers of political organizations, many of these major urban counties have average to poor political capital scores. The major contributing reason is homicide rates which are quite high especially in high dense urban areas and thus reduce the political capital scores. Another reason could be low voter participation rate as a percentage of the population as these urban centers, especially New York, have a large percentage of foreign nations that are unable to participate in the political process in the US. This would result in lower voter participation rates and thus negatively affect the political capital score.

Social capital in the Mideast region is average. Membership in labor organizations, business organizations, and professional associations are high for a region well known for its manufacturing and financial sectors. Religious organizations are high in number due to large, diverse populations in the region, with New York City having some of the highest counts. Surprisingly, counties containing New York City have some of the lowest social capital in the region. While the city has numerous facilities and organizations, it may be possible that the city does not have adequate amounts of these social capital institutions to serve its multimillion-person population. Less populated counties in upstate New York and Pennsylvania tend to have high social capital scores, possibly due to social capital not strained by massive populations and thus are widely available to the population.

Cultural capital in the Mideast region is very high and some of the highest in the nation. New York City is a world-known cultural capital for music, acting, and other entertainment industries and due to its size and influence, it leads to surrounding counties to have high levels of cultural capital as well. Employment for creative individuals in these cultural fields are some of the highest in the nation. One reason for such high levels of cultural capital is the regions high affluence levels. Wealth populations have more disposable income to spend on fine arts, concerts, art exhibits, and plays. This disposable income becomes salaries for these artists and musicians and helps spur a creative scene in the region.

Human capital in the Mideast is high as well, with concentrations in northern and central portions of the region and less in southern regions bordering the Southeastern region. The main reason for high human capital in the Mideast is due to high levels of education attainment in the region. The region contains some of the most prestigious colleges and universities both in the United States and the world, notably a portion of the Ivy League colleges as well as other well-renown state and public institutions. High education attainment levels are associated to high-skill, high-paying occupations commonly found in the region, such as those in the financial and technology sectors. We do see some moderate levels for health issues in areas such as HIV rates, diabetes, mortality, and high health care costs. Most of these instances are found in urban areas where high income inequality occurs. While the region is noted for being affluent, it also has a substantial low income population that is much more susceptible to high disease rates and high health care costs.

6.2.9 New England Region

The New England region also has high levels of physical capital for similar reasons as the Mideast region. Many of the industries in New England focus on medical, biotechnical and other technology industries. This is partially due to the high numbers of high-skill, high-paying jobs atrributed by the region's well-developed educational system. The region has a dense population requiring a vast network of road and railways, though the population is not as dense as that of the Mideast region. Public transportation, primarily rail, is also common in areas such as Boston and in counties in Connecticut, though the later's rail network mainly serves as an extension of the New York City's rail network in the Mideast region. Housing levels are high and broadband access is some of the highest in the nation, though much of the broadband access is concentrated along the coast and far less concentrated inland.

Natural capital in the New England region is about average, sharing many characteristics with the Mideast region. Some main influences on the factor score include cold winters and lack of sunshine in winter months. The extensive coast line in the New England region moderates temperatures thus winters are not too cold. Coastal counties also score well due to large percentages of water area included within their county borders.Lake effect snow can be present in the inland counties in New Hampshire and Vermont, however, and may be causing these counties to have relatively low natural capital scores. The region does have relatively high levels of humidity, but because of cooler summers, the penalty against the region is not as severe as other regions.

The New England region has average to above average political capital factor scores in the region, with the highest scores more concentrated in Maine. Many of the New England counties are comparatively wealthy and thus also have more political organizations as wealthy citizens are more likely to donate towards political causes than lower income citizens. There is strong, historical political tradition in the region, dating back to the Boston Tea Party days near the country's birth to influential congressmen and presidents from the Kennedy family. Counties in the region tend to be more progressive and thus more likely to vote Democrat, but rural inland counties and substantial portions of Maine tend to be more conservative. However, some dense, urban counties like those containing Boston and Providence may have lower levels due to homicide rates. Despite being notable political centers of power, these homicide rates detract from the political capital factor scores of these urban counties.

Social capital in the New England region is average, with high factor scores in rural parts of Maine, Vermont, and New Hampshire and less so in more urban counties of Massachusetts, Connecticut, and Rhode Island. Membership in labor organizations, business organizations, social organizations, and professional associations are high in this region. Religious organizations are high in number due to large, diverse populations in the region. The region does have historically religious roots originating from the original settlers escaping religious persecution in Europe, however the region has been supplanted by the Southeast region as 'the Bible Belt' of America. Urban counties, while having numerous facilities and organizations, still tend to rank lower than rural counties in terms of social capital. This may be due to urban counties still requiring even more institutions to properly serve their dense populations.

