THE NEXUS OF PLACE AND FINANCE IN THE ANALYSIS OF EDUCATIONAL ATTAINMENT: A SPATIAL ECONOMETRIC APPROACH

by

Farah Sutton

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF EDUCATIONAL POLICY STUDIES AND PRACTICE

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY
WITH A MAJOR IN HIGHER EDUCATION

In the Graduate College

THE UNIVERSITY OF ARIZONA

2012

THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

As members of the Dissertation Committee, we certify that we have read the dissertation

prepared by Farah Sutton

entitled The Nexus of Place and Finance in the Analysis of Educational Attainment: A Spatial Econometric Approach

and recommend that it be accepted as fulfilling the dissertation requirement for the

Degree of Doctor of Philosophy.

____ Date: 07/12/2012
Regina Deil-Amen

____ Date: 07/12/2012
Cecilia Rios-Aguilar

____ Date: 07/12/2012
Sandy Dall'Erba

Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

____ Date: 07/12/2012
Dissertation Director: Regina Deil-Amen

STATEMENT BY AUTHOR

This dissertation has been submitted in partial fulfillment of requirements for an advanced degree at the University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this dissertation are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the copyright holder.

SIGNED: Farah Sutton

ACKNOWLEDGMENTS

Thank you to everyone who has helped me during my educational journey. Thank you to all of the professors I have had over the years and the friendships I developed along the way. A special thanks to Regina Deil-Amen, my mentor and advisor. You have been there and supported my doctoral endeavors from my first week in the program. Thank you to my committee members Regina Deil-Amen, Cecilia Rios-Aguilar and Sandy Dall'Erba, my dissertation is stronger because you continuously worked with me and pushed me to go further.

Thank you to my family – my parents, Debbie and Larry, and my grandparents, JoAnn and Dennis – for being there to encourage and support me through everything.

Most importantly, thank you to Kylee. You have inspired and motivated me. I recognize all of the sacrifices you have had to endure along this journey. For your unwavering love and confidence in me, I am forever grateful.

DEDICATION

This dissertation is dedicated to my family.

To Kylee, for inspiring me to be a better person;

to my parents, for your endless encouragement, motivation and support;

to my grandparents, for your understanding and compassion;

to Dan, for your reassurance;

I dedicate this all to you.

Thank you for all that you do.

TABLE OF CONTENTS

LIST OF TABLES 9
LIST OF FIGURES 11
ABSTRACT 13
CHAPTER ONE: INTRODUCTION 14
The Need for Educational Attainment 14
Education and Geography 15
Purpose and Significance 20
Organization of the Study 22
Summary 23
CHAPTER TWO: REVIEW OF THE LITERATURE 24
Spatial Analysis: An Overview 24
Spatial Relationships 29
GIS: History 31
The Science of Geographic Information 32
GIS Software 34
Spatial Analysis in Education Research 35
Educational Attainment 37
Determinants of Educational Attainment 40
Summary 54
CHAPTER THREE: CONCEPTUAL FRAMEWORK 55
Geography of Opportunity 55
Geography and Educational Opportunity 57
Comprehensive Economic Framework for Educational Attainment 60
An Integrated Framework 62
Summary 65
CHAPTER FOUR: RESEARCH METHODS 67
Data 67
Measures 70

Dependent variable 70
Independent variables 72
Data Analysis 80
Spatial Analysis 80
Regression Analysis 84
Limitations of this Study 88
CHAPTER FIVE: FINDINGS 90
Research Question 1: The Spatial Patterns of Educational Attainment 90
Spatial Patterns of the Independent Variables 104
Spatial Patterns of Allocation of Funds 104
Spatial Patterns of Economic Indicators 109
Spatial Patterns of Industry 113
Spatial Patterns of HS Diploma and Higher Education Institutions 117
Spatial Patterns of White Population 121
Research Question 2: The Relationship between Educational Attainment, Allocation of Funds and Economic Indicators in a Spatial Context 123
Classic Linear Regression 124
Spatial Autoregressive Models 131
Summary of Findings 141
CHAPTER SIX: DISCUSSION AND IMPLICATIONS 143
Research Question 1 Discussion 143
Spatial Distribution of Educational Attainment 146
Spatial Patterns of Allocation of Funds 150
Spatial Patterns of Economic Indicators 151
Spatial Patterns of Industry 152
Spatial Patterns of HS diplomas, White Population and Quantity of Institutions 152
Relation to the Geography of Opportunity 153
Research Question 2 Discussion 157
How the Conceptual Framework Guides Question 2 157

Factors Impacting Educational Attainment 157

Classic Linear Regression Model v. Spatial Lag Model v. Spatial Error Model 164

Implications and Contributions 165

Directions for Future Research 168

APPENDIX A: RESULTS USING FEDERAL FUNDS PER FTE 171

APPENDIX B: RESULTS USING VARIOUS SPATIAL WEIGHT MATRICES 178

REFERENCES 191

LIST OF TABLES

Table 1. List of Independent Variables 78

Table 2 Descriptive statistics for the variables used for the analysis of educational attainment model.. 79

Table 3. Lowest 12 states for percent of the workforce with a bachelor's degree or higher in 2009, contiguous extent of the United States.. 92

Table 4. Highest 12 states for percent of the workforce with a bachelor's degree or higher in 2009, contiguous extent of the United States.. 93

Table 5. Spatial Weight Matrix and Moran's I statistics for the percent with a bachelor's degree or higher in 2009. 95

Table 6. Definitions of the 4 Quadrants in the Moran's Scatterplot 98

Table 7. Local Spatial Autocorrelation. 101

Table 8. Moran's I statistics for the funds allocated by U.S. Department of Education to postsecondary education and state appropriations to higher education per FTE in 2007........... 108

Table 9. Moran's I statistics for the spatial distribution of median family income and poverty level in 2007.. 112

Table 10. Moran's I statistics for the spatial distribution by industry type in 2007. 114

Table 11. Moran's I statistics for the spatial distribution of the percent of the workforce with a high school diploma or equivalent in 2004, the ratio of the workforce population to the number of higher education institutions in 2007 and the percent of the population that was white, non-Hispanic in 2007. 118

Table 12. Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, classic regression model 128

Table 13. Diagnostics for Spatial Dependence 132

Table 14. Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, spatial lag model 136

Table 15. Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, spatial error model 137

Table 16. Comparison of the AIC and SC for the classic regression and spatial lag models..... 138

LIST OF FIGURES

Figure 1. Map of the contiguous United States. 69

Figure 2. States with a 10% or greater difference between bachelor's degree or higher and bachelor's degree only. 71

Figure 3. Spatial Distribution of the Percent of the Workforce with a Bachelor's Degree or Higher in 2009. 91

Figure 4. Moran's Scatterplot of the percent of the workforce with a bachelor's degree or higher in 2009 using the K-Nearest Neighbors spatial weight matrix, with k = 4.................................. 99

Figure 5. LISA Cluster Map for the percent of the workforce with a bachelor's degree or higher in 2009. 102

Figure 6. Spatial Distribution of the U.S. Department of Education Funds allocated to the States in 2007 Divided by the Workforce Population of the State in 2007.. 106

Figure 7. Spatial Distribution of the State Appropriations to Higher Education per Full-Time Equivalent (FTE) in 2007. 107

Figure 8. Cluster Map of the Median Family Income in 2007. 110

Figure 9. Cluster Map of the Poverty levels in 2007. 111

Figure 10. Cluster Map of the Share of Workers in a Goods-producing Industry in 2007. 115

Figure 11. Cluster Map of the Share of Workers in the Information and Communication Technology Industry in 2007. 116

Figure 12. Cluster Map of the Percent of the Workforce with a High School Diploma or Equivalent in 2004. 119

Figure 13. Cluster Map of the Population per Higher Education Institution in 2007. 120

Figure 14. Cluster Map of the Percent of the Population that is White, non-Hispanic in 2007. 122

Figure 15. Cluster Map of the Classic Linear Regression Residuals. Blue indicates statistically significant clusters of over-prediction. Red indicates significant clusters of under-prediction.. 130

Figure 16. Cluster Map of the Spatial Lag Model Regression Residuals. Blue indicates statistically significant clusters of over-prediction. Red indicates significant clusters of under-prediction. 140

ABSTRACT

This study examines the spatial distribution of educational attainment and then builds upon current predictive frameworks for understanding patterns of educational attainment by applying a spatial econometric method of analysis. The research from this study enables a new approach to the policy discussion on how to improve educational attainment for the states and nation; a dialogue where states are viewed not as independent, isolated observations but as a part of a larger system or cluster of observations.

This research utilized data from the U.S Census Bureau, American Community Survey of 2009 and examined the percent of the workforce population with a baccalaureate or higher degree. Exploratory spatial data analysis was conducted to study the spatial distribution of educational attainment. Based on initial results, both classic linear regression and spatial autoregressive models were used.

The findings from this study indicate that educational attainment is spatially dependent and furthermore, the consideration of the spatial context through spatial autoregressive models can provide greater insight and understanding into educational attainment. This research was able to distinguish significant geographic location effects on educational attainment from funding, economic and industry effects. In particular, spatial concentration of educational attainment was proven to be significant. Several important policy implications were derived from these findings. These policies relate to the following issues: a) allocation of funds to postsecondary education, b) consideration and promotion of industry, and c) acknowledging spillover effects from adjacent states.

CHAPTER ONE: INTRODUCTION

The Need for Educational Attainment

At no other time in history has the attainment of education, a proxy for knowledge, been so closely linked to the economic well-being of individuals, communities and states. The opportunity to compete economically in today's world market largely depends on the postsecondary education of a country's population (Lingenfelter, 2010; Lee, Edwards, Menson & Rawls, 2011; Cheah, 2010). The proliferative need for a knowledge-based economy is moving the nexus value of educational attainment beyond a personal benefit to an essential factor for the economic sustainability of communities, states and even nations.

Perhaps, a more profound economic transition than the industrial era, the technological and information age of the twenty-first century has radically redefined what is considered a 'valued workforce' not just in the U.S. but globally (Scott, 2008). Modern economies are predominately knowledge-based service economies (Cheah, 2010). Specifically, over the last thirty years the global service sector has developed from approximately fifty-five percent to seventy percent of the total world economy (Claessens, Evenett, & Hoekman, 2010). The global service sector encompasses jobs that produce services and intangible goods, as opposed to products produced by the industrial/manufacturing sector.

Over the last three decades, the repositioning of America's economy and workforce from skilled-labor manufacturing to a knowledge-based service economy has left many unprepared. However, the imperative call for increased education attainment has not been effectively realized, even though the United States has some of the best higher education institutions that produce a significant portion of the world's college educated individuals (Lee et al., 2011; Matthews, 2010). The current challenge of inadequate bachelor degree attainment numbers is less a matter of access but completion (Goldrick-Rab, 2008). The United States' postsecondary education attainment needs cannot be mitigated by a refocus toward manufacturing since the sector share is no longer substantial enough to offset employment needs (Claessens, Evenett, & Hoekman, 2010). Automation and innovation have improved the volume of mass production while reducing the number of workers needed.

Modern manufacturing requires an ample supply of knowledge service workers in a variety of fields from informational technology to financial services. In addition, Carnevale, Smith and Strohl (2010) forecast that there will be openings in the service sector for 16.9 million individuals with at least a bachelor's degree by 2018. They estimate that this demand for college-educated workers will outpace supply by 300,000 per year. As a result, by 2018 it is projected that there will be a 3 million college graduate deficit as necessitated by the labor market (Claessens, Evenett, & Hoekman, 2010). Consequently, there truly is no way of avoiding the need to improve educational attainment in the twenty-first century economy (Claessens, Evenett, & Hoekman, 2010; Lee et al., 2011).

The federal government has made substantial financial investment in the country's higher education system since the mid-twentieth century with regard to college access (Goldrick-Rab, 2008). It is essential that successful policies for attainment be explored and replicated, since solely increasing access to higher education is not going to address this shortfall as fewer students are completing the bachelor's degree in four years as compared with previous decades (Astin & Oseguera, 2002; Bautsch & Williams, 2010).

Education and Geography

Postsecondary educational attainment is critical to a robust national economy (Matthews, 2010; Lingenfelter, 2010). Therefore, various education foundations and associations as well as state and federal government leaders are striving to increase the percent of the American workforce with postsecondary degrees or credentials (Matthews, 2010). The economic well-being of states and communities is dependent on the education of their citizenry (Cheah, 2010). "The states with the highest per capita income and the states with the strongest, most resilient economies have the highest percentage of citizens with a baccalaureate degree" (Lingenfelter, 2010, p. 2). Significantly increasing educational attainment for the American work force is ultimately necessary to sustain the standard of living in the United States throughout the twenty-first century (Hauptman & Kim, 2009; Goldrick-Rab, 2008). The Lumina foundation makes a strong case for a goal of sixty percent of the population to possess a quality higher education degree or credential to meet the employment needs of the United States (Matthews, 2010). The maps in the Lumina report (Matthews, 2010) display regional clustering of educational attainment. These findings show that the south and largely rural areas have the lowest educational attainment levels. These visual findings suggest assessing the postsecondary educational attainment distribution geographically within the state and its interdependence with neighboring states, relative to economic variables and funding may be a valuable early step to spotlight gaps for optimal effectiveness. The acknowledgement that geography matters and an understanding of geographical differences and disparities is vital in the development of a national strategy for change and improvement (Metcalfe, 2008).

Geography matters in virtually every aspect of social demographics from market success (Redding, 2003) to health conditions (Chan-Yeung et. al., 2005) to education attainment (Tate, 2008; Waldorf, 2007). The different and varying geographic location influences the outcomes of the variables across a variety of social sciences. In addition, the locational proximity (or geographic closeness), influences neighboring observations. In other words, geographic proximity matters in the various studies across the social sciences. Therefore, the importance of geography in the research process is undeniable. Redding's (2003) innovative study regarding economic development and market access and Tate's (2008) paper regarding the geography of opportunity form the basis of this study. Redding (2003) found that there is less incentive to be highly educated in remote areas that are on the periphery (as opposed to the core) of economic trade. Redding's (2003) findings means that if there is limited market access, there will be fewer individuals that attain higher levels of education. This notion of uneven opportunity is referred to as the geography of opportunity. The geography of opportunity traditionally addresses the consequences of race and class segregation has on life outcomes (Briggs, 2005). Tate (2008) employed both quantitative and qualitative methodology to see if an uneven geography of opportunity was present in two different metropolitan areas relating to education. Tate's (2008) findings indicate that indeed, there are educational achievement and income disparities geographically. This uneven geography of opportunity is caused by not only physical but also political isolation. Through spatial analysis this dissertation serves to provide a visual illustration of the uneven geography of opportunity that is a factor in education attainment in the United States. Interestingly, the unequal distribution of opportunity is not just a challenge for the United States; international studies replicate the same findings throughout the world in developed as well as undeveloped countries, even countries with relatively high homogenous populations (Redding, 2003; Chan-Yeung et. al., 2005).

Spatial analysis uses techniques that consider geographical area and/or location to analyze data in order to identify and explain patterns and conditions (Openshaw, 1994). Anselin (1999) mentions that there are three key contributions spatial analysis can provide to the social sciences. These contributions include the ability to analyze spatial links and patterns of census data enabling researchers to analyze beyond the aggregate of the entire nation or region; the application of exploratory spatial data analysis (ESDA); and the use of spatial statistical approaches to find more appropriate and functional models, essentially the ability to consider the spatial context of the variables of interest. This enables researchers to consider geographic related factors. As an example, Tate (2008) mentions how communities can be central, yet, isolated because of proximity to public transportation and railways. This study will utilize all three advantages spatial analysis offers for the analysis of educational attainment.

Over the last fifty years the United States has made dramatic investments in higher education and as a result there has been a considerable increase in education attainment (Waldorf, 2007). While 29% of Americans have attained a bachelor degree or higher, this highly educated population is not distributed evenly between states or regions. The spatial variance between the highly educated and those of limited education (high school completion) or the under educated (less than a high school diploma) is substantial and according to research more cumulative with each study. In other words, areas with a highly educated populace continue to draw more of the highly educated; while deficit areas continue to stagnate (Redding, 2003; Waldorf, 2007). As the highly educated continue to migrate toward urban and high density suburban areas with high market access, the regions affected by the so-called “brain drain” are abandoned by the most educated and face economic stagnation and even decline (Redding, 2003; Waldorf, 2007).

This unequal selected migration of the highly educated populace impacts the economic resources and development of a region. A highly educated work force corresponds with higher income jobs, a greater tax base, and less demand on social services. This scenario becomes a sort of micro-boon as more revenue for infrastructure and economic drivers further develop and inspire continued growth creating a microcosm while the rest of the nation may be left economically flat lining or even economically declining. Areas with a highly educated work force reap many benefits for their communities and states. While the reverse is true for areas with limited or undereducated workers; incomes are lower, the tax base is smaller, limited funds are available for infrastructure or economic development, and there are often greater demands on public assistance services.

The field of higher education has produced a number of studies that examine the causes and effects of postsecondary education retention and graduation rates within the United States (Astin & Oseguera, 2002). Studies show that a variety of factors other than cost negatively affect completion rates of higher education (Baum, 2010). Geography is one of those other factors. A broad spectrum of research from a variety of disciplines abounds with data that links geography to higher education levels, employment prospects, and health benefits, to the strength of local and state economies (Redding, 2003; Waldorf, 2007). As a result of modern technology and software applications, data mining and the development of spatial research models, GIS related research has become popular. GIS is defined as Geographic Information Systems (the S can also be short for Sciences). Yet GIS related research has largely concentrated on identifying space as a factor rather than harnessing the analytical capabilities of GIS (Rios-Aguilar, Cantwell, Deil-Amen, & Wissler, 2010; Lee et al., 2011). Very few reports comprehensively analyze information with a spatial focus (Lee et al., 2011). This study uses spatial analysis, classic regression and a spatial autoregressive model seeking to identify spatial patterns in educational attainment for the contiguous United States in order to provide recommendations in to how to better understand the phenomenon of educational attainment.

Purpose and Significance

Traditionally studies modeling educational attainment have analyzed family background and economic inputs (Deil-Amen & Turley, 2007; Conley, 2001). This study will differ in that it will use exploratory spatial data analysis (ESDA) to examine the spatial distribution of the percent of the workforce with a baccalaureate degree or above and then employ spatial econometric analysis through a spatial autoregressive (SAR) model. The utilization of spatial analysis can be used to determine if considering the spatial context in regression and predictive models will provide for a better fit for educational attainment. This is similarly used in other social sciences to improve statistical inferences (Voss, et al, 2006). In essence, this model attempts to capture the geographic clustering of postsecondary attainment in ways that traditional models cannot. Past, quantitative approaches tend to use the geographic boundaries of states in ways that may not be particularly useful for understanding how differences in educational attainment are distributed.

This research will examine the spatial dependence of educational attainment and then build upon current predictive frameworks for understanding patterns of educational attainment. From a policy perspective, the acknowledgement of the spatial dependence of educational attainment beyond state boundaries can push our thinking to consider that perhaps "each state should not be viewed as an independent observation," (Rey & Montouri, 1999) in addressing the phenomenon of educational attainment. Moving forward, education models need to consider the geographic component because as Massey (1984, p.305) stated almost three decades ago though still relevant today is that the "recognition and understanding of geographical variation is essential for any strategy of national political change."