Cultural capital in the New England region very high and some of the highest in the nation. Many counties, such as those serving Boston, are cultural hubs for music, acting, and other entertainment industries. While the New England region pales in comparison to the cultural clout of the Mideast and Far West regions, New England still attracts creative people in pursuit of arts and humanities. Due to the region's high comparative wealth, these affluent populations have more disposable income to spend on activities such as fine arts, concerts, and other expressions. Like the Mideast region, this disposable income becomes salaries for these artists and musicians and helps spur a creative scene in the region. However, rural, less-populated counties in Maine and New Hampshire have lower factor scores. These counties may be more focused on other capitals and thus cultural capital may not be as highly valued their urban counterparts.

Human capital in the New England region is some of the highest in the whole nation thanks to its extensive network of higher education institutions and quality healthcare. Like the Mideast region, the New England region contains some of the most prestigious colleges and universities both in the United States and the world, notably a portion of the Ivy League colleges as well as other well-renown state and public institutions. These high education attainment levels are directly associated to the number of high-skill, high-paying occupations commonly found in the region, such as those in the financial and technology sectors. We also see some lower levels of health issues in areas such as diabetes and mortality. One reason is that the region produces high quality medical knowledge and medical care, allowing the population to seek advanced treatments that may not be accessible elsewhere. However, while the region is noted for being affluent, it also has a substantial low income population that may be more susceptible to high health care costs and higher number of ailments than high income populations.

6.3 DEA Results

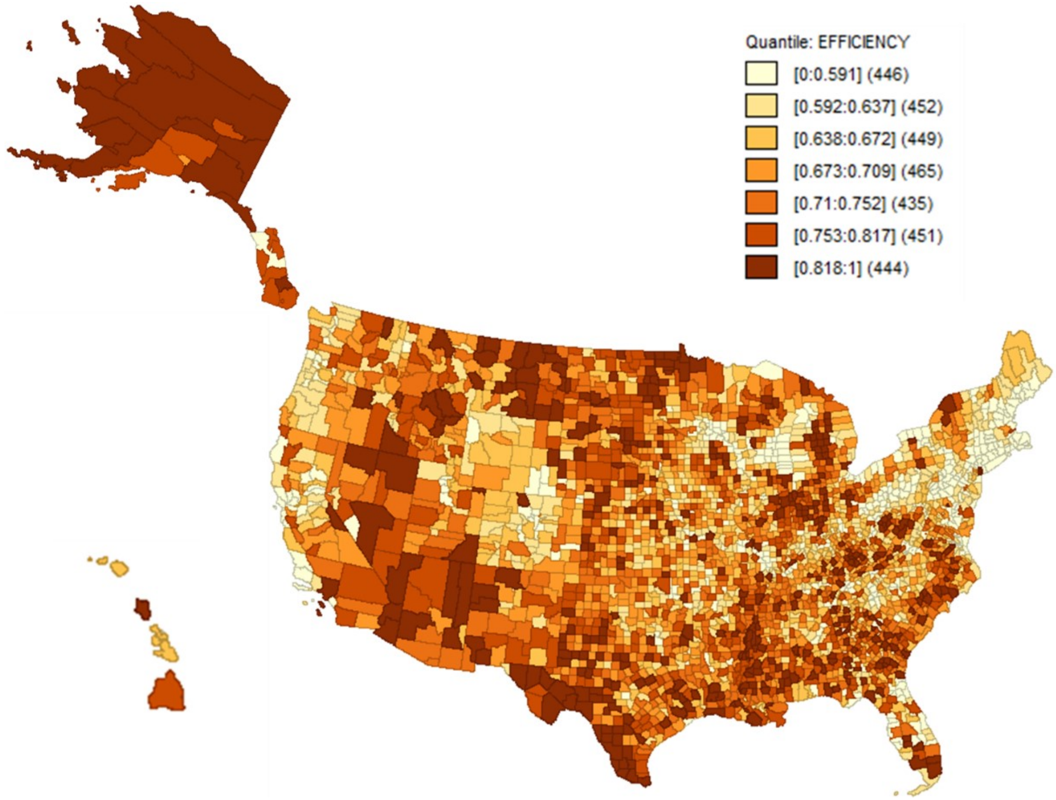

Figure 5 – DEA efficiency scores for US counties and county equivalents

Given our community capital factor scores, we see many patterns with efficiency levels in the United States, with notable patches of inefficiency—levels around 0.60 or below—in the Mideast and New England regions. We also see some inefficient areas in the coastal parts of the Far West region, the Colorado-Wyoming area of the Rocky Mountains region, and parts of Florida in the Southeastern region. Other areas of inefficient counties are scattered throughout the nation. Meanwhile, we see that some of the most efficient counties are often located in urban counties of the US. This does not come as a surprise as Raab and Lichty (1997) already stated that urban counties would have higher efficiency rates. Urban counties, such as Los Angeles County and the counties of New York City, tend to have high population densities and thus necessitate high levels of physical, political, social, and human capital. However, there are many rural counties also having high efficiency values, notably those in Southeast, Plains, Rocky Mountains, and Far West regions of the country.

One may initially interpret the efficiency results such that some counties are generally much more efficient at converting capital resources into economic output than other counties that may appear to be wasteful due to their low efficiency scores. Rural counties tend to be less endowed and thus must be able to convert their available capital resources efficiently to have any opportunity to increase economic output. Some dense, urban counties may also have this issue. While some of these urban counties tend to have high capital endowment, the sheer density and heterogeneity of their populations are taxing for these counties and thus must be incredibly efficient to properly serve their entire populations. Notable efficient examples include rural counties such as Macon County, Alabama and highly urbanized counties such as Los Angeles County, California where efficiency scores are at 1.00. This interpretation does have some merit, but such conclusions over-simplify the nature of efficiency and lack depth as to why the results are behaving as such.

The more comprehensive way to interpret the results deals with an issue of resiliency. Resiliency in terms of economic development is how well a community or region can sustain an exogenous economic shock and still maintain economic output levels. The results from the DEA tend to show that counties with less efficiency are generally more resilient, a scenario that Singh (1986) proposed. More so, it seems that wealthy, high economic output counties tend to be some of the least efficient counties in the nation. It may seem odd, but counties with such inefficiencies may actually be better positioned to cope with negative changes in economic conditions. Wealthy, high-GDP counties can afford to be inefficient due to their high endowment of capital resources. These counties use this extra endowment as reserve capital resources. In times of recession or other negative economic shocks, these counties can become more efficient and better utilize these reserve resources to weather adverse economic conditions and maintain current economic output. Notable examples of this include the majority of counties in the Mideast and New England region with low efficiencies but high capital endowment in general.

This same logic can be applied on the inverse towards counties that are already highly-efficient. Many of these highly efficient counties are either largely rural, low-population counties with limited resources to serve their populations, or major urban counties that may have large resource endowments but due to the strain of large populations, these urban counties comparatively have inadequate resources to truly serve the entirety of their population. This can prove troublesome in negative economic shocks as these counties, which are already producing at max efficiency just to produce day to day, may now see their economic output decrease due to lack of available capital resources. This should not be surprising as economic shocks have historically had much more pronounced ramifications in counties where resource efficiency is already maxed. Urban examples such as Wayne County, Michigan—home to Detroit—have seen their economic environments deteriorate to points where economic output has severely decreased and capital resources have also decreased as a result of 'spiraling-down' as described by Emery and Flora (2006).

Chapter 7 – Summary and Conclusion

It is important to note that this research has its implications and limitations. The obvious implication of this research is that county officials will now have better metrics to judge capital performance and efficiency. Constructing the data results into a figure such as Figure 4 can allow for quick, easy interpretation of the data and show how the performance of a county or region compares to others within a defined geography. Officials can then determine funding needs for these capitals and identify capitals that need improvement. Officials can delve even further into the individual manifest variables within each capital and develop strategies on how to increase or decrease values for certain variables such as education attainment levels and homicide rates respectively. Such strategies can focus on the factor loadings of each manifest variable within the factor score. Changes in one manifest variable may have more influence on the capital factor score than another manifest variable, thus prioritizing which variables to alter, given a constraint such as budget or time, becomes critical in any strategy. This research also helps quantify some of the more ambiguous capitals, notably social and cultural capital, where measurement of capital performance was difficult before DEA and community capitals framework usage.

For county officials and economists, the issue of resiliency and efficiency is a double-edged sword. While a highly-efficient county can convert its capital inputs into GDP output effectively, such a county may not be resilient in the face of exogenous shocks. The county could ultimately see GDP output fall if it were unable to meet the demands of its population should such an unfavorable economic climate occur. Likewise, wealthy yet inefficient counties have the potential to scale up capital resource conversion efficiency should a negative economic shock occur may be more resilient but may have to sacrifice potential GDP output gains in the present for security gains in the future. Such an economic policy, while safe, may be unpopular among the county citizens who may want to see greater GDP growth now to fund better infrastructure and services. This research hopefully makes such decisions easier to make by providing empirical evidence to support any given side of the efficiency and resiliency issue.

However, there are some limitations to this study that need to be addressed. Because DEA is a relative study, changes to the selected geography and latent/manifest variables can alter DEA efficiency results considerably. For example, when the number of counties in a study are constricted to a single state, DEA efficiency scores tend to change because the construction of the DEA frontier is only considering the counties with that particular state, not all other states in the nation or region. Thus, a statewide DEA study may identify a county as the most affluent and possibly the least efficient, but that same county, if the study is expanded on a national basis, may conclude that this county is now one of the least affluent and possibly one of the most efficient counties in the nation. One possible avenue for future research would be developing state models of DEA efficiency within a community capitals framework and compare the results to this study in this thesis. Such a statewide study would essentially be blending our research with that of Raab and Kotamraju (2006); applying their statewide DEA study within our community capitals framework.