This study will address the following research questions:

1. What are the spatial patterns of the distribution of educational attainment at the state-level for the contiguous United States?

2. How does considering the spatial context of educational attainment influence the relationship between the allocation of federal and state funds, median family income and educational attainment?

   2a. Does a spatial autoregressive model provide improved predictive powers over a classic linear regression model in the analysis of educational attainment?

The purpose of this research was two-fold. The first part of the study examined the spatial dependence of educational attainment. Data was analyzed at the state levels for the contiguous[1] United States. Educational attainment was defined as the percent of the workforce age-eligible (ages 25-64) population with a bachelor's degree or higher level degree (an advanced graduate or professional degree) within a state. Bachelor degree attainment statistics will include individuals with advanced graduate or professional degrees since a baccalaureate degree is a prerequisite to advanced degrees. Exclusion of advanced degree attainment statistics would otherwise downwardly skew the education level of each states' population. In fact, at least ten percent of the populace from twenty states holds degrees beyond the bachelor level. Massachusetts leads the range with over seventeen percent, while at six percent, Arkansas has the least advanced degrees among their population. As a result, inclusion of advanced degree data in bachelor

[1] For the purposes of this study, continental United States is used synonymously with the contiguous United States. The terms are meant to represent the exclusion of Alaska and Hawaii.

degree attainment statistics will provide a more accurate picture of higher education attainment levels so that the remainder of the population can be focused on for further attainment.

The second part of this study is to examine the relationship between financial and economic variables and educational attainment while considering the spatial context of the observations. The financial variables used in the analysis were state appropriations to higher education and the federal postsecondary fund allocation to states. The economic variables were poverty level and the median income for the states being observed.

The research from this study enables a new approach to the policy discussion on how to improve educational attainment for the states and nation; a dialogue where states are viewed not as independent, isolated observations but as a part of a larger system or cluster of observations.

Organization of the Study

To examine the spatial dependence of educational attainment in the United States and then further explore the spatial context of educational attainment, this research study is arranged in to six chapters. Chapter two presents literature on spatial analysis and educational attainment. This literature focuses on the use and history of spatial analysis and then provides a review of spatial analysis literature with an educational context. The literature review also discusses the determinants of educational attainment. Chapter three discusses the conceptual framework that guided this study. The concept of geography of opportunity is discussed as a means to guide the dialogue on spatial patterns that exist. This chapter also discusses the comprehensive economic framework for analyzing educational attainment as a means to address the second research question in concert with the constructs of geography of opportunity to create a unifying framework. Chapter four presents the research methods that were employed to answer the research questions. Chapter five provides the findings from the exploratory spatial data analysis and spatial autoregressive model used to analyze educational attainment in the contiguous United States. Finally, chapter six provides for a discussion of the findings and the implications for both policy and future research.

Summary

The educational attainment of the nation's citizenry is a vital element in ensuring the economic health and stability of the country. Given this importance, it behooves policy makers to consider the different approaches to improving the percent of the workforce with a bachelor degree or higher. Acknowledging the importance of geographic location in education research and the influence location has on outcomes by researchers such as Tate (2008), Morris & Monroe (2009), Flores (2008); as well as the importance for understanding the role of location on outcomes for a strategy to improve educational attainment as highlighted by Metcalfe (2008) and (Massey, 1984), the next logical step seems to include spatial analysis of educational attainment. The inclusion of spatial analysis in educational attainment research enables policy makers and future researchers alike to have a greater understanding of the educational attainment phenomenon and tool to attempt to diminish disparities.

CHAPTER TWO: REVIEW OF THE LITERATURE

In the literature review, I begin with an overview of spatial analysis that includes the history and use in education research. I follow the spatial analysis section with the literature on educational attainment with particular attention given to studies focusing on the determinants or variables considered in this research. I conclude with a summary of how spatial analysis can contribute to the educational attainment literature.

Spatial Analysis: An Overview

A spatial analysis uses data quarried via a variety of tools from a geographical area to identify and explain patterns and conditions (Openshaw, 1994). In this context, spatial analysis could be considered to date back to prehistoric times, when primitive man drew pictures on cave walls of specific animals, lines toward the animals locations and hash marks to quantify the size of the herd. Certainly John Snow's work on the 1854 London cholera outbreak, which took over five hundred lives, was an early example of spatial analysis (Ousley, 2010). Using geography, he was able to pinpoint the outbreak to a contaminated water well, at a single London intersection.

From the early explorers and mapmakers to modern, everyday travelers, all can attest to noticeable distinctions between places, environmental attributes, and people over distance and time (Ousley, 2010; Smith, Goodchild & Longley, 2011). Yet for all of this spatial heterogeneity there is a persistence of similarity within local ranges (Anselin, 1993). It is important to note that the proportions and distance of these ranges of similarity can vary in distance substantially (Smith, Goodchild & Longley, 2011). This persistent similarity of nearby things is termed spatial dependence. The theory of spatial dependency is occasionally referred to as Tobler's First Law of Geography especially in earlier publications and papers written by and for the academic community (Goodchild , 1987; Goodchild, Anselin, Appelbaum & Harthorn, 2000; Smith, Goodchild & Longley, 2011).

Geospatial analysts use geographical information systems (GIS) to spatially analyze geocoded data. Geocoded data is essentially information of interest that has been geographically referenced or linked to a particular geographic location (Openshaw, 1994). Location, place, space, attributes, people, context and time are the types of observation information or data considered (Rhind, 1988). Researchers analyze the data, comparing and contrasting in an effort to find patterns, anomalies and dependent variables where science would otherwise predict independent variances (Openshaw, 1994). Smith, Goodchild & Longley (2011) summed the concept concisely with their assertion that, "the power of location comes not from location itself, but from the linkages or relationships that it establishes – from relative positions rather than absolute ones." The element of time can also have a substantial impact on both location and attributes and may be expressed as a temporal variable time series or referenced as data from a snapshot in time as a historical comparison (Longley & Batty, 1996). The relevance of distance can be affected by location, time and attributes. These distinctions of geography are fascinating in and of them themselves yet when combined with other disciplines such as economics, sociology, medicine and politics relationships between geography and other disciplines enrich the value of the research (Anselin, 1994; Openshaw, 1994).

Spatial analysis and the resulting evolution of geographic information science has proven useful in a variety of disciplines worldwide, yet the functions, proprietary data rights, and uses have varied widely (Goodchild, 1992). Especially in the early decades, many researchers focused the applications and advancement of GI systems within their particular field of study and research needs without imparting much of their discoveries to outsiders (Coppock & Rhind, 1991). As a consequence of the paucity of information sharing regarding GIS methods and development, the mixed attitudes (Pickles, 1995) toward the science of it, and the substantial resources needed in the early phases, GIS has developed rather asymmetrically around the world (Anselin, 1987; Coppock & Rhind, 1991). The early leaders in GIS study have without a doubt been in North America (Canada and the United States) followed by Great Britain (Coppock & Rhind, 1991).

As a result of this uneven evolution, there has been an overlapping of the phases of GIS development (Coppock & Rhind, 1991). Beginning in the late fifties, Coppock and Rhind (1991) term this stage that lasted until about 1975 as the pioneering age, where the resourcefulness and individual determination of the researchers themselves shaped the achievements in GIS and spatial analysis (Isard, 1956; Goodchild, 1987; Goodchild et al, 2000; Coppock & Rhind, 1991). These early geographers, statisticians, economists and other researchers also influenced the expansion of GIS during this esoteric phase by focusing development and application on their particular work and fields of study (Goodchild, 1992). The fields of economics, geography and cartography predominately encompassed most of the earliest GIS achievements reported. Early GIS researchers were highly motivated toward their projects so their time and focus was not toward development of theory nor writing papers detailing their successes, many failures, methods or scientific practices (Coppock & Rhind, 1991).

The following stage began around 1973 and lasted approximately a decade during this timeframe organizations seemed to have the greatest influence in spatial analysis and GIS development (Coppock & Rhind, 1991). Comprehensive projects necessitated the commitment of resources and infrastructure that only a large organization would have at their disposal that included funding, staffing and of course computers (Goodchild, 1992; Tate & Unwin, 2009).

Organizations like Regional Science Association, Parks Canada, International Geographic Union, United States Geographic Survey (USGS) and the U.S. National Parks Service began to take the lead on Spatial and GI systems research (Coppock & Rhind, 1991; Tate & Unwin, 2009). These organizations helped to influence scientific standards in spatial analysis and for GIS researchers as well (Tate & Unwin, 2009).

Then, increased computer availability and the explosion of commercial products the third phase was ushered in around 1983 (Coppock & Rhind, 1991). In acknowledgement of the plethora of technology, some researchers like Goodchild (1992), referred to this time period as one of a technology-driven geographic information systems. It was the proverbial cart before the horse situation in that new GIS technology was created and looking for an application project. In the same boat as industry and research, the education agenda for geographic analysis instruction has also followed a technology-driven set of imperatives (Tate & Unwin, 2009). Some of the challenges during these phases were that spatial analysis and GIS were primarily limited to the laboratory setting with large staffing needs and the old mainframe computers that often required the aid of computer science or technology experts (Rosenberg & Anderson, 2011). Of course the significant expenditures of human and technological resources required an equally significant funding supply, thus limiting the development of spatial analysis and GIS to those researchers in positions with adequate resources (Coppock & Rhind, 1991; Tate & Unwin, 2009). The beginning of these technology bursts (Goodchild, 1992) translated into widespread market appeal that seemed to have no end in sight and aided in the modernization of product lines (Tate & Unwin, 2009). Vendors continued to improve technology, software and other products to interface with desktop computers and be user-friendly (Rosenberg & Anderson, 2011) in an effort to capitalize in the market place.

The capitalist marketplace and the proliferation of information via the World Wide Web (Tate & Unwin, 2009), combined with the incredible technological advances over the last two decades, have marshaled in the latest stage (Goodchild et. al., 2000; Rosenberg & Anderson, 2011). This latest phase of geographical information systems and spatial analysis has been an era of individual dominance (Coppock & Rhind, 1991) where geographic reference and analysis has become increasingly exoteric (Rosenberg & Anderson, 2011). Goodchild (1987) notes that, "the element which distinguishes geographical information systems from other forms of spatial data handling activity, such as automated cartography and remote sensing, is an emphasis on analysis." The ubiquitous mobile computer systems, prevalent web-based geographic information, common global positioning systems (GPS), availability of remote sensing and geographic imaging virtually everyone from an experienced researcher to the dilettante can use GIS to spatially analyze a variety of available data (Tate & Unwin 2009). In consideration of the imperative nature of technology in geographic information systems, Tate & Unwin (2009) coined the abbreviation as GIS&T, since technology has enabled so many to use it. This stage of individual dominance (Coppock & Rhind, 1991) has expounded GIS related information and literature around the globe (Goodchild, 1992) as evidenced by the websites like "onlinespacialanalysis" last updated in December 2011. Authors Smith, Goodchild & Longley (2011) note that the online publication is the most effective manner to present current GIS information since the typical delays of hard-copy manuscript production could render the data outdated before publication and distribution.

Today the GIS evolution has become mundane (Tate & Unwin 2009). Generally speaking, those who desire it, have access to GIS and technology related products such as personal computers, cell phones, GPS units and so on. Goodchild (2007) refers to this as the "democratization of GIS" (p.213). However, Turner (2006) asserts that the new breed of geographers and the masses that enjoy the geographic related functions of their technology engage in what he terms "neogeography." In fact, this new generation of geographers, who take for granted user-friendly programs such as Web 2 and the integrated Volunteer Geographic Information (VGI) (Goodchild, 2007) and have little homage for the GIS progenitors cited in this dissertation (Turner, 2006). Tate and Unwin (2009) contend that the decoupling of GIS&T from academic geography is apparent, evidenced by a higher value of basic web-base computer skills than the knowledge of GIS science, the dilemmas and issues GIS predecessors thought important. The decoupling scenario Tate and Unwin (2009) reference in the United Kingdom does not appear to be occurring in the United States, likely because of market value for GIS related skills/ credentials and the less-formal pedagogic style in the U.S. tertiary lends toward hands-on learning.

Spatial Relationships

At the foundation of spatial or geographic analysis is Tobler's (1970) First Law of Geography that states "everything is related to everything else, but closer things are more related than distant things," suggesting spatial dependence to be the rule rather than exception (Anselin, 1993; Miller, 2004; Ullah & Giles, 1998). Meaning that, generally, relationships exist between spatial variables that are affected by proximity. Another term often used in the environmental sciences for spatial dependence is autocorrelation (Smith, Goodchild & Longley, 2011). Autocorrelation as a predictor is frequently applied to continuous ordered datasets relating to time series or spatial data codified by distance band (Longley & Batty, 1996). When all of the data points are not known, sample points are used often in a raster with estimates made for all cells to predict or estimate undetermined data points. This is often the case when conducting analysis at the state level. Following Tobler's theory, the concept of spatial interpolation is "the assumption that points closer together in space are more likely to have similar values than points more distant" (U.S. Environmental Protection Agency, 2004, p. 3). Regression models are used to measure the relation between the dependent data variable and the independent data variables (Smith, Goodchild & Longley, 2011). After decades of model development and refinement a variety of approaches can simulate and predicatively model the kinds of spatial relationship "implicit to Tobler's First Law, spatial dependence that is association related to geography or namely analytical and numerical relationships which describe, predict and optimize interaction" (Longley & Batty, 1996, p.150).

Unique spatial statistical models are required for analyzing geographic data since it does not conform to traditional formal statistical models, which assume independence. "Spatial statistics is a term more commonly applied to the analysis of discrete objects (e.g. points, areas) and is particularly associated with the social and health sciences" (Smith, Goodchild & Longley, 2011).

"Tobler's First Law is at the core of spatial autocorrelation statistics, that is, quantitative techniques for analyzing correlation relative to distance or connectivity relationships" (Miller, 2004, p.1). Space can be mathematically quantified by measuring the given attributes of observations. While this may sound simplistic and obvious, a variety of measurement alternatives exist for a spatial framework. Quantifying geographic space by distance, connectivity, direction and other spatial weights matrices enables analysts to compare, distinguish patterns and identify relationships (Fotheringham, Brundson, & Charlton, 2002). Distance calculations provide fundamental tools for all geographic analysis. Measurements can capture varying data with different methods such as Nearest Neighbor, Gradient distance, Euclidean distance and Grid (Smith, Goodchild & Longley, 2011).

Spatial data models are always approximation or generalizations of reality (Goodchild, 1992). To determine appropriate models the following three considerations are necessary: data aggregation, dependence structure and the spatial boundaries of analysis (Varga, 1998). Exploratory spatial data analysis (ESDA) provides researchers with a set of statistical tools to examine the spatial nature of the data. These tools include visualization through mapping, using spatial weight matrices to define a connection between places, Moran's I and Scatterplot, and Local Indicators of Spatial Association (LISA) statistics. Moran's I shows spatial dependence and autocorrelation, while Moran's I is inversely related to the Geary's C yet it is not identical. Moran's I is a measure of global spatial autocorrelation, while the (LISA) model as evidenced by its title is more sensitive to local spatial autocorrelation. This dissertation employs both Moran's I and LISA data statistics through GIS. The history of GIS and related software will be discussed in the next section.

GIS: History

A geographer, Roger Tomlinson is widely referenced and acknowledged as the "father of GIS" as the result of his innovative work during the early 1960s (Coppock & Rhind, 1991). Tomlinson pioneered GIS development as part of an ambitious computer-based, multilayer, mapping project with the Canada Land Inventory to evaluate data from a million square miles. His project involved the large mainframe computers of the day, a score or more of staff and the technical advice and assistance from IBM computer scientists (Coppock & Rhind, 1991; Goodchild, 1992).

A discussion of the history of GIS should include a definition of GIS to assure like understanding. In fact, clarification of terms is a useful activity when undertaking most GIS related conversations. This relatively nascent field of study is so intertwined with other disciplines, new technology and vendor buzz words with updates and applications that a variety of terms are used, compounded or just newly created. A precise definition or understanding of GIS, that is the geographic information systems, of today, in light of modern technology, would be limited to "a computer-based system for analyzing spatially referenced data" (Coppock & Rhind, 1991, p.22). However this rigid definition would not acknowledge the early contributions of many geographers, cartographers, mathematicians, statisticians, computer scientists, software developers and social scientists (Coppock & Rhind, 1991). A more inclusive definition of GIS that would recognize the distinctive hallmarks of development is, "as any system for handling geographic data" (Coppock & Rhind, 1991, p.22).

The Science of Geographic Information

Geographic information systems and as a result spatial analysis have evolved exponentially since the late 1950s when spatial mapping using computers was first published. The early years of geographic inquiry and comparison primarily related to the handling of spatial data (Rhind, 1981). As noted in the previous section the historical use of geographic analysis can be quite comprehensive, sharing common concepts of location, space, attributes and maps to communicate the spatial data (Coppock & Rhind, 1991). Much of the challenge of documenting the history of GIS is that some organizations, researchers and vendors have not been forthcoming with their research related information (Goodchild, 1987; Coppock & Rhind, 1991). As with any science documenting and sharing failures as well successes can lead to an advancement of the science and system needs. Organizations both government and academia provided the necessary structure and empirical references for the spatial analysis to develop as a science. Early research from organizations like the Canadian Geographical Information System, abbreviated to CGIS, (Tomlinson, Calkins & Marble, 1976), the Harvard Computer Graphics Laboratory (Chrisman, 1988) and the Experimental Cartography Unit (Rhind, 1988) developed and integrated GIS software for a range of uses (Rhind, Openshaw, & Green, 1989). Commercial enterprise and sales of GIS related products for a wide variety of applications created a robust race for technology development and market share. The science of geographic information largely exists because of the popularity of spatial analysis and the efforts of pioneering analysts from a variety of disciplines (Coppock & Rhind, 1991; Goodchild, 1992).

While Tobler (1970) is credited with defining the first law of geography, Anselin (1988) expanded the theory that data has similar characteristics to other data in nearby locations and termed it spatial dependence. Openshaw (1994) noted that while spatial data is dependent and influenced by its neighbors when point-based observations are modified into zones the aggregate of the spatial partitions (modifiable areal unit problem-MAUP) could affect the statistical results. Goodchild (1992) seeks to develop the role of science in GIS noting the uniqueness of geographical data and problems. Like Anselin, Goodchild sought to promote the potential empirical value of spatial analysis to other social sciences. Goodchild (1992) noted that while some measures of study such as algorithms to spatial indexing schemes are specific to GIS others were adapted from other social science disciplines. A number of researchers believe that this theory of spatial dependence is a key feature that makes it (geographical information) worthy of scientific status (Anselin, 1989; Rafanelli, Klensin & Svensson, 1989; Goodchild, 1992).