Another issue with this study is sensitivity of the manifest variables. Factor analysis and DEA are only responsive to what manifest and capital latent variables are included in the analysis; it cannot calculate the effects of non-included variables. Thus, the choice of these variables becomes critical to the researchers and needs considerable thought and acknowledgement of past literature. Even then, some important, influential manifest variables may have been omitted; one possible influential manifest variable omitted from this study was mineral and natural resource reserves, most notably oil and natural gas. Including these variables may now greatly alter the results for some of the capital latent variables.

There is also the sensitivity issue of under which latent variable to insert a manifest variable. Including a manifest variable in one capital versus another capital could also greatly impact the results of the study. To demonstrate this, let us conduct our own sensitivity analysis of relocating one manifest variable, homicide rates, from political capital to social capital. Results of the factor scores looking only at social capital are shown as followed:

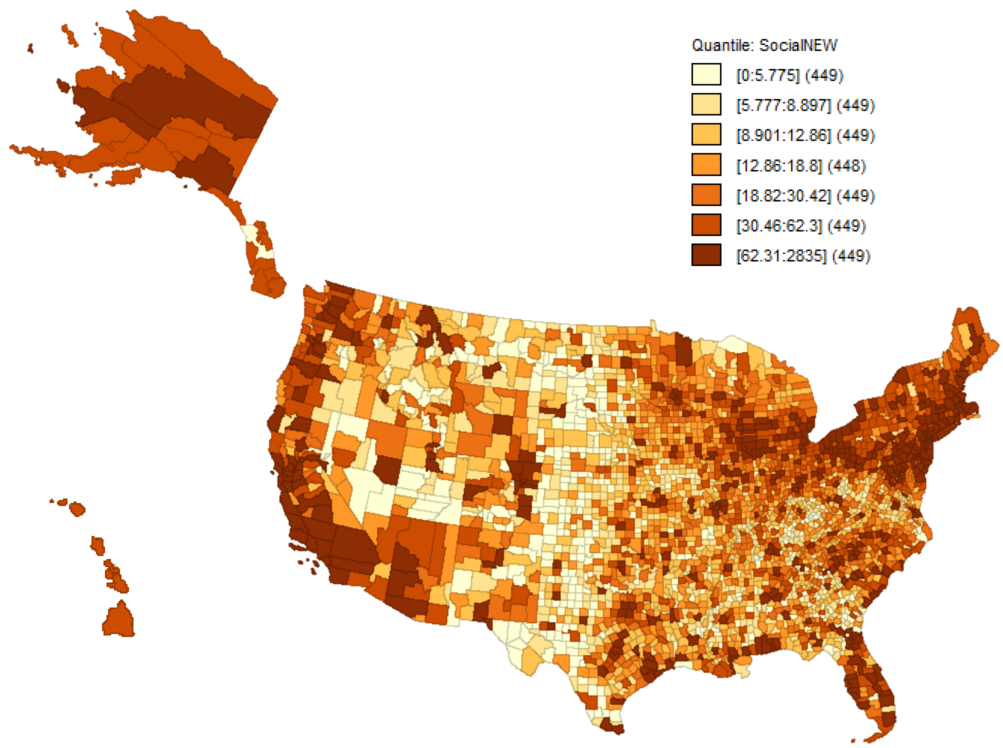

Figure 6 – Alternative social capital factor scores for US counties and county equivalents when homicide rate is added

When comparing Figure 6 to the original study's social capital factor scores found in Figure 11 in the Appendix, we see a substantial change in the maps. The original map for social capital factor scores has major clustering of high social capital factor scores in the Plains region, specifically Iowa and surrounding states such as Minnesota and some of the Dakotas. However in this new map above, we see a completely different picture with social capital now concentrated along the coasts of the US, specifically the Mideast, New England, and Far West regions. Also interesting is that the Plains region now has some of the relatively lowest factor scores for social capital. What is important to note that this is just *one* manifest variable that changed which capital latent variable it was described under; changing many of manifest variables and under which latent variables they lie can cause profound alterations to the results. Identifying which manifest variables should be under what capital manifest variables is critical and future research to develop such a template would be beneficial.

In conclusion, while there are some major limitations to the study requiring more research, we hope this research has at least laid the groundwork for better understanding of economic development in the US. By structuring this research in a community capitals framework and conducting DEA to produce efficiency levels, the hope is that county officials will now have better information about their counties and can decide how improve the economic output for their counties.