GIS Software

Geographic Information Systems related software has been developed exponentially in the last thirsty years (Tate & Unwin, 2009). Research papers written two or three decades ago by geographers, economists and others engaged in spatial analysis would debate the merits of various methods and programs like raster versus vector analysis (Goodchild, 1987) and computations that are moot with the hybridized systems available today. A variety of popular user friendly GIS products like GeoDa and PASSaGE 2 are available without charge to download from the web (Rosenberg & Anderson, 2011). GeoDa was used in this dissertation and is known for its statistical analysis capability. PASSaGE 2 a newly updated product developed in Arizona that is reportedly capable of performing multi-dimensional spatial analysis and statistical analysis with a user-friendly graphic interface (Rosenberg & Anderson, 2011). Another GIS product system is ArcGIS, a comprehensive fee based product line that is well known for exceptional graphics (mapping and visualization) and spatial data storage via cloud GIS computing (ESRI, 2012). ArcGIS was employed to create the graphics and maps of this paper. With this said, Tate & Unwin (2009) contend that with the current integrated computer systems available today, users do not need to know GIS&T software. Such an assessment likely represents their frustration with the ease at which the current generation use geographic technology compared with the time consuming and staff intensive process they endured. Software like everything else in the present climate of GIS, it is relative to the user and the project not so much the past.

The use of GIS applications and mapping in social science research is steadily increasing (Anselin, 1999). More recently GIS from a theoretical standpoint connects individual behavior to a context and seeks to quantify concepts (Abbot, 1997; Morenoff & Sampson, 1997; Sampson, 2000; Anselin, 1999). The connection between theoretical and empirical approaches has advanced and intertwined the use of geography with various social sciences including sociology, politics, economics and other disciplines such as medicine and engineering that were early beneficiaries of a spatial approach to research (Ousley, 2010; Coppock & Rhind, 1991).

Spatial Analysis in Education Research

The role of place has taken hold in social science policy research mostly around the issues of race and housing (Pastor, 2001). Geographic analysis continues to be a dynamic influence in the policy debate for a variety of fields, including business, economics, sociology, and public health (Tate, 2008). Stakeholders in education should place a greater emphasis on the importance of geography in the research process where appropriate. “An uneven geography of opportunity, left unaddressed, generally grows” (Rusk, 2003; Tate, 2008). This means that uneven opportunities or geographic disparities tend to increase and worsen over time. Kalogirou (2010) notes similar unequal distribution of tertiary educational attainment in Greece. However, the importance of location in issues of education is still largely associated and researched regarding issues of race and student achievement measured by test scores (Tate, 2008; Morris & Monroe, 2009; Flores, 2008).

Educational based studies including place as a factor have been conducted on a small scale from a geographic and policy perspective. The research studies of Tate (2008), Morris & Monroe (2009), Flores (2008) and Kavroudakis, Ballas & Birkin (2012) included geographical location as a variable, noting that location was a significant factor in educational achievement. Location was measured and defined differently in all studies. Tate (2008) looked at location within metropolitan areas, while Morris & Monroe (2009) looked at the counties within a state. Flores’ (2008) study examined neighborhoods in Santiago, Chile. The studies of Tate (2008) and

Morris & Monroe (2009) focused on educational achievement measured by academic grades and performance on standardized tests. Flores (2008) was analyzing the Chilean capital city, Santiago, as a means to infer issues regarding the country-wide voucher system in Chile. Kavroudakis, Ballas & Birkin (2012) research exhibited the value of spatial microsimulation (a set of techniques that allow the characteristics of individuals living in a particular area to be approximated, based on a set of constant variables that are known about the area) and policy relevance by investigating inequalities in educational opportunities in two United Kingdom regions. Spatial microsimulation is. However, even this analysis of the importance of geographical location is limiting for many reasons. Primarily the scale and sample were not substantial enough to make general comparisons other than to the specific areas studied. These studies did however find that the geographic location did influence the educational outcomes of interest. Kavroudakis, Ballas & Birkin (2012) research exhibited the value of spatial microsimulation and policy relevance by investigating inequalities in educational opportunities in two United Kingdom regions. Waldorf (2007) conducted a considerably larger study, in the United States using the U.S. Census Bureau's 2005 American Community Survey (ACS) data. Waldorf's (2007) research demonstrated that educational capital is an economic driver and focused toward selective market places, thus growing disparities between education levels across the country appear to be continuing furthering brain-gain and brain-drain scenarios.

While the American College Board routinely publishes geographically based higher education related statistical data that is temporally compared with previous reports (Lee, Edwards, Menson & Rawls, 2011) the level of analysis beyond comparisons is limited in contrast to the plethora of information available. In addition, the College Board lists a disclaimer that the data can be intentionally altered to protect anonymity. This in party can be done in rural or less populated areas with racial minorities to protect the identities of those individuals. The impact of place on a specific educational variable such as educational attainment has not been the sole focus of analysis. While these comparative statistics of educational attainment are on face value interesting, the absent data analysis leaves a greater potential for misinterpretation than understanding or policy consideration. Just as the small-scale studies mentioned in the previous paragraph are of limited value for areas outside those studied, the raw data of these census reports are not weighted or considered for dependence or contamination by other variables. In addition, comparison between states can be ripe for misinterpretation since attributes, populations, institutions, geography and goals can and do vary significantly. Exploratory spatial data analysis research examining the spatial relationship of educational attainment for the United States from a macro, national perspective appears to be largely absent from the literature (Kavroudakis, Ballas & Birkin 2012), therefore this study is poised to contribute to the literature on educational attainment.

Educational Attainment

This section, begins with how educational attainment is typically analyzed in terms of methods and variables. Then in greater detail I discuss the determinants of educational attainment used in this study. I conclude the section noting the influence of other factors such as market forces and urban/rural differences on educational attainment.

"The "winners" in today's winner-take-all labor markets are differentiated by advanced levels of educational attainment, especially higher degrees" (Elman & O'Rand, 2004, p. 123). It is a fact; in this modern economy that higher levels of education are essential to fill many of the high technology related job positions (Evans, et al., 2010). In the literature, when discussing education attainment, it is imperative not to confuse the label with college graduation rate as the two terms address distinctly separate measures (Hauptman & Kim, 2009). Education attainment refers to an individual's success in attaining a degree by accumulating a prescribed number of credits and related coursework regardless of time frame or number of institutions attended; while graduation measures the cohort at the beginning of the academic year and the institution's progress in graduating this cohort typically in four and six year time frames for a bachelor degree or two and four year for an associate degree.

The United States is one of the most educated nations in the world yet according to a variety of leaders in the private sector, government and higher education the U.S. is not producing enough college graduates to maintain American's standard of living in a knowledge-based economy (Matthews, 2010; Hauptman & Kim, 2009; Lee, et al., 2011). Currently the United States does not produce enough educated workers to meet demand, "Harvard Business School found that immigrants comprise nearly half of all scientists and engineers in the United States who have a doctorate, and accounted for 67 percent of the increase in the U.S science and engineering workforce between 1995 and 2006" (Immigration Policy Center, 2011, p.1).

The recent Great Recession has impressed upon Americans the need for an education as evidenced by a surge in enrollment (McPherson & Shulenburger, 2008). U.S. population between eighteen and twenty-four seems to be taking heed to these new economic conditions realizing the employment value of a college education, since enrollment for this group has risen 24 percent in 2008 (Wellman, Desrochers, & Lenihan, 2008; Berube, 2010; McPherson & Shulenburger, 2008). The two year period between December 2007 and November 2009 saw unemployment levels rise 5.7 and 7.4 (percentage points) for workers with high school diploma and those without a high school degree, compared with the 2.7 unemployment increase for workers with a bachelor's degree. As the unemployment rate within an area increases, individuals seek out postsecondary education in an effort to retool and become more marketable. The fields with the highest unemployment have lower graduates in the years following the decrease (Betts & McFarland, 1995). The decrease in degree attainment in those fields with previous high unemployment rates is due to a perception that there is little economic utility or return to pursuing that educational path.

Levels of educational attainment have been increasing for the last century in most industrialized countries (Lauer, 2002). This is also true in the United States as educational attainment levels have on the aggregate improved since the 1940s (Crissey, 2009) yet these levels fall short of commensurate student enrollment levels for this time period (Wellman, Desrochers, &Lenihan, 2008). Put simply, comparatively America doesn't have an access or enrollment problem, it has a completion problem (Hauptman & Kim, 2009; Lee, et al., 2011). "Less than 60 percent of students entering four-year institutions earn bachelor's degrees, and barely one-fourth of community college students complete either associate's or bachelor's degrees within six years of college entry" (Goldrick-Rab & Roksa, 2008, p.1). The educational attainment levels of individuals can have significant long-term impacts on both the individual and the society in which they reside (Barro & Lee, 2001). The focus of all stakeholders of American higher education should be college degree attainment (McPherson & Shulenburger, 2008; Wellman, Desrochers, &Lenihan, 2008; Goldrick-Rab & Roksa, 2008; Hauptman & Kim, 2009, Lee, et al., 2011). Numerous researchers and stakeholders also agree that an increase in college attainment should not be at the expense of high level skills and learning acquisition in higher education, as college degrees should reflect the intended program knowledge gained and be rewarded in the labor market (McPherson & Shulenburger, 2008; Wellman, Desrochers, & Lenihan, 2008; Goldrick-Rab & Roksa, 2008; Hauptman & Kim, 2009; Lee, et all, 2011).

The United States as a culture has commonly subscribed to the ideals of an individual's ability to improve their own destiny through education and hard work (Sutton, 2008; McPherson & Shulenburger, 2008). And this cultural ideal does align in key ways with the reality of the relative payoff to higher levels of education for individuals (Evans et. al., 2010). On average, a college graduate earns approximately $1 million more than an individual with only a high school diploma in a lifetime (Southall, 2006). The impact of educational attainment also is evidenced in personal knowledge, health and relationships. An individual's educational level can provide a certain amount of access and cultural capital that will enable them to navigate through society with greater ease (DiMaggio & Mohr, 1985). Individuals' opportunities to attain higher levels of education affect their marketability and future success (McPherson & Shulenburger, 2008; Wellman, Desrochers, & Lenihan, 2008; Goldrick-Rab & Roksa, 2008; Hauptman & Kim, 2009, Lee, et al., 2011). There are also implications from the level of educational attainment for the community and society in which the individuals reside (Hauptman & Kim, 2009; Lee, et al., 2011). An educated citizenry is better for the economy of that society as it helps attract and retain higher wage jobs and provides human capital (Matthews, 2010; Barro & Lee, 2001; Kane, 1999).

The following section discusses the explanatory variables considered in this spatial analysis of educational attainment.

Determinants of Educational Attainment

"Considerable disparities exist across U.S. metropolitan labor markets in the educational attainment of their residents, due to differences in their underlying economic and demographic structures, migration patterns, and historical and cultural mores that affect the real and perceived return to education" (Berube, 2010, p.107). These differences in educational attainment levels are commonly examined and traditionally linked to racial/ethnic characteristics, and socioeconomic status (Cameron & Heckman, 2001; Crissey, 2009; U.S. Department of Education, 2006; Goldrick-Rab, 2008; Kaba, 2010). There have been some unique and substantial research regarding educational attainment using non-traditional variables, the presence/ number of books in the home (termed scholarly culture theory), geography and time were analyzed to determine the scope and relevance of the research. Researchers postulated that scholarly culture would enhance educational achievement in all societies, regardless of race, parental educational attainment, wealth, poverty, era, capitalist, communism or apartheid conditions (Evans et. al., 2010). While this paper does not pursue the variable of scholarly culture theory, it is significant to note that in a study encompassing 70,000 people in 27 countries, over scores of years, that this determinate had a greater statistical value than any other variable (Evans et. al., 2010).

In sociology there have been numerous studies on educational attainment. One notable study is the Wisconsin model of status attainment. The Wisconsin model considers the influence of socioeconomic status on educational and occupational attainment (Deil-Amen & Turley, 2007). Sociologists have studied college completion from the perspectives of individual attributes such as academic preparation and work experience; family background which includes parental education levels and income; and institutional factors such as type of institution (Deil-Amen & Turley, 2007; Goldrick-Rab, 2008).

A direct relationship between the level of educational attainment and exogenous (or explanatory) variables is generally assumed (Lauer, 2002). Traditionally the economic perspective of educational attainment has been within-family behavior, with the family agency acting as a production unit to generate utility for the individuals within the family (Haveman & Wolfe, 1995). Both economic and social science perspectives acknowledge the importance of parental or family education and background in predicting the attainment levels of future generations (Haveman & Wolfe, 1995; Cameron & Heckman, 2001). This chapter continues with a more detailed presentation of the predictors of education attainment literature. The discussion begins with literature on the financing of higher education, race and income. Then literature on institutional characteristics and market conditions is presented.

Federal & State Role in Financing Higher Education

In just over twenty-five years the state and local governments have nearly tripled their funding of higher education from 23.5 billion in 1982 to 89.1 billion in 2008 (SHEEO, 2008, p.7). In doing so, the public funding of higher education has largely remained constant, even as enrollments have skyrocketed at institutions across the board (Wellman, Desrochers, & Lenihan, 2008). Over three –fourths of these public monies were distributed to the general operating expenses of public higher education, even as some protest substantial tuition increases, state and local taxpayers still contribute more than twice as much as the revenue received from 2008 tuition income (SHEEO, 2008).

Just as colleges and universities across America have been summoned to increase educational attainment, they have been encouraged to control costs (Pederson, 2009). In recent years, college costs have significantly spiraled upward out pacing government subsidies and thereby increasing tuition and fees, yet the actual cost of a college education is virtually unchanged in the last decade (McPherson & Shulenburger, 2008). Higher education leaders respond that students have many low-cost alternatives and spending is necessary to maintain quality specifically citing Baumol's cost disease theory when non-profit sector salaries increase without further productivity just to maintain employees (Wellman, Desrochers, & Lenihan, 2008). As tuition rates climb and America moves toward the goal of 55 percent with a college degree by 2025 (Kaba, 2010) roles of the federal and state government in financing higher education will be further debated.

Some political forces seem to parallel economic challenges in that many in the public as well as politicians have grown weary of taxes. As evidenced on April 8, 2011 by the narrowly avoided federal government shutdown, legislators face constant demands from constituents for a reduction in government spending, as well as expectations for tax rate reductions (Bendavid & Hook, 2011). While the actual cost of educating students at public colleges and universities has remained consistent for more than a decade, other costs like student financial aid and employee costs have caused college spending to increase to nearly double that of inflation (Wellman, Desrochers, & Lenihan, 2008). As if these expenses weren't enough, college leadership feel compelled to compete with each other for the same top students, faculty and national rankings, which generally costs money (McPherson & Shulenburger, 2008).

In recent decades tuition costs have soared, while public funding has remained relatively constant, it has not kept pace with additional spending (Wellman, Desrochers, & Lenihan, 2008). As a result there has been a noticeable redistribution of expenses traditionally covered by taxpayers that is now covered by tuition, fees, and endowment (Sutton, 2008; Goldrick-Rab & Roksa, 2008). This shift of a greater share of the cost burden to the student and their family has the potential to price some students out of the market and saddle others with a mountain of debt (Baum 2003; Baum 2010; Goldrick-Rab & Roksa, 2008). A wide range of options are available for students to budget their higher education investments between the most and least expensive groupings of colleges there is ten to one difference in cost ratio from $3,234 to $33,551 (McPherson & Shulenburger, 2008, p.16). Cost-sharing in a higher education context is based on mutual benefit that costs are shouldered by some combination of four principle groups: the government (tax payers), parents (families of students), students, and donors (philanthropists) (Johnstone, 2004). Some believe that the government should assume a greater portion of higher education expense as is the case in other parts of the world, (McPherson & Shulenburger, 2008) likewise others view the public funding of higher education as a free ride for a few, specifically middle and upper income students (Goldrick-Rab & Roksa, 2008). The apodictic reality is that higher education is a long-term individual and societal investment that is mutually beneficial to individuals, the community and state (Sutton, 2008; McPherson & Shulenburger, 2008).

The subsequent sections discuss the role of the federal and state government in financing higher education.

Role of the Federal Government

The federal government established the United States Department of Education to in part ensure the federal commitment to equal educational opportunities (Public Law 96-88, 1979; U.S. Department of Education, 2010). The federal government's role in financing higher education has been multi-faceted. The different roles are mentioned here and then explored in greater detail below. In an attempt to keep higher education accessible to the masses, the federal government has attempted to control tuition prices, (McPherson & Shulenburger, 2008) or at least mitigate sharp tuition increases (McKeon, 2003). Simultaneously, the federal government has participated to a greater extent in cost-sharing through the utilization of taxpayer dollars to subsidize higher education (Johnstone, 2004). This section on the role of the federal government concludes with a discussion of the federal government increasingly relying on state government to contribute a greater percentage for the expense of higher education (Turner, 2002; Baum, 1995).

In recent years, congress has taken up the mantle to investigate increasing tuition rates in higher education finance by holding hearings and creating a shame list of colleges or universities that have excessive tuition increases (Wellman, Desrochers & Lenihan, 2008; McPherson & Shulenburger, 2008). Legislators, largely due to constituent demands, have been critical of institutions of higher education for raising tuition at rates that far outpace inflation (McKeon, 2003). The concern is that tuition increases, in addition to outpacing inflation and the consumer price index, are also outpacing the government's ability to subsidize the cost of higher education (Goldrick-Rab & Roksa, 2008). Subsidies that inadequately fund higher education limit access to low-income students (Wellman, Desrochers & Lenihan, 2008; Goldrick-Rab & Roksa, 2008; Baum, 2010). There has been much debate regarding whether the federal government can and/or should control tuition prices (McPherson & Shulenburger, 2008). Legislators have taken the stance that, "the federal government provides 70 percent of all financial aid, it is time for Congress to demand accountability," (McKeon, 2003, p. 2) and ensure that institutions are concerned with financial access for low-income students and are operating efficiently (Wellman, Desrochers & Lenihan, 2008).

As mentioned by McKeon (2003), 70 percent of financial aid comes from the federal government. With such a large percentage of funding it is important to understand what types of subsidies exist. Subsidies used in the financing of higher education consist of grants, loans and tax credits (Kane, 1999). Tax benefits encourage individuals to save in advance of college through tax-exempt programs; to donate to institutions; and provide an opportunity for individuals to earn credits on their annual taxes for a portion of their higher education expenses. Tax benefits have a minimal influence on an individual's ability to finance and participate in higher education and are thought to have a greater advantage to middle and upper income students and their families (Kane, 1999; Baum 2003).

Income and resource-based grants and loans are the second largest source of financing for higher education. Federal government programs provide a large portion of these monies to low-income students for college access (Kane, 1999). These programs include the Pell grant, Work-Study as well as Stafford, Perkins and other loan programs (Hearn, 1998; Kane, 1999). Loans represent the largest portion of federal aid and are available to students from all income levels. (Hern, 1998; Baum 2003). “The dramatic rise in public and private institution’ tuition levels since 1980 are closely linked to the parallel expansion of student loans,” (Hearn 1998, p. 70). Many students have amassed so much education related debt through both government and private issuers, their concern that monthly loan repayment obligation when considered with basic living expenses may exceed resources and result in default (Baum, 2010) .The perceived, prohibitively high tuitions costs, excessive student loan debt and the potential for costly defaults has become a talking point of both the president and congress by seeking to control tuition prices to maintain access and limit the debt burden of students (Wellman, Desrochers & Lenihan, 2008; McPherson & Shulenburger, 2008).