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Appendix

Summary Statistics and Figures

REGIONS	FACTOR SCORES AND DEA EFFICIENCY VALUES						
AVERAGE	***PHYSICAL***	***NATURAL***	***POLITICAL***	***SOCIAL***	***CULTURAL***	***HUMAN***	***EFFICIENCY***
Far West	0.15284	7.90104	0.21050	9.91988	103219.01486	0.04101	0.70045
Rocky Mountains	0.11938	7.51312	0.23030	11.14537	22254.91187	0.04302	0.69654
Southwest	0.15482	6.70500	0.18864	9.47471	30763.41323	0.02961	0.74495
Plains	0.17980	4.32952	0.24698	14.26528	12930.06039	0.03933	0.71304
Southeast	0.26855	5.00492	0.18876	9.59153	24167.83158	0.02633	0.70710
Great Lakes	0.26350	3.58019	0.23182	12.09440	39773.15661	0.03623	0.69878
Mideast	0.38026	4.91845	0.20886	10.42298	99980.43478	0.03884	0.61714
New England	0.33744	5.76469	0.23543	11.39540	99557.05143	0.04315	0.55293
MEDIAN	***PHYSICAL***	***NATURAL***	***POLITICAL***	***SOCIAL***	***CULTURAL***	***HUMAN***	***EFFICIENCY***
Far West	0.13030	7.41196	0.21724	10.50388	13312.10000	0.04052	0.68300
Rocky Mountains	0.10754	7.48467	0.23123	10.80179	3030.50000	0.04219	0.67950
Southwest	0.14248	6.38738	0.18861	9.24008	4281.10000	0.02895	0.72800
Plains	0.16992	4.26346	0.24983	13.98088	2828.65000	0.04026	0.70000
Southeast	0.22859	4.86290	0.19138	9.54405	5642.70000	0.02605	0.69600
Great Lakes	0.24558	3.44476	0.23165	12.15062	10290.80000	0.03598	0.68400
Mideast	0.32675	5.07597	0.21411	10.74523	31280.42000	0.03890	0.60800
New England	0.32438	5.60299	0.23866	11.31400	36744.63800	0.04449	0.54900
MAXIMUM	***PHYSICAL***	***NATURAL***	***POLITICAL***	***SOCIAL***	***CULTURAL***	***HUMAN***	***EFFICIENCY***
Far West	1.97013	13.01504	0.29262	17.56820	3695431.80000	0.06208	1.00000
Rocky Mountains	0.59108	11.72734	0.30605	21.69479	507624.10000	0.06356	1.00000
Southwest	0.53481	11.99618	0.55655	26.75175	1473239.80000	0.05580	1.00000
Plains	1.35551	7.95587	0.31738	31.62356	717427.60000	0.05968	1.00000
Southeast	1.43235	9.63858	0.27024	18.32623	798124.60000	0.05419	1.00000
Great Lakes	1.09131	6.66282	0.30870	18.65170	2250066.80000	0.05453	1.00000
Mideast	1.68281	6.75417	0.29781	17.22439	1237653.80000	0.05118	1.00000
New England	1.00520	7.58801	0.28770	17.10385	1000356.80000	0.05424	0.76000
MINIMUM	***PHYSICAL***	***NATURAL***	***POLITICAL***	***SOCIAL***	***CULTURAL***	***HUMAN***	***EFFICIENCY***
Far West	0.00000	3.38533	0.10216	0.00000	341.40000	0.02377	0.42100
Rocky Mountains	0.01073	2.25015	0.14745	5.71213	0.00000	0.01422	0.44300
Southwest	0.02610	3.74584	0.07916	1.65024	26.40000	0.01260	0.51300
Plains	0.05969	0.00000	0.06557	6.15200	14.00000	0.00084	0.43400
Southeast	0.06379	1.18609	0.00000	1.93142	243.30000	0.00000	0.44100
Great Lakes	0.07358	0.08735	0.11254	3.88745	551.60000	0.01706	0.45300
Mideast	0.09493	2.01584	0.00870	2.32516	944.50000	0.02404	0.47900
New England	0.11145	4.01267	0.12133	5.94345	1236.20000	0.02966	0.43400
VARIANCE	***PHYSICAL***	***NATURAL***	***POLITICAL***	***SOCIAL***	***CULTURAL***	***HUMAN***	***EFFICIENCY***
Far West	0.02969	4.71881	0.00110	5.98533	1.15129E+11	4.18E-05	0.01527
Rocky Mountains	0.00409	2.87881	0.00067	8.08101	4649548089	5.10E-05	0.01109
Southwest	0.00392	1.98660	0.00149	8.22633	17037051804	5.35E-05	0.01034
Plains	0.00831	1.73942	0.00076	9.03371	2464797916	6.37E-05	0.00922
Southeast	0.02836	1.44708	0.00104	3.64428	4903807998	5.36E-05	0.01143
Great Lakes	0.01306	1.50514	0.00071	3.20175	17928769441	3.31E-05	0.01254
Mideast	0.05345	0.82875	0.00104	3.76539	27672167065	2.71E-05	0.00868
New England	0.02107	0.71884	0.00055	2.71905	25883650037	2.95E-05	0.00555
ST. DEVIANCE	***PHYSICAL***	***NATURAL***	***POLITICAL***	***SOCIAL***	***CULTURAL***	***HUMAN***	***EFFICIENCY***
Far West	0.17232	2.17228	0.03322	2.44649	339306.51620	0.00647	0.12357
Rocky Mountains	0.06396	1.69671	0.02581	2.84271	68187.59483	0.00714	0.10533
Southwest	0.06264	1.40947	0.03858	2.86816	130526.05795	0.00731	0.10166
Plains	0.09118	1.31887	0.02765	3.00561	49646.73117	0.00798	0.09603
Southeast	0.16840	1.20295	0.03222	1.90900	70027.19470	0.00732	0.10689
Great Lakes	0.11427	1.22684	0.02669	1.78934	133898.35488	0.00576	0.11200
Mideast	0.23120	0.91036	0.03224	1.94046	166349.53281	0.00521	0.09317
New England	0.14514	0.84784	0.02352	1.64895	160883.96451	0.00543	0.07449

Figure 7 – Summary Statistics of Capital Factor Scores and DEA Efficiency Scores

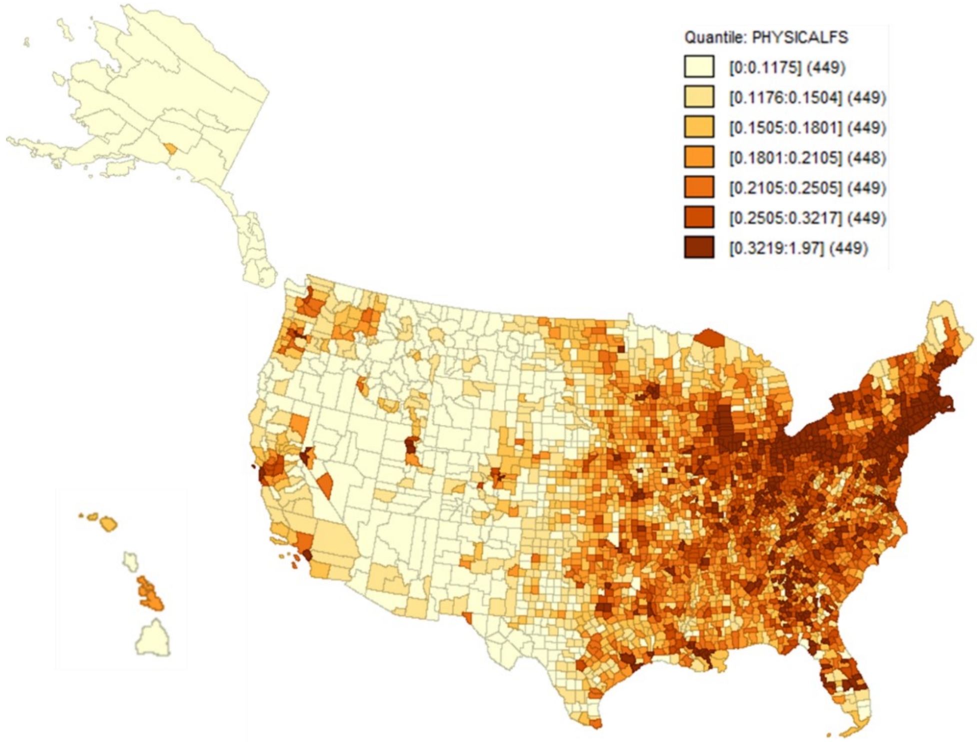

Figure 8 – Physical capital factor scores for US counties and county equivalents

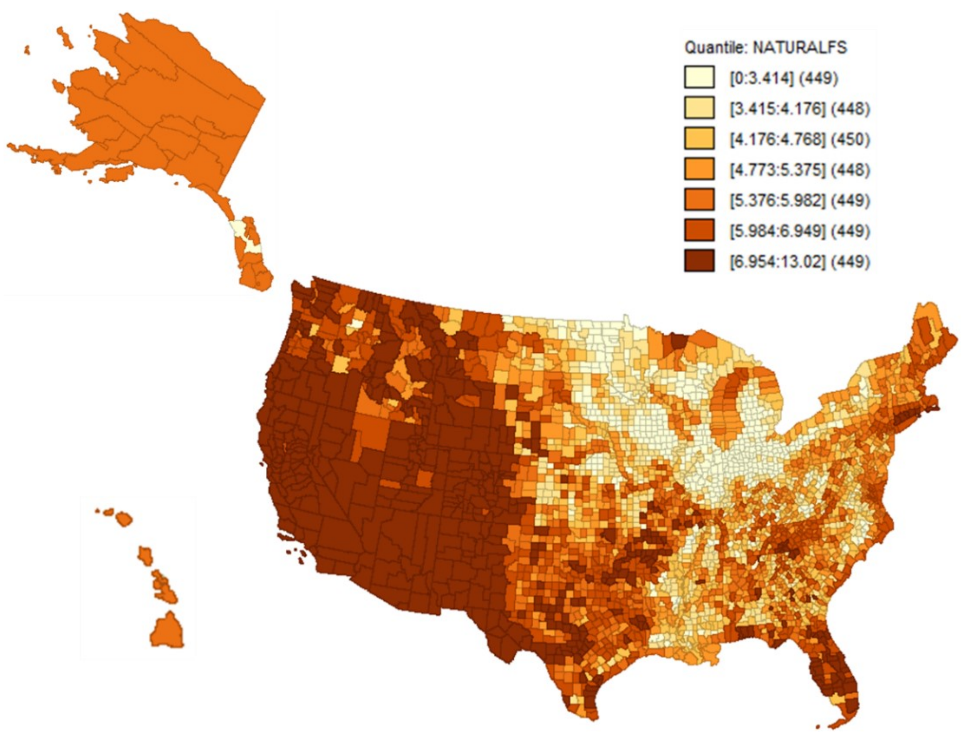