Funding is often a contentious issue in the debate over allocations of public monies toward higher education. At the root of the debate is likely the ominous yet unanswered question of, “How much is enough? In relation to the other 29 countries in the Organization for Economic Cooperation and Development (OECD), the United States government far and away leads in total spending and financial commitment to higher education yet the U.S. falls short in leading with college degree attainment (Wellman, Desrochers & Lenihan, 2008; McPherson & Shulenburger, 2008; Hauptman & Kim, 2009). “In terms of education spending per student, the U.S. figure of $18,600 is more than $5,000 higher than that of the next-largest spender—

Canada—and well more than twice as much as the OECD average of $8,000 per student"(Hauptman & Kim 2009).

In the United States the public funding of higher education has largely been viewed as a state function and responsibility. Yet, the federal government does allocate funding for postsecondary education to each state for distribution (Archibald, 2002; Hossler, et al., 1997; Heller, 2002). Traditionally, an educated workforce has been thought of to have the most benefit to the state. However with increased workforce mobility and the new global economy, the benefit of an educated labor market is distributed to both the states and nation (Lee et all, 2011, Turner, 2002; Knight & Shi 1996; Baum, 1995). Subsidies allocated to the financing of higher education comprise a very small portion of the budget (Baum, 1995). Given the economic advantages it behooves the federal government to continue to direct funds towards subsidies that can be used to finance higher education, especially given the economic downturn and the abysmal budget situation that most states find themselves in (Wellman, Desrochers & Lenihan, 2008; Lee et all, 2011).

Role of the State Government

State and local governments provide primary funding of public higher education (Archibald, 2002; Hossler, et al., 1997; Heller, 2002; SHEEO, 2008). Unlike the federal government that directs a substantial portion of the funds towards financial aid programs, the state government directs a major portion of funds to finance higher education through institutional operation subsidies and only a smaller share to state financial aid programs (Kane, 1999; Baum, 1995). Every state has a distinctive combination of conditions including policies, goals, resources and challenges that vary and make replication of successes difficult (SHEEO, 2008; Wellman, Desrochers & Lenihan, 2008).

According to the National Bureau of Economic Research, the recession that began in late 2007 (Bartash & Mantall, 2010) and has caused states to not only closely monitor but limit budget spending by drastically slashing appropriations. "States already spend a substantial portion of their budgets on higher education and are unlikely to be sufficiently solvent to increase spending on higher education in the near future" (Goldrick-Rab & Roksa, 2008 p.23; SHEEO, 2008). In times of budget shortfalls, discretionary spending is the first to be cut (Wellman, Desrochers & Lenihan, 2008, p.9). Unfortunately state appropriations to higher education fit into the discretionary spending category (Cheslock & Gianneschi, 2008). This coupled with the federal budget cuts and stagnation, defined as the increase of student enrollments without additional funding, have resulted in a larger cost-sharing or tuition and fees burden among the students and their families through severe tuition increases (SHEEO, 2008). In addition to stagnation a scant 34 percent of students attain a bachelor degree in four years even after eight years only 69 percent complete their degree (Goldrick-Rab & Roksa, 2008). Students also lag at a similar rate for completion of associate degrees taking three to four years instead of the traditional two years (de los Santos & Sutton, 2012; Goldrick-Rab & Roksa, 2008). To put the recent impact and magnitude of stagnation in perspective community colleges enrollment alone grew 24 percent in 2008, in the midst of the Great Recession when tax revenues were down and demand for social services like Medicaid, a mandated spending program was up (Wellman, Desrochers & Lenihan, 2008 p.9).

Griswold & Marine (1996) noted that financial constraints could act as a catalyst for changes in higher education and the financing of it, at the state and even institutional level. These changes manifest differently depending on the type institutions, tuition and aid policies in place, revenue availability and higher education needs and goals (Wellman, Desrochers & Lenihan, 2008). Technology introduces a range of cost saving and redesign options for academia; distance learning may be the most poignant change to date that has had varying degrees of acceptance (Lee, et all, 2011; McPherson & Shulenburger, 2008). As states cope with the realities of the recession, they will adapt to the complex demands of financing higher education in various ways (Callan, 2002).

In addition to including the allocation of federal and state funds to higher education as the government factor in a predictive model for determining educational attainment, this study also considered race, median family income, institutional characteristics and industry/market forces.

Race

Progress has been made in the last forty years with respect to college or university enrollment and degree attainment for all demographics (Kaba, 2010). In what may be a surprise to many outside of academia, Kaba (2010) notes that according to the U.S. Census Bureau in 2007 there were proportionately more black females in college than Caucasians or Hispanics. The 2008 American survey census report found that “Hispanic enrollment at community colleges increased 173 percent, black enrollment increased 207 percent, and white enrollment 35 percent" (McPherson & Shulenburger, 2008, p.10). Community college enrollments grew the fastest of any college or university sector as the most affordable tertiary option, on average tuition at community colleges actually decreased in relation to inflation-adjusted dollars (Wellman, Desrochers, & Lenihan, 2008). A similar albeit less explosive enrollment increases occurred “at public very high research universities, Hispanic enrollment rose by 51 percent, black enrollment by 22 percent and white enrollment by 14 percent" (McPherson & Shulenburger, 2008, p.10).

Some researchers link the disparity of education attainment between races, ethnic groups and socio-economic levels to cultural conventions (Knight & Shi, 1996; Cameron & Heckman

2001; Berube, 2010; Evans et al., 2010). Cameron and Heckman (2001) in their study of black student college access and attainment found that students' background is more indicative of tertiary education than tuition assistance at the time of college attendance. Yet, the Hispanic identifier encompasses a culturally diverse demographic with the largest group being of Mexican descent. The U.S. census survey does not measure descendants of other ethnic groups so it is difficult to identify if common attainment struggles also exist for other groups. In their study, Knight and Shi (1996) found that China's ethnic minorities shared a similar disparity in education attainment to minority groups in the United States and postulated a cultural and economic relationship since the minorities are geographically isolated from the majority and a low rate of return exists for individual attainment. The researchers noted that according to the 2008 American Community Survey approximately 18 percent of blacks and 31 percent of whites hold a bachelor degree. However Asians have made the greatest gains in education attainment as of 2008 about 50 percent hold a bachelor's degree, (Berube, 2010) likely brought about by cultural mores dating back to Confucian attitudes and in the case of Chinese; a history reinforced by competitive examinations to attain wealth and power with government positions (Knight & Shi, 1996 p.85). As a result of decades of diversity measures and studies, race will also be a considered variable in this study.

Income and Poverty

The students of low-income families are less likely to complete college than students from middle or upper-income families (Baum, 2010). Inversely, individuals from higher socioeconomic backgrounds are more likely to have higher levels of education attainment (Cameron & Heckman, 2001; Crissey, 2009; U.S. Department of Education, 2006). Despite extensive financial aid and college non-financial assistance programs such as tutoring, a student's socio-economic background is consistently a powerful indicator of college attainment (Knight & Shi, 1996; Goldrick-Rab & Roksa, 2008; Baum 2010, Kaba, 2010). "An analysis of the relationships between family background, academic preparation, and educational attainment undertaken by economists from the Universities of Michigan and Virginia found that the negative influences of declines in academic ability among entering college students are more than offset by substantial increases in the levels of parental education enjoyed by those students" (Goldrick-Rab & Roksa, 2008, p.7-8). Perhaps most shocking is the research that indicates that students from a high SES (socioeconomic status) culture who are in the lowest academic ability quartile as measured by SAT scores have a greater likelihood of completing college than academically gifted students in the highest academic quartile but from a low SES background (Goldrick-Rab & Roksa, 2008).Given the importance and significance that family income has displayed on educational attainment in past studies, it is important to consider this variable so as to not overlook a significant factor in predicting educational attainment.

Institutional Characteristics and Factors

The United States has reaped incredible benefits by advocating and subsidizing a college education for the populace; however with increased enrollment and costs many higher education institutions struggle to provide a quality postsecondary education at a very low price point (Goldrick-Rab & Roksa, 2008). College tuition has increased at nearly double the rate of inflation since 1998 (Wellman, Desrochers & Lenihan, 2008). College enrollment does not necessarily equate degree attainment (Waldrof, 2007; McPherson & Shulenburger, 2008; Wellman, Desrochers & Lenihan, 2008; Goldrick-Rab & Roksa, 2008; Hauptman & Kim, 2009). "Less than 60 percent of students entering four-year institutions earn bachelor's degrees, and barely one-fourth of community college students complete either associate's or bachelor's degrees within six years of college entry" (Goldrick-Rab & Roksa, 2008). These low attainment rates correlate with greater expense for the state and student (Hauptman & Kim, 2009). Although most agree that college degree attainment levels need to improve, the degrees must reflect a high standard of learning and skills commensurate with the program of study, to be rewarded in the marketplace (McPherson & Shulenburger, 2008; Wellman, Desrochers & Lenihan, 2008; Goldrick-Rab & Roksa, 2008; Hauptman & Kim, 2009).

Colleges and universities in terms of access, affordability and resources are best-evaluated intra-sector of the Carnegie Classifications (Wellman; Desrochers, & Lenihan, 2008; McPherson & Shulenburger, 2008). The institutions are categorized by public or private, highest degree issued, size and level of research; knowledge of the options enable students to make a selection that best meets their needs, budget and potential for degree attainment (McPherson & Shulenburger, 2008; Wellman, Desrochers, & Lenihan, 2008). Just as students have choices in the resources and affordability of institutions they select, so too do college and university leadership have the ability to generally determine tuition levels. "It is possible for any university to reduce tuition if it chooses to adopt the staffing, building, equipment and support practices prevalent in a Carnegie Classification with a cost structure less expensive than its own" (McPherson & Shulenburger, 2008, p. 49). The contrast between higher education sector spending patterns relate far more to disparity in non-instructional costs than to the direct costs of student education as costs are thousands of dollars more at research universities (Wellman, Desrochers, &Lenihan, 2008). "Low-income students tend to cluster in community colleges and relatively open admissions universities; high-income students tend to cluster in selective admissions universities" (McPherson & Shulenburger, 2008, p.32). Students recognize that a college degree adds an outstanding value to their future earning potential and as a result tuition will likely continue climb beyond manageable subsidy levels because of demand (Wellman, Desrochers & Lenihan, 2008; Goldrick-Rab & Roksa, 2008). This might be an exception in areas where there is an extremely higher cost of living. Black, Kolensnikova & Taylor (2009) found that earnings and returns to education vary by location. In their study, returns on a college education tend to be less in large, expensive cities because of the higher cost of living (Black, et. al., 2009). While returns on education vary location, so do the market forces and opportunities vary.

Market Forces

In the last fifty years, the United States experienced a remarkable increase in educational attainment, yet not all areas have been affected equally, smaller markets and rural areas have not been able to attract new intellectual capital many have even declined from previous levels (Waldorf, 2007; Berube, 2010). This phenomenon is not unique to the U.S., a similar market magnetism or draw for educated citizenry is also occurring in Western Europe and even China/Asia (Kalogirou, 2010; Knight & Shi, 1996; Kavroudakis, Ballas, & Birkin, 2012). Education attainment has a direct link to individual income and rise in developing economies (Knight & Shi, 1996). The knowledge capital gained through educational attainment is strongly reflected in labor-market rewards, as well as a whole host of other benefits, including health, family stability, and lifestyle options (Goldrick-Rab & Roksa, 2008; Sutton, 2008). This uneven landscape of knowledge capital, commonly referred to as brain-gain and brain-drain is a simultaneous occurrence that can stretch though broad regions or manifest in smaller localized pocket-like areas (Waldorf, 2007). Nearly 40 percent of the adults in the Northeast hold a college degree making it the most highly educated region yet less than a third of the adults in the South have a college degree (Berube, 2010; Goetz & Rupasingha, 2003). Examples of highly successful local economies that have national and even international market access are California's Silicon Valley and the Research Triangle in North Carolina. While local areas like Scranton, PA; Modesto, CA and Riverside, CA have relatively lower educated adult population that may present a barrier to attracting diverse knowledge-based industries and the robust economy that these businesses create (Berube, 2010). Some researchers are concerned that the disparity trends will continue to increase "locking in longstanding attainment differences across metropolitan areas rather than narrowing gaps" (Berube, 2010, p.107) thereby creating a long term winner-loser situation (Waldorf, 2007).

Summary

Utilizing spatial analysis in the consideration of how funding, income and place impact educational attainment can provide for increased understanding. Using spatial analysis to expand upon prior research can provide a deeper understanding of issues relating to baccalaureate or higher degree attainment in the United States. Considering the spatial context enables policymakers to consider another level of data and guide decisions. Using geographic location provides an opportunity for educational, policy and social science researchers to explore new possibilities in the analysis of educational attainment. The presentation of spatial analysis and the controls offers a context for the discussion of the conceptual framework, specifically how these variables fit with the concepts that are guiding this study.

CHAPTER THREE: CONCEPTUAL FRAMEWORK

In Chapter One, I discussed the importance of educational attainment for the economic well-being of communities and individuals, as well as, the potential benefits of using a spatial approach to analyzing educational attainment. In Chapter Two, literature on spatial analysis, GIS, and educational attainment were presented. Emphasis was placed on the use of spatial analysis, the history and use in education research, and factors attributed to educational attainment. In this study, I examined the spatial dependence of educational attainment and further analyzed how the consideration of geographic location can improve educational attainment studies.

This chapter introduces the conceptual framework that guides this study. I begin by discussing the concept of geography of opportunity. I provide a discussion on the application of the concept of geography of opportunity to educational attainment. Next, I discuss the comprehensive economic framework for analyzing educational attainment as constructed by Haveman & Wolfe (1995). Finally, I integrate the comprehensive economic framework for analyzing educational attainment with the concept of geography of opportunity to create a unifying framework to address educational attainment.

Geography of Opportunity

The conceptual framework that was employed in this study utilized a lens that was grounded in the construct of the geography of opportunity. The concept of geography of opportunity is defined as the notion that, "where individuals live affects their opportunities and life outcomes," (Rosenbaum, 1995, p. 231). This framework was originally presented by Galster & Killen (1995) and is largely linked to the work of Briggs (2005) relating to housing and race. This concept indicates that individuals' opportunities are influenced by geography (Galster &

Killen, 1995; Rosenbaum, 1995; Briggs, 2005; Rosenbaum, Reynolds & Deluca, 2002). The concept of 'geography of opportunity' holds that not only are current opportunities influenced by the geographic location of individuals but also future opportunities and outcomes are affected by location (Galster & Killen, 1995; Rosenbaum, 1995). Traditionally in the housing literature, the uneven geography of opportunity was "color coded" and the mechanism of varying opportunity was largely based on race and socioeconomic status within specific metropolitan areas (Briggs, 2005). In this study, I not only looked at the traditional notion through race and income but further considered the clustering of other variables of opportunity based on factors such as income and industry prevalence within a state at a national level.

Opportunities are routinely presented in proximity or connection of social structure/contacts. This network of contacts can offer benefits for individual members of the social circle. The geography each network encompasses varies on the nature of the social structure and the resources of the network members. This variance is in part is due to the information that individuals use in decision-making. In other words, individuals have a varying amount of information depending on their social circle. "Perceptions might match reality perfectly, but reality varies geographically. Or reality might not vary geographically, but perceptions of it do" (Galster & Killen, 1995). As an overarching theme in geography of opportunity literature, even though individuals may have the same opportunity as those in other geographic locations, the perceived opportunity varies. This concept is similar to that of Wilson's on deprivation in neighborhood effects. Both assume that the environment within the geographic location influences opportunities and aspirations.

The construct of geography of opportunity is not to be confused with the concept of "community social capital." Community social capital is short sighted in that the approach considers human capital that is passed on generationally. This approach omits the peer effects that contribute to outcomes (Manski, 1993; Johnson Jr., 2012). The geography of opportunity allows for a more holistic approach that considers how the current location impacts individuals' future outcomes. Galster (2012) contends that for low income minorities, location is progressively becoming the hurdle for advancement. According to Galster (2012), opportunities are restricted by two factors. These factors are race/ ethnic origin, and socioeconomic status. These factors vary between locations. Opportunity is influenced by the types of economic activity within the location. "Income inequality begets income segregation, and income segregation facilitates the reproduction of poverty," (Wodtke, Elwert and Harding, 2012).

Geography of opportunity holds that place matters. Place or location matters because there are uneven opportunities based upon location. These uneven opportunities influence outcomes. Location (or space) matters because as Wodtke, Elwert and Harding (2012) stated, inequities replicates and further produces more inequalities. The importance of location has not gone unacknowledged as more social scientists are beginning to acknowledge place in their studies. Even though social scientists are considering place in research, the construct of the geography of opportunity "has been somewhat underdeveloped as a policy and research topic," (Tate, 2012, p.2) in education. The next section will present how the concept of geography of opportunity has been used in education research.

Geography and Educational Opportunity

The value of geography has not been thoroughly examined in education research (Tate, 2012). An uneven balance of opportunity has been demonstrated to influence educational outcomes. Tate (2008) demonstrated that an unequal distribution of opportunity geographically leads to uneven educational outcomes. Therefore, educational outcomes such as attainment are influenced by spatial effects. Again, spatial effects in this context are the influence that location has on educational attainment above and beyond individual attributes such as race and SES.

Spatial effects of educational outcomes have two prongs. This first prong refers to spatial heterogeneity. Spatial heterogeneity is mechanically defined as structural instability meaning that forms and parameters vary by location (Anselin, 1988; Smith, Goodchild & Longley, 2011). Furthermore, spatial heterogeneity describes the variance in relationships from place to place (Rey & Montouri, 1999; Le Sage, 1999; Smith, Goodchild, & Longley, 2011). The difference in location contributes to the uneven distribution of opportunities because of varying processes (Flores, 2008). In an educational context, educational opportunities and outcomes within one location are different and distinct from the opportunities within another location. Spatial heterogeneity relates to the geography of educational opportunity through similar notions that these different educational systems affect educational outcomes differently (either through advantage or disadvantage). These differences could include factors such as k-12 funding or quality of education at the elementary and secondary levels.

The second prong is that the educational outcomes in one location are influenced by the educational outcomes of a location in close proximity. This is referenced as spatial dependence meaning that the educational outcomes in one location have a diffusion or spatial spillover into neighboring locations due to proximity (Anselin, 1988; Rey & Montouri, 1999; Flores, 2008). This second prong also takes into account Tobler's First Law (discussed in Chapter 2) where things that are near are more alike than things that are farther apart. Spatial dependence is the idea that spatial proximity affects outcomes due to exposure and diffusion of neighboring locations (Anselin, 1988; Rey & Montouri, 1999; Smith, Goodchild & Longley, 2011). However, it is important to also acknowledge the possibility for a second form of spatial dependence, referred to as nuisance dependence (Rey & Montouri, 1999; Anselin, 1988). This form of spatial dependence, nuisance dependence, is the result of boundary mismatch. Nuisance dependence can occur when spatial boundaries for government purposes and perceptions are not aligned (Rey & Montouri, 1999). One example of this mismatch could occur when the governmental definition of neighborhoods and the perceptual definition differ. In terms of the concept of geography of opportunity, the second prong furthers the construct by expanding beyond a neighborhood or community idea of place or location to the state level. The construct of geography of opportunity, as used in this research recognizes the simultaneous processes of both spatial heterogeneity and spatial dependence.

Geography of opportunity in an educational context, acknowledges spatial heterogeneity of educational outcomes by recognizing that the distribution of opportunities may not be even, either perceptually or actually. Spatial heterogeneity means that the educational outcomes vary geographically because the educational opportunities are distributed differently. Using this construct, the opportunities in one state are different and unique from the opportunities in another state. A few examples of these differences are state allocation of funds per full-time equivalent student, the number of institutions (institutional access) or market demand for college educated workers. These distinct differences in opportunity can result in different outcomes.

Spatial dependence of educational outcomes means that the educational attainment levels in one location (i.e. state); influence the educational attainment levels of another state based on proximity. These influences become weaker as distance, or proximity, increases. This notion relates to Tobler's First Law (1970) which states that closer things are more similar than distant things (Flores, 2008). As the distance between locations increases, the spatial dependence on educational outcomes becomes less important. Under this premise of spatial dependence and geography of opportunity, educational opportunities are not isolated to one state but these opportunities spillover or diffuse to other states, as well.

Even though geography influences opportunities and subsequent baccalaureate attainment and builds upon existing education research literature by considering geography, only considering location as a factor omits the vast body of educational attainment research available. Therefore this conceptual framework seeks to include factors that have been considered influential in modeling educational attainment. In order to realize and actualize the demands of the labor force presented in chapter one, the framework needs to not only look to advance education research through the inclusion of geography but also look back to traditional social science and economic studies of educational attainment in order to guide variable selection. In attempting to consider both common determinants of educational attainment from the social science and economic perspectives, the integrated framework guiding this research will be comprised of elements of the comprehensive economic framework for education attainment. The comprehensive economic framework for educational attainment is discussed in the ensuing section.

Comprehensive Economic Framework for Educational Attainment

As discussed in the literature review, economic and social science perspectives have considered and emphasized multiple factors in determining educational attainment. These various factors contribute differently to the extensive body of research on educational attainment. The framework described below will serve as a guide in the variable selection of this research since it encompasses the market needs for higher percentages of the workforce to have a bachelor's or higher degree, as presented in chapter one, through individual choice; while still acknowledging the role of income and finance in educational attainment.

Haveman & Wolfe (1995), considered both economic and sociological models to educational attainment to synthesize what has been coined a more comprehensive economic framework. Tate (2012) makes a strong case for the value of interdisciplinary research to create a more comprehensive plan that considers a broad range of community factors. In 1970, prominent psychologist Edmond Gordon cited "the challenge of educating so called 'socially disadvantaged children' is not a matter of pedagogy, but rather it involves all aspects of the community" (Tate, 2012, p. 524). This concept can be reasoned to justify that the level of opportunities and resources available in a community are extended to the individual either as a benefit or detriment when compared to other individuals and their respective communities' opportunities and resources. The nature of geography of opportunity is furthered extended a long this line of reasoning when considered in the context of Haveman & Wolfe's (1995) model of choices. The Haveman & Wolfe (1995) framework views the educational attainment of children as dependent on three principal factors. These factors are:

1) Choices made by government. This factor accounts for the social investment in resources and spending towards education.
2) Choices and circumstances of parents (or family).This factor accounts for family income, and expectation environment.
3) Choices made by individuals. This factor assumes that individuals have considered the benefits and made choices that best reflect their own interest (p.1836).

This framework is based on the view of choices. All three factors, government, family and individuals, are able to make choices that best serve their interests given the information and opportunity available to them (Haveman & Wolfe, 1995). The factors in this framework were utilized for variable selection. In the context of geography of opportunity the choices made externally, outside the individual or their family, influence the opportunity of that geography.

Under this framework, governmental choices and influences were represented as the federal and state role in financing higher education. As stated in chapter two of the literature review, education is considered primarily to be a state and local function, however, federal funding is increasing. Therefore, two governmental funding variables were considered in this research, in order to distinctively view the state and U.S. Department of Education role in financing higher education. Family or parental resources represented a proxy for family choices and expectations. Individual choices were represented by the percent of the workforce to obtain a high school diploma or equivalent.

This research study utilized and integrated the three factors in this maximizing approach to educational attainment analysis for variable selection. This framework was integrated with the concept of geography of opportunity to synthesize an integrated approach that considered not only traditional social science and economic variables but also geographic location in order to better understand the phenomenon of educational attainment. The next section will present the synthesized, integrated framework that was used in this study.

An Integrated Framework

The framework for this study was an integrated combination of the frameworks discussed above. This integration of frameworks is essential since a variety of factors affect individuals and their states. Both are unique, complex and influenced by the macro geography and economy of the surrounding states and region that all together create geography of opportunities that are meshed with the choices of the comprehensive framework. Using the comprehensive economic framework for variable selection, I focused on variables that fit into each of the three determinant categories. Geography of opportunity was used as a lens for analysis and discussion. Now, considering the geography of opportunity framework, the spatial location will fit into the government (or social) investment choices as a means to analyze policy. This categorical designation is the most commonly used in studies (Haveman & Wolfe, 1995).

The choices made by government in funding influence the opportunities of residents within each state. Using this framework, government not only sets the spending levels but also provides an environment where various industries will survive and maybe thrive or cease to exist. Government spending is considered a factor directly affecting attainment, whereas, industry has more of an indirect impact. The HS diploma shows the investment individuals are willing to make based upon the opportunities available to them within their geographic boundary. Median family income, the income proxy for resources available, that reflects the quantity and quality of opportunities that families can provide.

The variables in the comprehensive economic framework above are not sufficient to adequately analyze educational attainment. Therefore, we looked to the geography of opportunity construct to provide a more complete understanding of the analysis of educational attainment and further variable selection. Using the geography of opportunity component in this framework, this research also included the number institutions and race as factors in the educational attainment model.

The structural and demographic characteristics of a geographic area are an important variable in educational opportunities (Galster & Killen, 1995; Kain, 2004; Flores, 2008). Structural characteristics include the quantity of institutions within the area. Families with limited financial resources tend to not be as mobile and this leads to pursuing educational opportunities that are proximally closer to home (Kain, 2004; Flores, 2008). Only being able to pursue higher education opportunities within the state, can greatly limit access. Therefore, the number of institutions can play a role in limiting the opportunities available to residents. "An uneven geography of educational opportunities that truncates opportunities for advancement later in life, and creates obstacles for upward social mobility," (Flores, 2008, p.4). The demographics of an area have traditionally influenced outcomes (Galster, 2012; Flores, 2008; Tate, 2008; Tate, 2012). Given the significance of race in the foundations of the concept of geography of opportunity and in traditional educational literature, this study also included a race variable.

This integrated framework will utilize government funding of higher education, family income, industry prevalence, individual choice, quantity of institutions and race as factors through the lens of geography of opportunity to analyze educational attainment. Using the geography of opportunity lens for this framework, this research will examine how opportunities, whether real or perceived vary while including these factors in the model for the analysis of the educational attainment phenomenon. In summation, this integrated theory of educational attainment emphasizes the importance of considering the impact governmental, familial income, individual and structural roles have on earning a baccalaureate or higher degree.

Using these different frameworks in concert to analyze educational attainment will provide for a perspective that includes not only commonly used determinants from both sociology and economic studies but also the consideration of geographic location in order to gain a greater insight and understanding of educational attainment. This collective disciplinary focus is essential if social scientists are to move "beyond parallel play in education research" (Tate 2012, p. 523) and thereby ultimately improve educational attainment for all.

In his recent epilogue, Tate (2012) referenced the term parallel play. This term is generally associated with Mildred Parten's 1932 related research of young children and their development. Tate (2012) noted how transferable the parallel play concept is today when individual are so focused with their own activity they tend to play, communicate or work beside each other rather than with one another. He explained that the term can be evidenced today in the manner that various social scientists, civic leaders and government entities approach research or problem solving plans within the sphere of their own realm instead of interacting for greater intellectual capital. Problem solving in an integrated approach where professionals of various fields of study in educational research and various entities in the problem solving process would likely be far more successful. This study intends to move beyond the notion of parallel play in research by combining traditional factors used in educational attainment analysis with spatial/ geographical methods of analysis.

Summary

Although derived from race and housing, in this study the concept of geography of opportunity is related to educational attainment levels. This resource-based approach to the framework acknowledges that the attaining of a bachelor's or advanced degree is impacted by the geographic location. As applied to my study, this concept challenges the local context by holding that geographical location at the state level influences individuals' educational attainment levels because there is an uneven geography of opportunity (Briggs, 2005; Tate, 2008). Applying this approach enables analysis to be conducted in a more spatial way as opposed to just a linear model. Consideration of the geographical location was used as a means to consider the spatial context of the observation and provide for a potentially better fitting model.

Educational attainment census data and spatial analysis was the focus of this study. The use of other variables such as state and federal funding, family income, percent of the workforce with a high school diploma, industry prevalence, race and institution quantity were considered as controls. These variables were included to enable for a better interpretation of the results. Recognizing the nexus of educational attainment and spatial analysis enables this study to benefit both in policy and practice.

CHAPTER FOUR: RESEARCH METHODS

This chapter discusses the research methods used in this study. This was a quantitative, spatial econometric study using national data. First the chapter discusses the data sources, sample and variables. The next section includes the data analysis methods employed in the study. This study utilized both initial spatial analysis methods of exploratory spatial data analysis (ESDA) and regression analysis to address the study research questions:

1) What are the spatial patterns of the distribution of educational attainment at the state-level for the contiguous United States?

2) How does considering the spatial context of educational attainment influence the relationship between allocation of funds, economic indicators and educational attainment?

    a. Does a spatial autoregressive model provide improved predictive powers over a classic linear regression model in the analysis of educational attainment?

I conclude this chapter with a discussion of the limitations of this study.

Data

This quantitative research utilized data collected from various sources. Multiple secondary data sources were used to gather the data. Data on educational attainment, number of institutions and population for each state were obtained from the United States Census Bureau.

This study employed data collected by the U.S. Census Bureau during the 2000 census, as well as the American Community Survey of 2009. Data regarding the state and federal funding of postsecondary education were obtained from the U.S. Census Bureau and the U.S. Department of Education. Public, secondary data were utilized because it is the most comprehensive, available data that is used in other similar analyses for the purpose of policy decisions.

To address the research questions in this study, I used state level data. State level data was evaluated since policy decisions tend to be based upon findings at a macro, state level. The sample size included all 48 states in the contiguous United States (Figure 1). Figure one presents the study area with the state abbreviations to facilitate ease of state identification and recognition. This study excluded Alaska and Hawaii as those two states exhibit special cases and would be considered outliers in the analysis.

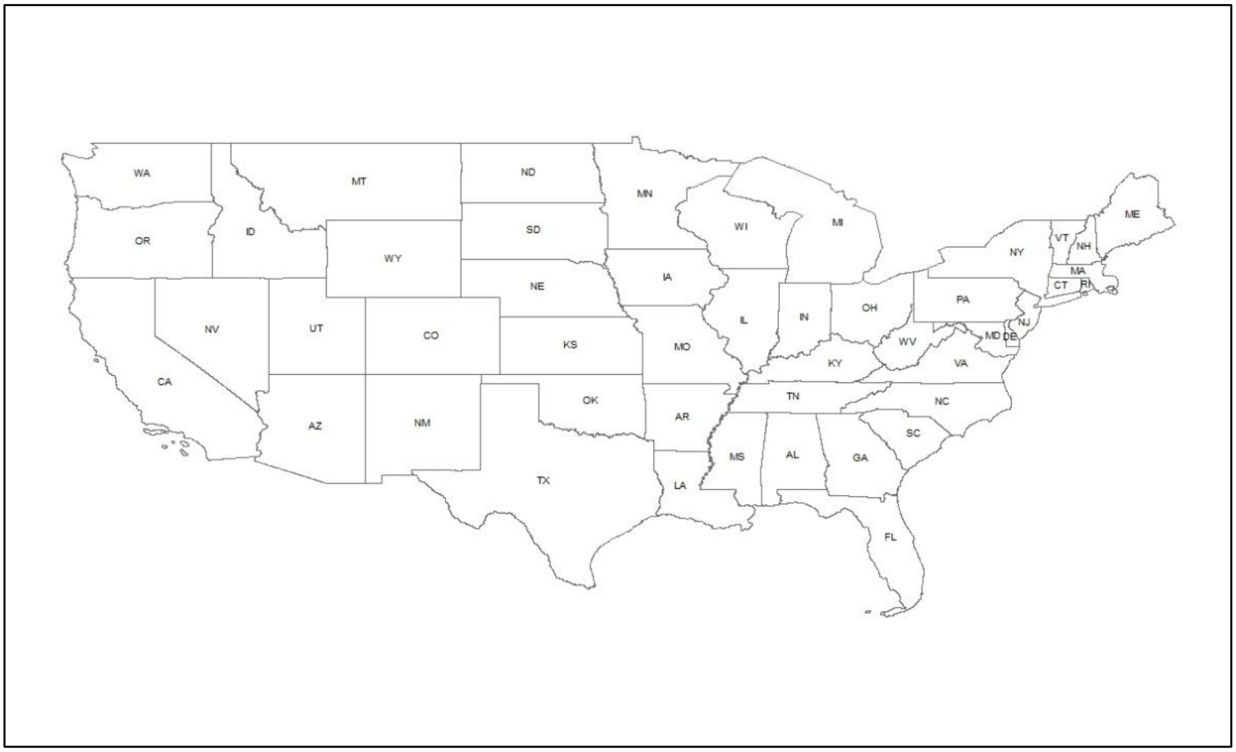


Figure 1. Map of the contiguous United States.

Measures

Dependent variable

The dependent variable considered in this study was the percent of the population that between the ages of 25 and 64 with a baccalaureate degree or higher in 2009. The population category of ages 25 – 64 was be used as a proxy to account for the workforce population. This data information was obtained from the U.S. Census Bureau and was consistent with their definitions. The study defined educational attainment as a baccalaureate degree or higher. This research study was intentional in including both bachelor's degrees and higher as part of the same variable, in an effort to more accurately reflect the educational achievements of each state. During initial data analysis, I noted that for 20 states to include the percent of the workforce population with a bachelor's degree only would misrepresent the educational achievements of 10% or more of the population. Figure 2 displays the states that would have misrepresented educational attainment levels by 10% or more.

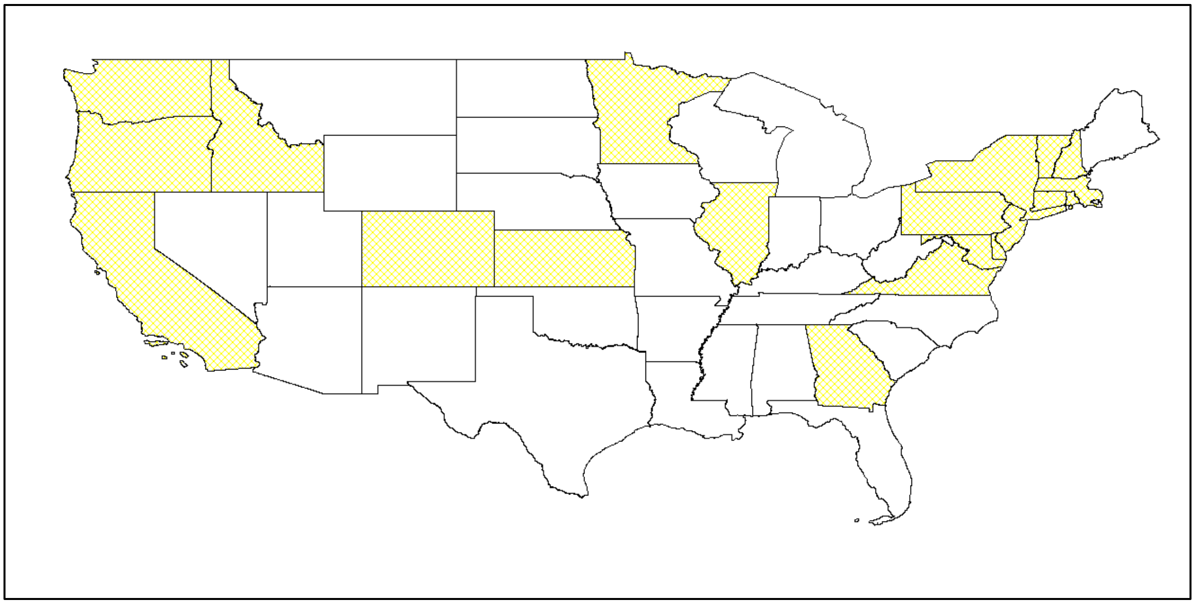


Figure 2. States with a 10% or greater difference between bachelor's degree or higher and bachelor's degree only.

Independent variables

This study used seven independent variables in the analysis. Many of the independent variables were related to economic and financial indicators. The economic variables that were considered in this study included median family income and the percent of the workforce in particular industries. The financial variables included federal postsecondary fund allocations to each state and state appropriations for higher education. Other variables that were examined in the analysis were race and the ratio of institutions within the state. Table 1 provides a complete list of the independent variables used in this research. Table 2 shows the descriptive statistics for the variables considered in the model to address these research questions. Below I will describe these variables and explain why there were chosen for this study.

Funding

There were two types of funding sources considered in this dissertation. The federal component of this analysis considered the allocation of funds to postsecondary education within each state that was provided by the U.S. Department of Education in 2007. The variable used in this research study was a ratio of the federal dollars distributed to each state by the U.S. Department of Education per the total workforce population of that state. A ratio was used to account for how funding varies depending on the population of the state.

This study used funds distributed by the U.S. Department of Education to the states as a proxy for federal funds to postsecondary education. The purpose of these monies from the Dept. of Education is to "to promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access," (U.S. Department of Education, 2010). Therefore, the very nature and purpose of this funding source fits with the conceptual framework, geography of opportunity lens that looks at how opportunity differences vary by location. This ratio is used with the entire workforce population because of the mission of the Department of Education. The goal is to increase access and limit inequalities; therefore this study needs to recognize the monetary access for the entire workforce population. The rise in college student enrollment in the 25 and older category is growing at a faster pace than that of traditional college students (U.S. Department of Education, 2011). Given the rise in non-traditional students and the literature acknowledgement of how individuals enroll in college later in life as an effort to retool and reposition themselves in the market (Betts & McFarland, 1995), this study will look at the entire workforce population[2].

The other funding source was the state and local appropriations, adjusted, to higher education per full-time equivalent student in 2007. This study utilized the adjusted appropriations number to ensure more accurate comparisons of allocations. Full-time equivalents are calculated and defined based upon annual instructional activity as reported to the State Higher Education Executive Offices. These calculations "exclude enrollments in public medical, osteopathy, dental, and veterinary schools" (SHEEO, 2012). The state appropriations, adjusted, are defined as the allocations per student adjusted for inflation, state cost of living, and public system enrollment. This number provided for a better comparison between the allocations of funds in each state. For example, when comparing the unadjusted state appropriations to higher education between Connecticut and New Mexico, Connecticut allocates $10,075 whereas New Mexico allocates $8,521. However when considering the adjusted number which accounts for inflation and cost of living, New Mexico appropriations ($8,631) are greater than appropriations in Connecticut ($8,445).