Figure 9 – Natural capital factor scores for US counties and county equivalents

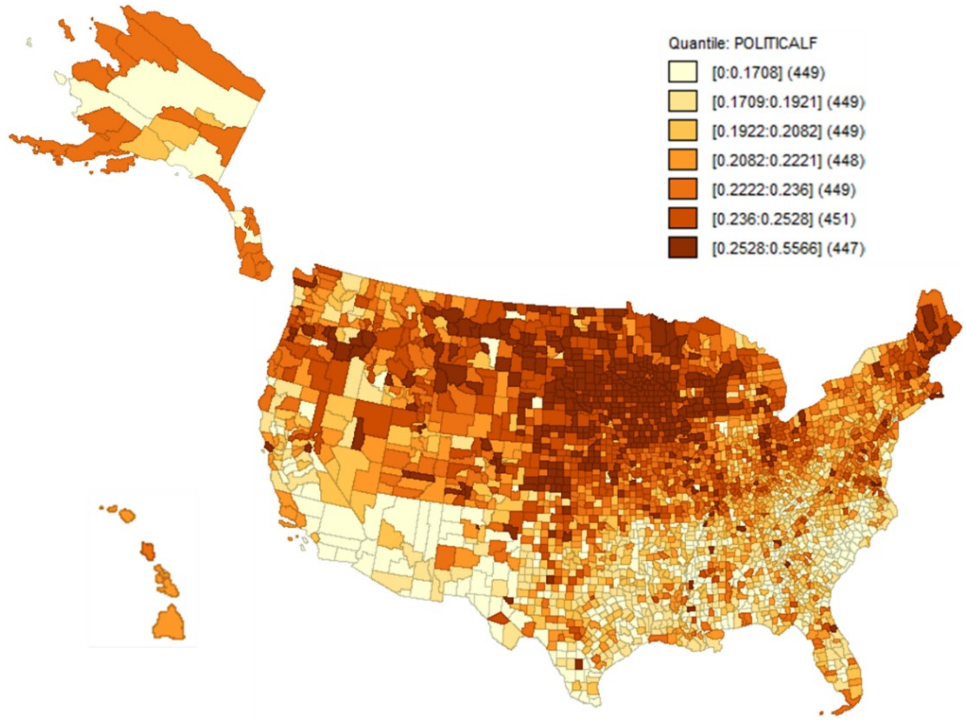

Figure 10 – Political capital factor scores for US counties and county equivalents