[2] The results found using the federal dollars to higher education from the U.S. Department of Education per full-time equivalent were consistent with the findings for the entire workforce population. See Appendix A for results using federal funds per FTE.

Conceptually, governmental funding was considered for two reasons. The integrated framework which incorporated components of the comprehensive economic framework for analyzing educational attainment considers government choice one of the three main factors in educational attainment. This research used government funding and appropriations to higher education as a proxy for government choice. The second reason for including funding stems from the geography of opportunity component of the integrated conceptual framework. Variance in funding can create uneven opportunity. Other variables that can create uneven opportunity include median family income, percent of the white population and the ratio of institutions per the workforce population. These variables will be discussed below.

Median Family Income, White Population and Institutions

Median family income was selected as a variable in this study. This dissertation uses the median family income for each state in 2007. Median family income for each state is defined as an annual family income figure representing the point where there is the same number of families earning more than that amount, as there are families earning less than that amount. Similar to the funding variables, this study utilized the median family income number in inflation-adjusted dollars in order to better account for differences by location. The selection of the median family income variable was grounded in the integrated framework's geography of opportunity foundation, as well as the parental factor of the comprehensive economic framework.

The geography of opportunity component of the integrated framework is the reason that the percent of the white population was considered in this study. This variable is the percent of the population that is white, alone. In this dissertation, white alone means non-Hispanic and not multi-racial. The concept of the geography of opportunity was originally focused on the studies of race and housing. A critical component of the framework is focused on race. Even in the present use of educationally focused studies with a geography of opportunity framework, race is considered. Therefore, in keeping with the traditional focus of geography of opportunity grounded research, this study will look at the role that the racial composition of the state has on educational attainment.

The number of institutions is also considered in the spirit of geography of opportunity. Conceptually, if there is a limited or lack of higher education institutions in the state, then there is also an absence of opportunity for the residents of the state to earn a baccalaureate degree, at least without leaving the state. Therefore, this creates an uneven opportunity for residents of certain states to achieve a higher level of educational attainment. Additionally, the number of institutions proportionate to the population is also a factor. This research uses the ratio population number per institution as the variable. The reason that a raw number is not used is due to the large variance in state populations. For states with the smaller populations, there is not the same need for higher education institutions as there is for states with the largest populations. In addition to the number of institutions, the percent of the workforce with a high school diploma or equivalent also is an important variable in determining educational attainment.

High School diploma and equivalent

The variable of the percent of the workforce population with a high school diploma or equivalent in 2004 was another variable used in this study. Selection of this variable was grounded in components from the comprehensive economic framework that is used in the integrated framework. This variable is within the choices made by individuals factor. This research assumes that the residents within the state have considered the benefits and made choices that best reflect their own interest. In this case, the benefit is of earning a high school diploma or equivalent. Also, this variable works as a baseline in this study since earning a high school diploma, GED or some equivalent degree is a prerequisite for obtaining a bachelor's degree. The reason this study uses the data from 2004 for this variable is due to the fact that it traditionally takes four years to complete a bachelor's degree. The study used bachelor's degrees or higher for the year 2009, so using high school diploma data from 2004 provides five years, one more than it traditionally takes to earn a baccalaureate degree. Another variable that influences choice and opportunity are the types and prevalence of jobs in various industries.

Industries

This study examined the relationship of educational attainment and two different types of industries. This research utilized both the goods-producing industry and information technology industry. For the purpose of this study, goods-producing industries includes those of manufacturing, construction, mining, farming, forestry, fishing and other related activities. This study used jobs in information, professional, scientific and technical services, and computer and electronic product manufacturing to comprise the informational technology industry. A mean of the information technology industry is used because this section accounted for two thirds of per capita income group in metropolitan areas during the 1990s (Goetz & Rupasingha, 2003) Both of these variables consisted of data from the year 2007. The year 2007 was selected to better understand the relationship between educational attainment and the types of jobs and employment prevalent within the state.

This research study acknowledged the presence of endogeneity in the dependent and explanatory variables. For example, it is safe to assume that the higher the median family income is within a state, the higher the percent of the workforce population with a bachelor's degree will be. In an effort to limit and address the concern of what came first, higher income or higher educational achievement levels (for example), this study utilized a time lag. However, endogeneity still might be present to some extent in the models. In all, these independent variables are grounded in the conceptual framework and provide for a better understanding of educational attainment at the state level.

Table 1. List of Independent Variables

Independent Variables
State appropriations, adjusted, to higher education per FTE in 2007
Federal postsecondary funds allocated to the state by the U.S. Department of Education in 2007
Median family income in 2007
Percent of the workforce with a HS diploma in 2004
Share of workers in a goods-producing industry in 2007
Share of workers in information and communication technology industry in 2007
Percent of the workforce population that is White, (non-Hispanic) in 2008
Ratio of the number of institutions per the workforce population in 2007

Table 2 Descriptive statistics for the variables used for the analysis of educational attainment model

Variables	Mean	Std. Dev.	Min	Max
Percent of the Population with a Bachelor's or higher degree in 2009	29.04%	11%	19%	42%
State appropriations, adjusted, to higher education per FTE in 2007	$6,709.46	$1,992.87	$2,413.00	$15,136.00
Federal postsecondary funds allocated to the state by the U.S. Department of Education per workforce population in 2007	$101.11	$31.08	$33.18	$221.10
Median family income in 2007	$60,603.08	$9,042.17	$44,769.00	$82,404.00
Percent of the workforce with a HS diploma in 2004	29.41%	4.18%	20.40%	41.97%
Share of workers in agriculture industry in 2007	18.30%	3.33%	10.65%	24.41%
Share of workers in information and communication technology industry in 2007	8.37%	2.12%	4.89%	13.41%
Percent of the workforce population that is White, (non-Hispanic) in 2008	74.22%	13.59%	41.74%	95.25%
Ratio of institutions per workforce population in 2007	34,851.57 people per institution	12,844.68 people per institution	13,770.32 people per institution	74,943.59 people per institution

Data Analysis

This study seeks to contribute to the literature by identifying and examining the spatial patterns of baccalaureate and advanced degree attainment in the United States. As well as to improve model "fit" in the analysis of educational attainment. Further, this study integrated two conceptual frameworks to provide a new lens for understanding and analysis. To effectively answer the research questions, this study applied both spatial analysis and regression analysis. The following sections describe the methods of analysis.

Spatial Analysis

To answer the first question relating to the spatial dependence of educational attainment, I employed spatial statistics tools in exploratory spatial data analysis (ESDA). ESDA is used to describe and represent spatial distributions, identify association patterns and clusters, and recognize spatial outliers (Dall'erba, 2005). This method consisted of first mapping the distributions to visualize the data. Before continuing analysis, I defined a spatial weight matrix. Next, I conducted further analysis of the spatial distribution of educational attainment using the Moran's I, Moran's scatterplot and local indicator of spatial association (LISA). Below I describe in greater detail each of these the spatial methods.

Mapping the Distributions

Mapping the distributions provides an initial point of analysis. This study created chloropleth maps of the distributions of educational attainment, allocation of funds to higher education and income. A chloropleth map is a thematic map proportioned on a statistical measure. For the purpose of this study, the chloropleth maps were divided into four quantiles, two quantiles representing values below the mean and two representing values above the mean.

This method and thematic map type was chosen because it provided a straightforward way to visualize and compare the differences relative to the mean across the geographic area.

The comparative, chloropleth maps, although useful in visualizing data do not provide ample tools for the determiniation of significant spatial effects. To address the limited ability of the maps alone to identify spatial effects, a spatial weight matrix was created to define the connection between places.

Spatial Weight Matrix

A spatial weight matrix provides a structure of assumed spatial interaction relationships, meaning it defines the connection between places. After creating and considering ten spatial weight matrices based on contiguity and distance, I decided to proceed with analysis using a spatial weight matrix based on the k-nearest neighbors, with k = 4. This weight matrix provided the highest Moran's I statistic while still maintaining a p-value of p = 0.001. A table of the different weight matrices is presented in the following chapter of the findings.

This matrix is commonly used in practice (Lee, 2009). The form of the spatial weight matrix is the following:

Let $W_{n,kn} = (w_{ij})$ be a spatial weight matrix constructed based on the k-nearest neighbors

where $w_{ij} = \sum_{i=1}^{n} d_{ij}$.

Then,

$$d_{ij} = \begin{cases} 1, \textit{if } j \textit{ is one of } i\textit{'s } k \textit{ nearest neighbors, where } k > 0 \\ 0, \textit{otherwise} \end{cases}$$

For this study, k = 4.

Equation 1

Moran's I

Moran's I was used to analyze the spatial distribution of the percent of the workforce with a bachelor's degree and higher, federal postsecondary funds allocated to the states, state appropriations for higher education, median family income and poverty level. Moran's I statistics were used to detect global spatial autocorrelation. The Moran's I is defined as,

$$I = \frac{N}{\sum_i \sum_i w_{ij}} \frac{\sum_i \sum_j w_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2}$$

Equation 2

For each variable, the linear association between its value at a location and the spatial weighted average of its neighbors was assessed. Using Moran's I statistics, I was able to detect whether global spatial autocorrelation of the variables of interest were present meaning that the percent of the workforce with a certain level of educational attainment is not randomly distributed by state. Values of I larger than the expected value E(*I*) = -1/ (n-1) indicate positive spatial autocorrelation, signifying high (low) percentage states have a propensity to be clustered close to other high (low) states.

Moran's Scatterplot

Further analysis was completed using the Moran's I scatterplot to assess the global spatial association. The Moran scatterplot displays the value at a location versus the average values of its neighbors. The neighborhood was defined by the spatial weight matrix of k-nearest neighbors, with k = 4. The scatterplot was divided into four different quadrants to denote the four types of spatial association. These quadrants were High-High (HH), High-Low (HL), Low-High (LH) and Low-Low (LL) and are defined as follows:

- Quadrant I (upper-right corner) indicates the states with high values (above average) of the percent of the population with a baccalaureate or higher degree surrounded by states with high values (above average) of the percent of the population with a baccalaureate or higher degree. This quadrant is commonly labeled as HH for High-High.

- Quadrant II (upper-left corner) displays the states with low values (percent of the workforce with a bachelor's degree or higher) surrounded by states with high percentage of the workforce with a baccalaureate or higher degree values. This quadrant is commonly noted as LH for Low-High.

- Quadrant III (lower-left) shows the states with low values (below average percent of the workforce with a baccalaureate or higher degree) surrounded by states with low values (below average percent of the workforce with a baccalaureate or higher degree). This quadrant is commonly labeled LL for Low-low.

- Quadrant IV (lower-right) displays the regions with high values of bachelor's or higher degree attainment surrounded by regions with low values of bachelor's or higher degree attainment. This quadrant is commonly noted as HL for High-Low.

The scatterplot is considered to have few spatial outliers when observations fall within quadrants I or III (HH and LL). The scatterplot was also used to examine the local indicator of spatial associations (LISA) statistic which is further explored in the next section.

Local Indicator of Spatial Association (LISA)

LISA statistics were calculated to better indicate the extent of spatial clustering and autocorrelation of similar values around the observations. This provided an indicator of spatial heterogeneity and the persistence of educational attainment differences. LISA methods assist in the identification of “hot spots” and clusters. LISA significance and cluster maps provided another way to look at the core of the clusters, while considering the statistical significance of clusters.

Regression Analysis

The methods used to answer the research questions in this study relating to the relationship between the funding of postsecondary education, income levels and education was classic linear regression analysis and a spatial lag model.

The independent variables used in the regression models were derived from the integrated framework discussed in Chapter 3. Using this integrated approach, this research contributes to the literature by utilizing the variables used in a comprehensive economic framework of educational attainment in concert with the geography of opportunity lens and variables typically used in the geography of opportunity construct.

The variables used under the comprehensive economic framework component in the integrated framework were funding, median family income, industry, and high school diploma. The choices made by government in funding influence the opportunities of residents within each state. Under this framework, government not only sets the spending levels for education but also provides an environment where various industries exist. Government spending is considered a factor directly affecting attainment, whereas, industry has more of an indirect impact. The HS diploma shows the investment individuals are willing to make based upon the opportunities available to them within their geographic boundary. Median family income, the income proxy for resources available reflected the quantity and quality of opportunities that families can provide for this study. The spatial location will fit into the government (or social) investment choices as a means to analyze policy. This categorical designation is the most commonly used in studies (Haveman & Wolfe, 1995).

The variables in the comprehensive economic framework above were not sufficient to adequately analyze educational attainment. Therefore, the geography of opportunity construct was used to provide a more complete understanding of the analysis of educational attainment and further variable selection. Using the geography of opportunity component in this framework, this research also included the number institutions and race as factors in the educational attainment model.

The structural and demographic characteristics of a geographic area are an important variable in educational opportunities (Galster & Killen, 1995; Kain, 2004; Flores, 2008). Structural characteristics include the quantity of institutions within the area. Families with limited financial resources tend to not be as mobile and this leads to pursuing educational opportunities that are proximally closer to home (Kain, 2004; Flores, 2008). Only being able to pursue higher education opportunities within the state, can limit access. Therefore, the number of institutions can play a role in limiting the opportunities available to residents. The demographics of an area have traditionally influenced outcomes (Galster, 2012; Flores, 2008; Tate, 2008; Tate, 2012). Given the significance of race in the foundations of the concept of geography of opportunity and in traditional educational literature, this study also included a race variable.

Using these different frameworks together to analyze educational attainment provides for a perspective that includes not only commonly used determinants from both sociology and economic studies but also the consideration of geographic location in order to gain a greater insight and understanding of educational attainment.

I first presented a classic linear regression model to determine the relationship. I used the independent variables listed in Table 1 and the dependent variable of the percent of the workforce with a baccalaureate or higher degree. The equation for the classic regression model was:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + \varepsilon$$

Where,

Y = Percent of the population with a bachelor's degree in 2009

a = Constant

X_1 = State appropriations to higher education per FTE in 2007

X_2 = Federal postsecondary funds allocated to the state by the U.S. Dept. of Ed. in 2007

X_3 = Median family income in 2007

X_4 = Percent of workforce with a HS diploma in 2004

X_5 = Percent of White population in 2008

X_6 = Ratio of workforce population per higher education institution in 2007

X_7 = Share of workers in a goods-producing industry in 2007

X_8 = Share of workers in the information technology industry in 2007

ε = Error

Equation 3

In the previous section of this chapter, methods were described to determine whether statistically significant spatial autocorrelation was present. This research determined that spatial autocorrelation was present, therefore a more statistically sound framework is a spatial autoregressive model (SAR). SAR models provide a framework to account for spatial autocorrelation with consistent parameter estimates, meaning the spatial context of the observations can be included in the analysis for improved results (Anselin, 1988). The SAR model that employed in this study was the spatial lag model. The integrated conceptual framework of this study, borrowing from geography of opportunity guided the selection of the spatial lag model that was used in this study. For this study, this model assumes that a dependent variable in one state is in part determined by the dependent variable in another state (Rey & Montouri, 1999). Theoretically, the spatial lag model can be used to account for spillovers and neighborhood interactions (Anselin, 2005). In addition, to a theoretical justification for the use of a spatial autoregressive model there is also the ability to statistically select and justify a SAR model. Using the regression outputs from the classic regression in GeoDa, you can determine the reasonableness of the spatially dependent (or spatial lag) and spatial error model.

The equation for the spatial lag model used is similar to the linear regression model used in equation 3. This spatial autoregressive model adds a spatial weight matrix for the percent of the workforce population with a bachelor's or higher degree in 2009. The following was the equation for the spatial lag model:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + pW * Y + \varepsilon$$

Where,

Y = Percent of the population with a bachelor's degree in 2009

a = Constant

X_1 = State appropriations to higher education per FTE in 2007

X_2 = Federal postsecondary funds allocated to the state by the U.S. Dept. of Ed. in 2007

X_3 = Median family income in 2007

X_4 = Percent of workforce with a HS diploma in 2004

X_5 = Percent of White population in 2008

X_6 = Ratio of workforce population per higher education institution in 2007

X_7 = Share of workers in a goods-producing industry in 2007

X_8 = Share of workers in the information technology industry in 2007

pW*Y = Spatial coefficient

ε = Error

Equation 4

Limitations of this Study

This study has limitations relating to the use of secondary data and the ability to account for mobility.

One of the limitations of this study is the use of secondary data. Using data that was not collected for the purpose of a study can inherently have problems (Carter, 2003). The census will not account for individuals temporarily residing within one boundary at the time the data was collected. Census data although broad in scope does not accurately count all individuals, most likely the census does not accurately represent the portion of the population from lower socioeconomic groups and those with low educational attainment levels.

Although this study intentionally does not examine workforce mobility in the analysis, interpretation of the results in regards to the movement across geographic boundaries was considered. The movement of the workforce with a specific educational attainment level can be attributed to specific sector/industry needs. Analysis of this type would be more accurately categorized as a workforce mobility study which is not the intent/ purpose of this research study.

This study is limited in that it does not account for brain-drain or brain-gain as the research does not examine who is coming into or leaving the state.

The limitations of using secondary data do not outweigh the advantages of using the national data collected and provided by the U.S Census Bureau. Methods of measurement of this data were refined to enhance accuracy. The national scope of this data and the common use in policy decisions also make it a beneficial source for data. Even though limitations exist with this research study, these findings have the potential to contribute to policy and the literature on predictive models for educational attainment.

CHAPTER FIVE: FINDINGS

This study investigated the relationship of educational attainment and geographic location within the contiguous United States.

Research Question 1: The Spatial Patterns of Educational Attainment

To answer research question one – what are the spatial patterns of the distribution of educational attainment at the state-level for the contiguous United States? – I used the spatial statistical tools in exploratory spatial data analysis (ESDA). The first map in this chapter (Figure 3) is a chloropleth mapping of the distribution of the percent of the workforce with a baccalaureate degree or higher in 2009. In the Figure 3 map, it is evident that states appear to be located next to states with similar values. Figure 3 is separated into quartiles, with the lighter colors representing states that are below the mean for the percent of the workforce with a bachelor's degree or higher in 2009; and darker shades represent states above the mean. States with the percent of bachelor's degrees or higher, below the mean (29% of the workforce with a bachelor or higher) seemed to be concentrated in the Southern portion of the country (Table 3); this is consistent with literature (Morris & Monroe, 2009) and popular perceptions of the southeast having fewer individuals with a bachelor's degree or higher. Table 4 lists the states in the highest quartiles of percent of the workforce with a bachelor's degree. States in the highest quartile of the percent of the educated workforce tend to be concentrated in the northeastern part of the country.

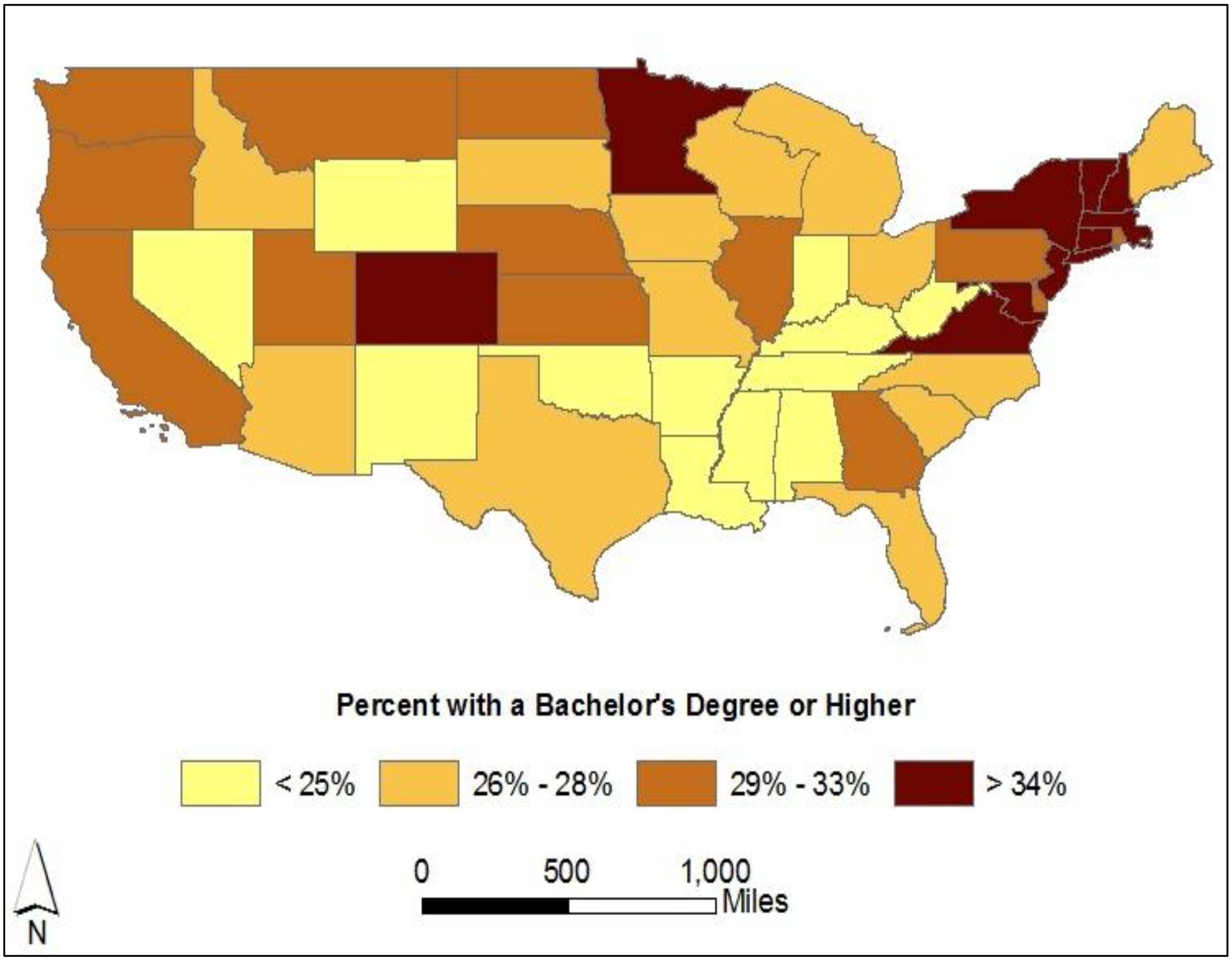


Figure 3. Spatial Distribution of the Percent of the Workforce with a Bachelor's Degree or Higher in 2009.

Table 3. Lowest 12 states for percent of the workforce with a bachelor's degree or higher in 2009, contiguous extent of the United States.

States	% of the Workforce with a Bachelor's or Higher
West Virginia	19.35%
Arkansas	20.11%
Mississippi	20.76%
Nevada	22.12%
Louisiana	22.75%
Kentucky	22.84%
Alabama	23.69%
Oklahoma	24.15%
Indiana	24.43%
Wyoming	24.74%
Tennessee	24.96%
New Mexico	25.46%

Table 4. Highest 12 states for percent of the workforce with a bachelor's degree or higher in 2009, contiguous extent of the United States.

States	% of the Workforce with a Bachelor's or Higher
Massachusetts	41.75%
Connecticut	38.27%
Maryland	37.75%
New Jersey	37.72%
Colorado	37.30%
Virginia	36.08%
New York	35.16%
Vermont	34.69%
Minnesota	34.15%
New Hampshire	33.93%
Rhode Island	33.29%
Illinois	33.24%

The previous map and tables, although useful in visualizing and gaining an initial understanding of the distribution of educational attainment in 2009 do not provide ample tools into the determination of significant spatial effects. To address the limited ability of the map alone to determine spatial effects, a spatial weight matrix was utilized to define the connection between places. After creating ten spatial weight matrices, consisting of both contiguity and distance-based matrices, it was determined that the k-nearest neighbors, with $k = 4$ would be utilized for the analysis as it provided for the highest Moran's I statistic (Table 5). The form of the spatial weight matrix was presented in equation 1, found in chapter four.

Table 5. Spatial Weight Matrix and Moran's I statistics for the percent with a bachelor's degree or higher in 2009.

Spatial Weight Matrix	Moran's *I*	Sig. p-value	Std. Dev.
Rook's Contiguity	0.3976	0.001	0.095
Queen's Contiguity	0.3908	0.002	0.095
K-Nearest Neighbors - 3	0.4790	0.001	0.106
K-Nearest Neighbors - 4	**0.4978**	**0.001**	**0.094**
K-Nearest Neighbors - 5	0.4387	0.001	0.079
K-Nearest Neighbors - 7	0.4347	0.001	0.068
Greater Distance – 204.07 miles	0.3180	0.008	0.123
Greater Distance – 303.24 miles	0.3201	0.002	0.098
Greater Distance – 402.40 miles	0.3466	0.001	0.069
Greater Distance – 501.56 miles	0.3177	0.001	0.060

Moran’s I was used to analyze the spatial distribution of the percent of the workforce with a bachelor’s degree or higher in 2009. The Moran’s I was defined in equation 2.The Moran’s I statistic was used to detect global spatial autocorrelation. For each variable, the linear association between its value at a location and the spatial weighted average of its neighbors was assessed. Using Moran’s I statistics, I was able to detect global spatial autocorrelation of educational attainment for 2009 ($I = 0.4978$; $p = 0.001$). As noted in Table 5, the Moran’s I statistic was 0.4978 using the k-nearest neighbor weight matrix, with k = 4. A permutation approach with 999 permutations was used. Values of I larger than the expected value E(I) = -1/(n-1) indicate positive spatial autocorrelation. For this case, E(I) = -0.0213. This Moran’s I statistic is positive and statistically significant (p-value = 0.001) for all variables meaning that the percent of the workforce with a bachelor’s degree or higher is not randomly distributed by state. For the percent of the workforce with a bachelor’s degree or higher variable, high percentage states have a propensity to be clustered close to other high percentage states. While, states with low percentages of bachelor’s or higher degrees tend to be clustered closer to states that also have lower levels of baccalaureate degrees.

Further analysis was done using the Moran’s I scatterplot to assess the global spatial association. The Moran scatterplot displays the value at a location versus the average values of its neighbors. The neighborhood was defined by the spatial weight matrix of k-nearest neighbors, with k = 4. Figure 4 displays the Moran’s scatterplot for the percent of the workforce with a bachelor’s degree or higher in 2009 using the 4-nearest neighbor spatial weight matrix. The scatterplot was also used to look at local spatial associations which will be further explored in the next section. The scatterplot is divided into four different quadrants to denote the four types of spatial association. These quadrants are High-High (HH), High-Low (HL), Low-High (LH) and

Low-Low (LL) and are defined on the subsequent page (Table 6). In other words, HH means that states with a high percentage of bachelor's degrees are neighboring other states that have a high percentage of baccalaureate and advanced degrees, while low-low graphically shows the inverse. These statistics and graphs illustrate the spatial relationship and impact neighboring states have on one another.

Table 6. Definitions of the 4 Quadrants in the Moran's Scatterplot

Quadrant II (upper-left corner) Displays the states with a low value of degree attainment surrounded by states with high values. This quadrant is commonly noted as LH for Low-High.	Quadrant I (upper-right corner) Indicates the states with a high percent of the workforce with a bachelor's degree (above average) surrounded by states with a high percent of the workforce with a bachelor's degree (above average). This quadrant is commonly labeled as HH for High-High.
Quadrant III (lower-left) Shows the states with a low percent of the workforce with a bachelor's degree (below average) surrounded by states with a low percent of the workforce with a bachelor's degree (below average). This quadrant is commonly labeled LL for Low-low.	Quadrant IV (lower-right) Displays the regions with a high percent of the workforce with a bachelor's degree surrounded by regions with low values. This quadrant is commonly noted as HL for High-Low.

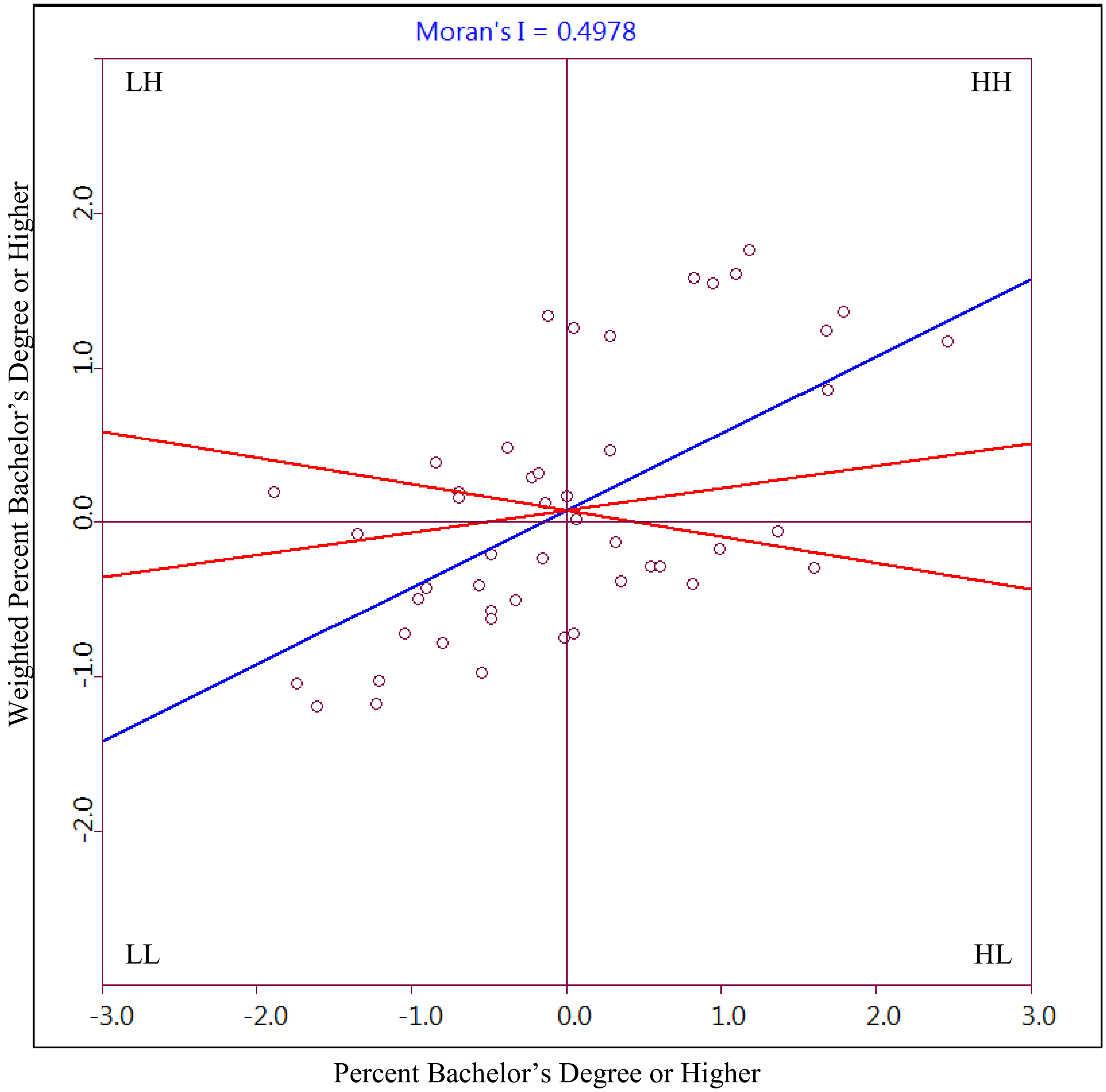


Figure 4. Moran's Scatterplot of the percent of the workforce with a bachelor's degree or higher in 2009 using the K-Nearest Neighbors spatial weight matrix, with k = 4.

Positive, spatial autocorrelation detected by the Moran's I is illustrated with Figure 4 since most states are located in quadrants I and III (HH and LL). This scatterplot has the majority of states fall into HH and LL quadrants. 18 states were considered spatial outliers (states that fall into quadrants HL and LH). The red lines, referred to as envelope slopes, denote statistical significance. Since the slope (blue line) is outside of the envelope slopes, the spatial autocorrelation of the percent of the workforce with a bachelor's degree or higher in 2009 is statistically significant. Table 7 presents the states within each quadrant for percent of the workforce with a bachelor's degree or higher in 2009. The next section further explores the local spatial statistics.

Local Indicator of Spatial Association (LISA) statistics were calculated to better indicate the extent of spatial clustering and autocorrelation of similar values around the observations. This provided an indicator of spatial heterogeneity and the presence of educational attainment disparities at the state-level.

Figure 5 represents the LISA cluster map for the percent of the workforce with a bachelor's degree or higher in 2009. These maps provide another way to look at the core of the clusters. The colors in the cluster map correspond with the four quadrants of Moran's scatterplot. The analysis found two statistically significant clusters, and one state that was a statistically significant outlier. One was associated with low percentage of baccalaureate or higher degree attainment surrounded by other locations of low attainment. These states are represented in blue in Figure 5. Locations that are surrounded by high percentages of bachelor's and higher degrees are concentrated in the Northeast and are depicted in red in Figure 5.

Table 7. Local Spatial Autocorrelation.

Quadrant	**State Name**
Quadrant I (High-High)	Connecticut*
	Delaware*
	Maryland*
	Massachusetts
	Montana
	Nebraska
	New Hampshire
	New Jersey*
	New York*
	North Dakota
	Pennsylvania*
	Rhode Island*
	Vermont*
Quadrant II (Low-High)	Iowa
	Maine*
	New Mexico
	North Carolina
	South Carolina
	South Dakota
	West Virginia
	Wisconsin
	Wyoming
Quadrant III (Low-Low)	Alabama*
	Arizona
	Arkansas*
	Florida
	Georgia*
	Idaho
	Indiana
	Kentucky*
	Louisiana*
	Michigan
	Mississippi*
	Missouri
	Nevada
	Ohio*
	Oklahoma
	Tennessee*
	Texas
Quadrant IV (High-Low)	California
	Colorado
	Illinois
	Kansas
	Minnesota
	Oregon
	Utah
	Virginia
	Washington

*denotes significant local statistic with a p-value ≤ 0.05.

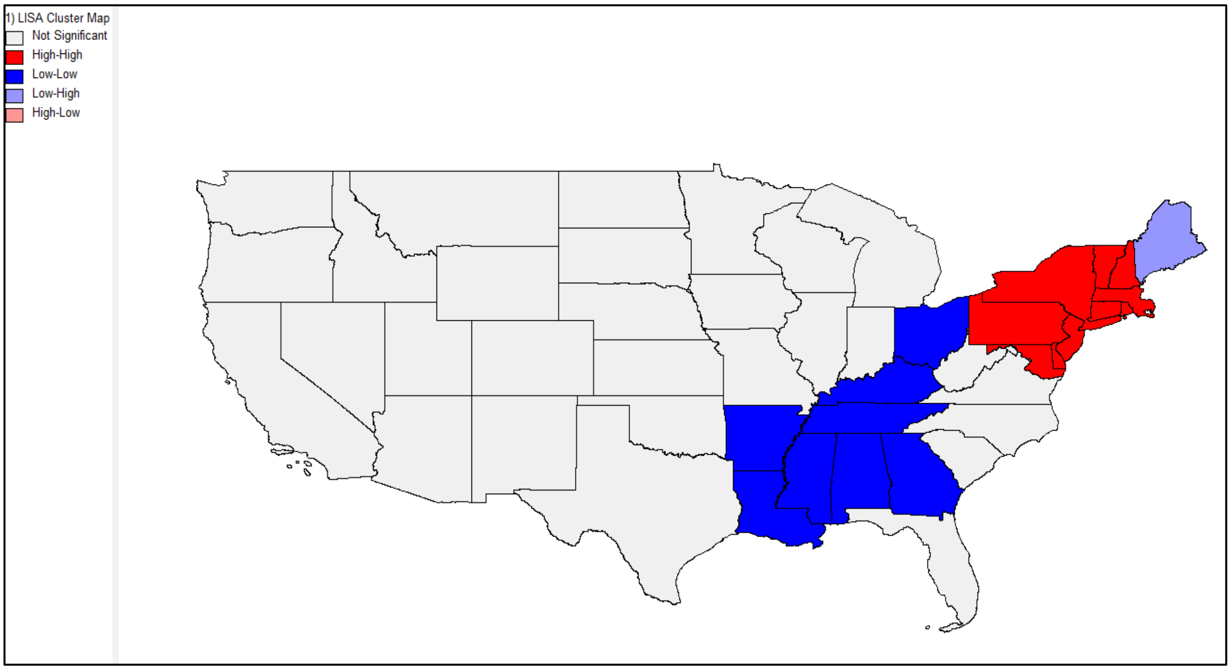


Figure 5. LISA Cluster Map for the percent of the workforce with a bachelor's degree or higher in 2009.

Now that the spatial dependence of educational attainment has been determined, I proceed using a different policy approach to addressing the bachelor degree attainment disparities in the United States. From this analysis, in addressing the low educational attainment levels prominent in the southeastern part of the United States it would behoove policy analysts and leaders to consider the interconnected nature of the states. In addition using the LISA cluster map as a guide, the core of the low attainment states surrounded by other low attainment states in the southeast appear to be Louisiana, Arkansas and Mississippi. This low-low core seems to have an interconnectivity that connects the core through Tennessee up to Ohio[3]. To continue to improve baccalaureate degree attainment, policy-makers at both the federal level and in neighboring states should target and seek to work with the core in the low-low to have results improve and have a "spillover" effect to neighboring states. Simultaneously, states that are at the core of the high-high should be emulated by lower attainment states.

The acknowledgement of spatial dependence is also an important contribution to the literature. Considering the spatial context of the observation can provide the literature with an improved fit in the model. In summation, the spatial relationship of educational attainment needs to be further explored as a means to more properly understand and improve upon predictive models so that efficient policy decisions can be implemented to improve educational attainment levels of the workforce population in the United States. This improved fit will be explored in research question 2. However, before proceeding to the second research question, I performed exploratory spatial data analysis on the independent variables under consideration. The following section discusses the spatial pattern findings in the independent variables.