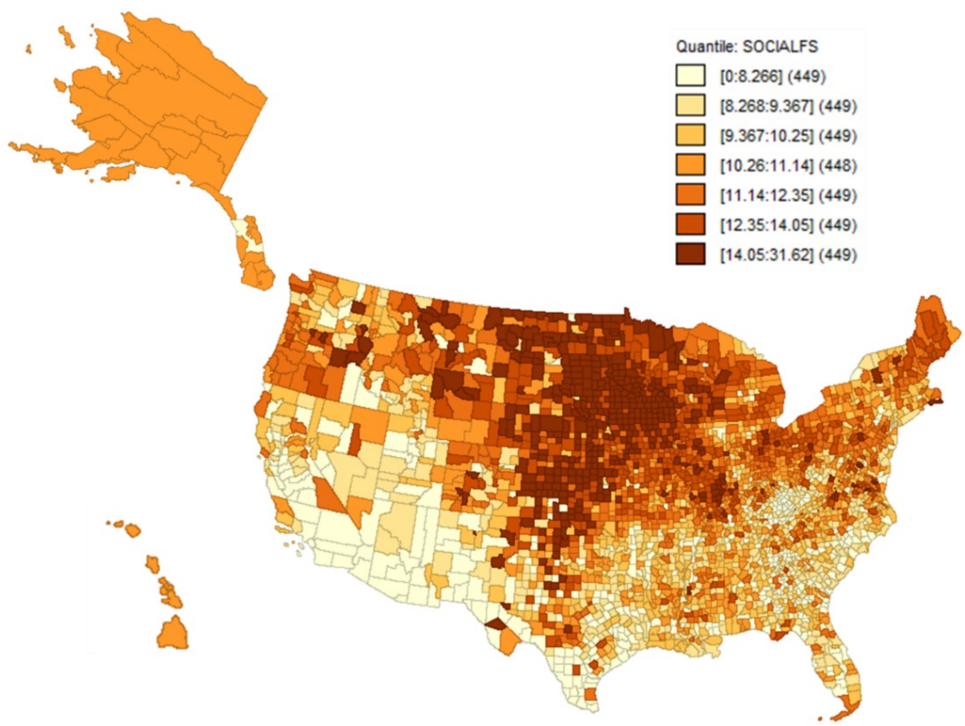

Figure 11 – Social capital factor scores for US counties and county equivalents

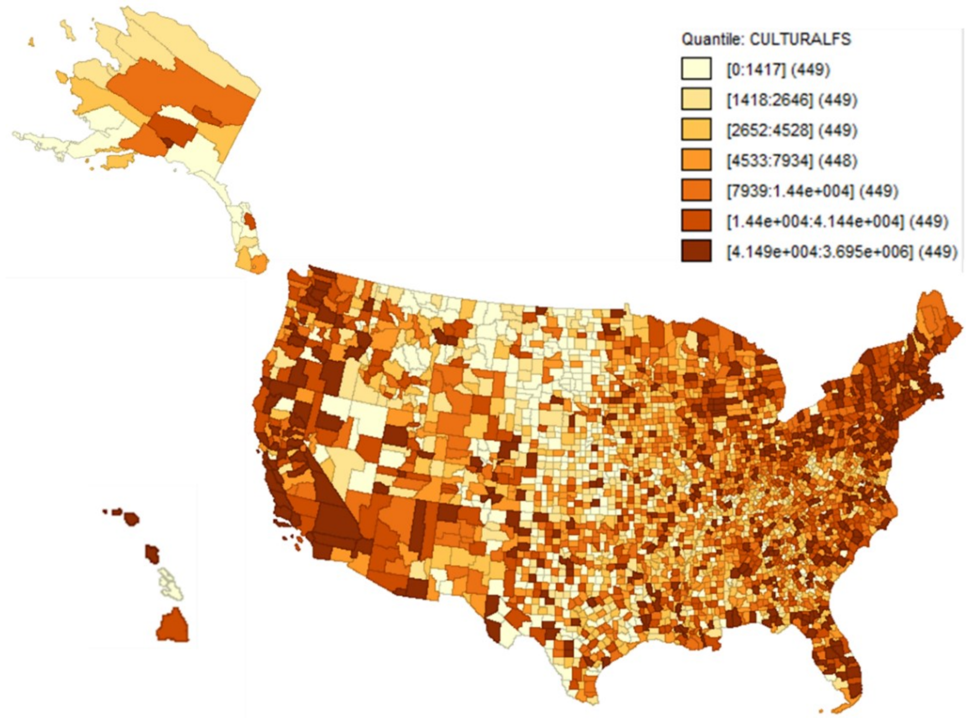

Figure 12 – Cultural capital factor scores for US counties and county equivalents

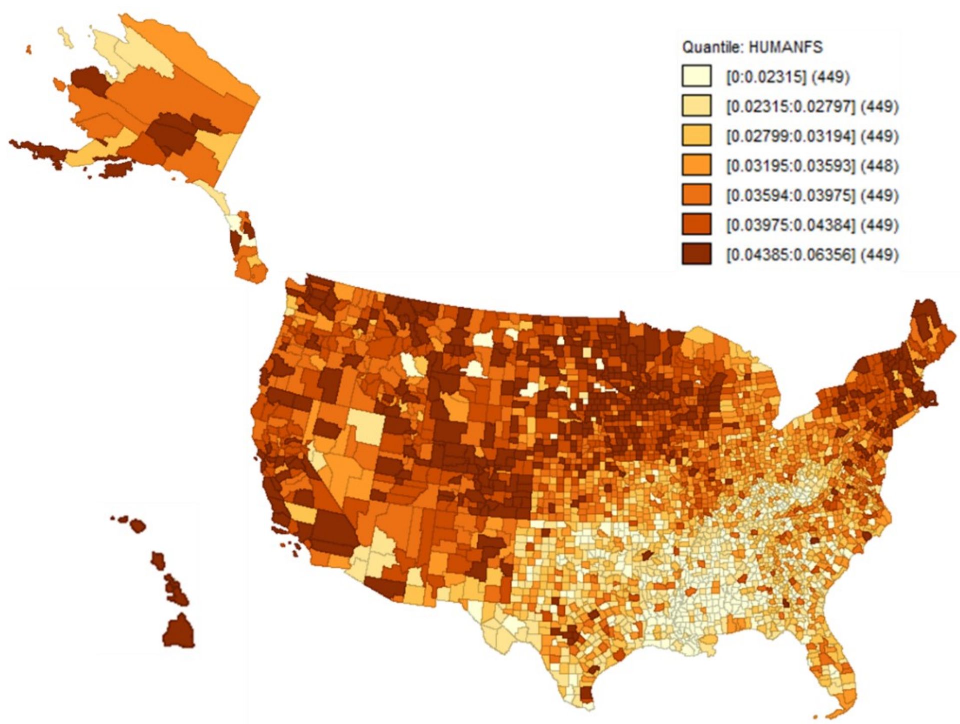

Figure 13 – Human capital factor scores for US counties and county equivalents