[3] Returns were consistent with other spatial weight matrices, as well. See Appendix B for results using other spatial weight matrices.

Spatial Patterns of the Independent Variables

This section examined the spatial patterns and distribution of the independent variables that were considered in this study. To better understand the phenomenon of educational attainment and the models presented in this study, I conducted exploratory spatial analysis on the explanatory variables in this study. For the list of the independent variables and the descriptive statistics, see Tables 1 and 2 of Chapter 4. Understanding the spatial pattern assisted in the analysis through the lens of geography of opportunity. Knowing where differences exist in these variables enabled the research to interpret variance in actual and perceived opportunities.

Spatial Patterns of Allocation of Funds

The two types of fund allocation of interest in this study were the U.S. Department of Education funds allocated to postsecondary education and the funds individual states allocate to higher education within the state.

Figures 6 and 7 represent the allocation of funds to higher education. Figure 6 displays the distribution of the amount of federal postsecondary funds the U.S. Department of Education allocated to the states in 2007 while considering the state workforce population in 2007. Figure 7 presents the distribution of state appropriations, with adjustments, per full-time equivalent (FTE) students in 2007. The adjusted figure for state appropriations to higher education per FTE considered cost of living and inflation. This adjusted figure equalizes allocation dollars that provide for a more accurate comparison.

The funds allocated to higher education do not appear to be clustered for either the federal or state allocation of funds. This was confirmed as the Moran's I was statistically insignificant (Table 8). These figures and tables can be interpreted to mean that the distribution of funds at both the federal level to the states and the state level appropriations to higher education per full-time equivalent are not spatially dependent or autocorrelated. In other words, there are not statistically significant clusters of high or low funding distributions to higher education.

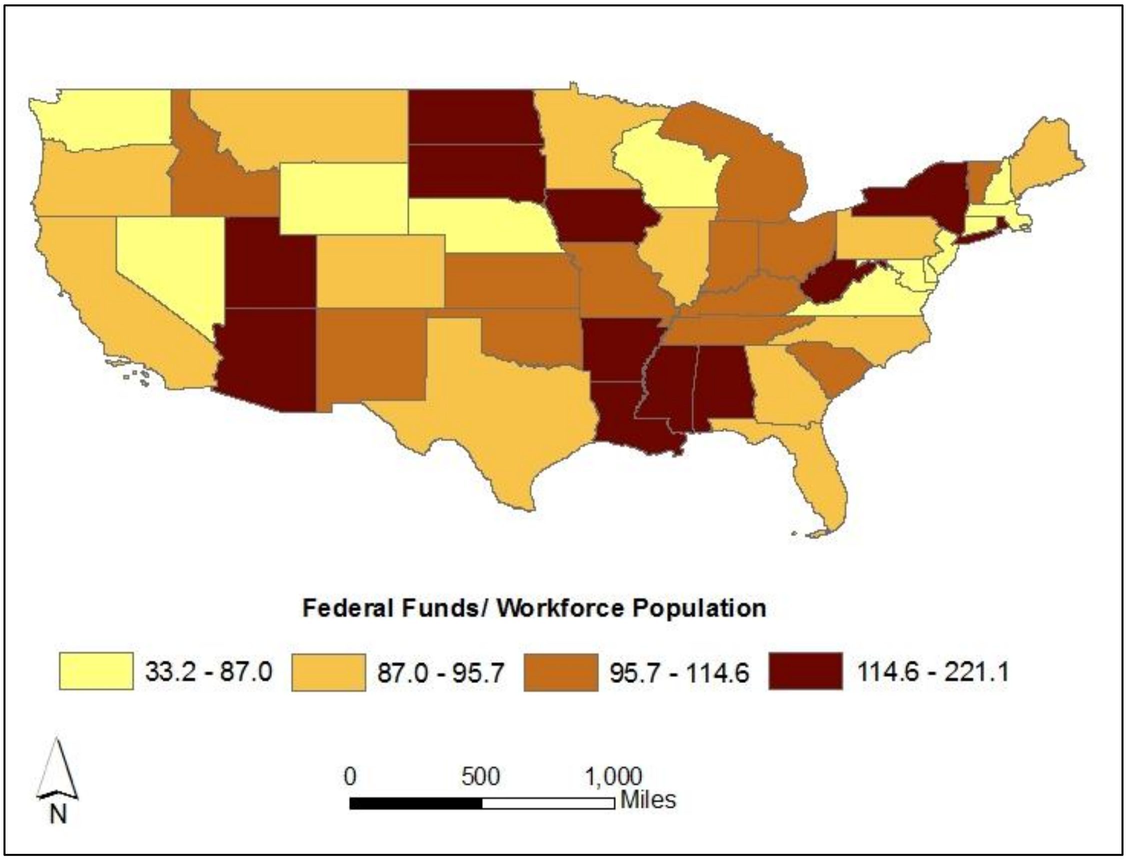


Figure 6. Spatial Distribution of the U.S. Department of Education Funds allocated to the States in 2007 Divided by the Workforce Population of the State in 2007.

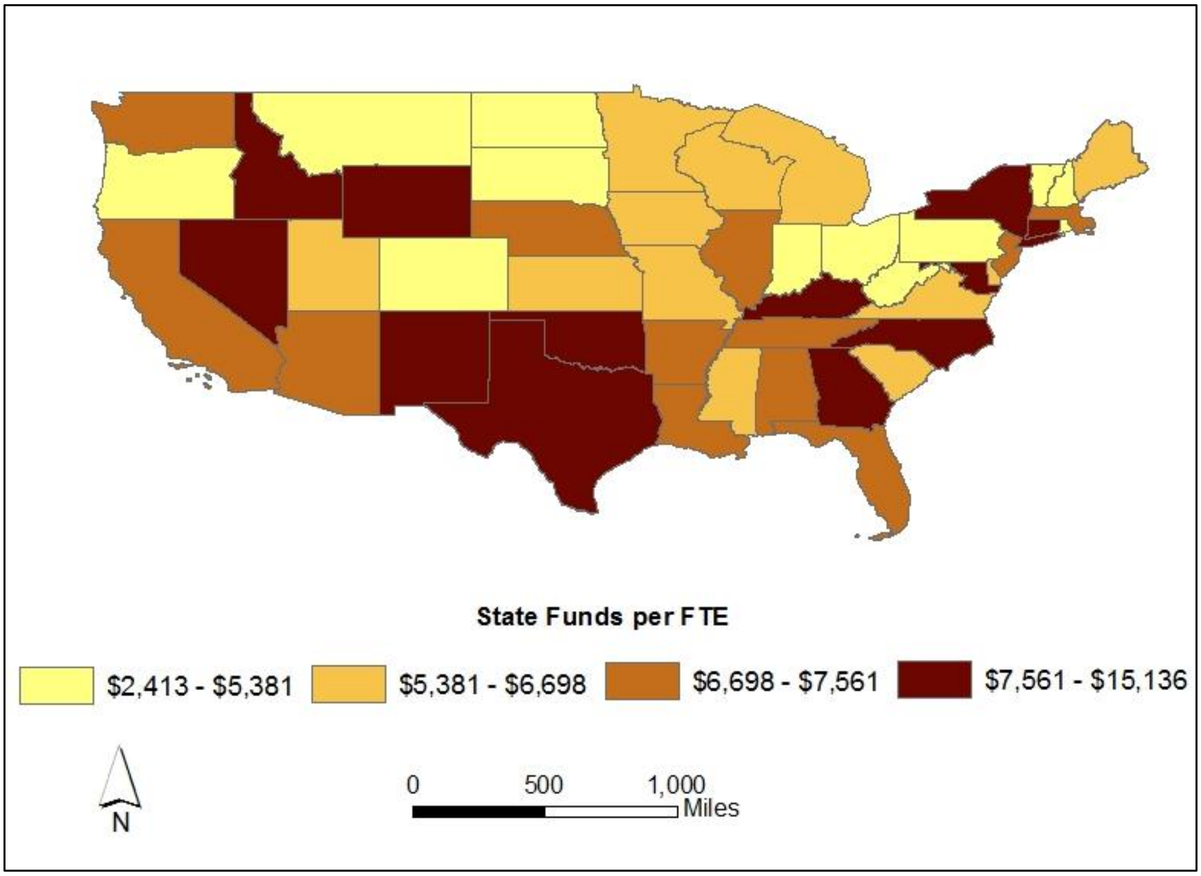


Figure 7. Spatial Distribution of the State Appropriations to Higher Education per Full-Time Equivalent (FTE) in 2007.

Table 8. Moran's I statistics for the funds allocated by U.S. Department of Education to postsecondary education and state appropriations to higher education per FTE in 2007.

Funding Source	Moran's I	p-value
U.S. Department of Education	-0.004	0.59
State Appropriations per FTE	-0.1085	0.14

Spatial Patterns of Economic Indicators

The two economic indicators that were considered in this study were median family income by state in 2007 and the poverty level in each state in 2007. These variables are inversely related and were both clustered and displayed statistically significant spatial dependence (Table 9). Figures 8 and 9 represent the statistically significant cluster of high and low states for median family income and poverty level by state, respectively. Interestingly, even though median family income and poverty level are considered inverse variables, the core, statistically significant cluster maps were not an inverse image. In particular, Florida and New York stand out. Florida is considered a state with a low median family income (part of the low-low cluster in Figure 8) but has lower poverty levels than the neighboring states (Figure 9). Both of these occurrences are considered statistically significant (p-value = 0.05). Meanwhile, the state of New York is considered to be a state with a high median family income and surrounded by other states with a high median family incomes (Figure 8) at a statistically significant level (p-value = 0.01), yet it is simultaneously considered to be a high poverty level state that is surrounded by states with low poverty levels (High-Low). For the median family income variable, the state of Maine is light blue, meaning Low-High. This can be interpreted as the median family income of Maine is lower than that of the neighboring states, which have statistically significant high median family incomes.

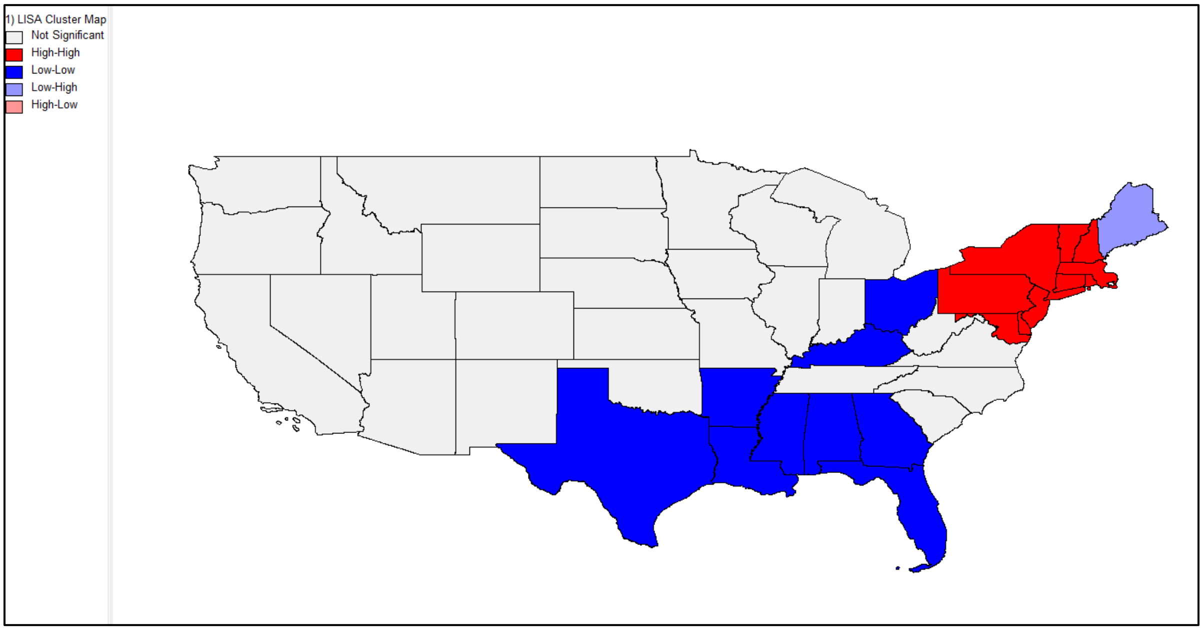


Figure 8. Cluster Map of the Median Family Income in 2007.

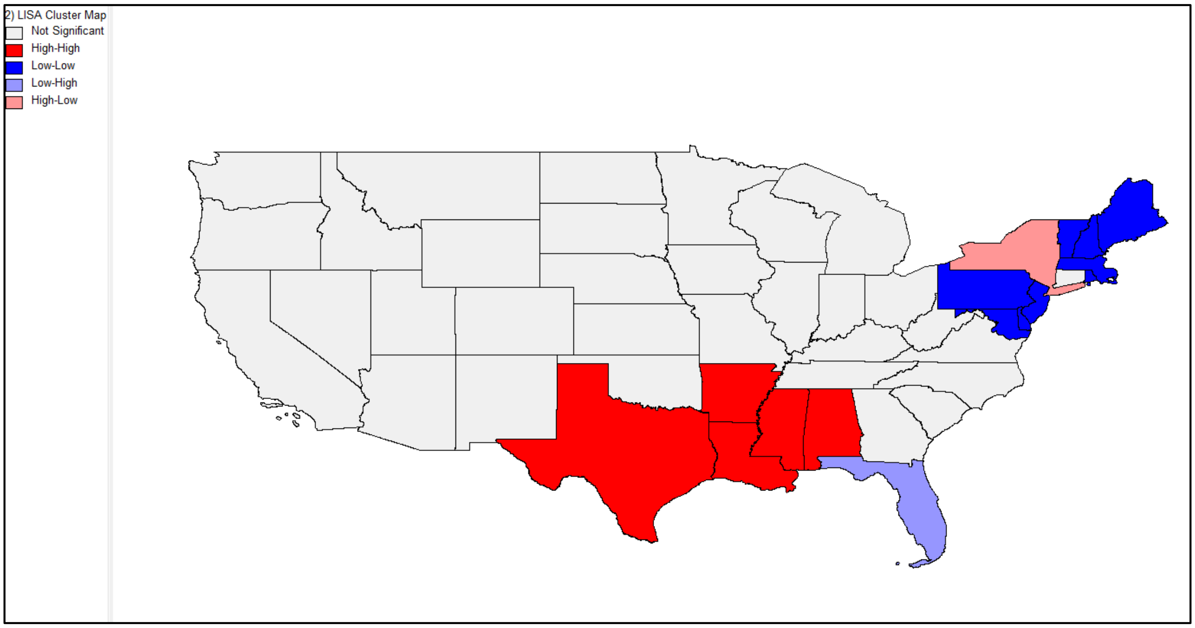


Figure 9. Cluster Map of the Poverty levels in 2007.

Table 9. Moran's I statistics for the spatial distribution of median family income and poverty level in 2007.

Economic Indicator	Moran's I	p-value
Median Family Income	0.5160	0.001
Poverty Level	0.5224	0.001

Spatial Patterns of Industry

The two types of industries that were considered in this research were goods-producing industry and information and communication technology industry. The goods-producing industry jobs are those positions commonly associated with agriculture and vocational jobs. In this study, goods-producing industries included positions in manufacturing, construction, mining, farming, forestry, fishing and other related activities. The information and communication technology jobs are those positions that frequently thought of being in the high tech industry. This study used jobs in information, professional, scientific and technical services, and computer and electronic product manufacturing to comprise the informational technology industry. To calculate the share, or percentage of workers, in each of these industries, the total number of jobs in all sectors and industries was used.

Both types of industry, exhibited statistically significance spatial dependence based upon the Moran's I (Table 10). The cluster map of the goods-producing industry (Figure 10) and the statistically significant cluster map of the information technology industry (Figure 11) were near inverses of each other. Also of note, a similar high value, statistically significant cluster was present for the information technology industry, as was present for the median family income. There were also similarities present in the cluster locations for the goods-producing industries as was present for the low median family income clusters. This could be interpreted to mean that the predominance of high tech industry jobs provided for a greater median family income and more opportunity.

Table 10. Moran's I statistics for the spatial distribution by industry type in 2007.

Industry Type	Moran's I	p-value
Goods-Producing	0.3791	0.001
Information Technology	0.2899	0.003

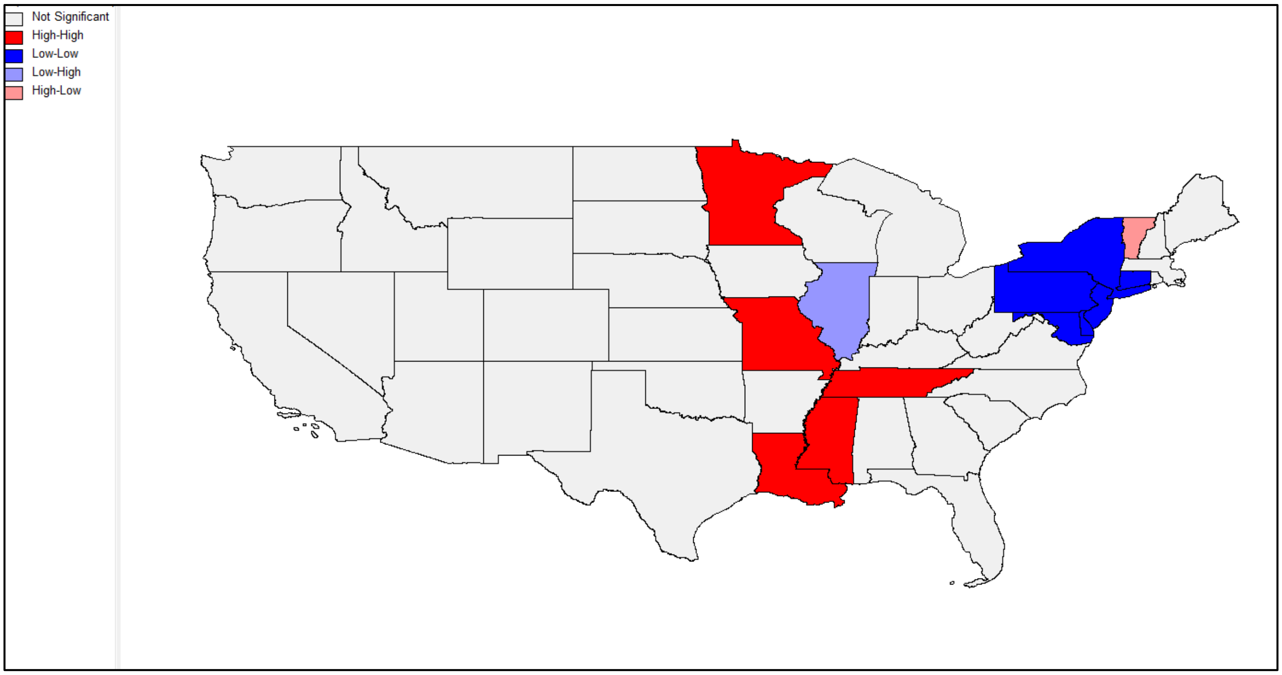


Figure 10. Cluster Map of the Share of Workers in a Goods-producing Industry in 2007.

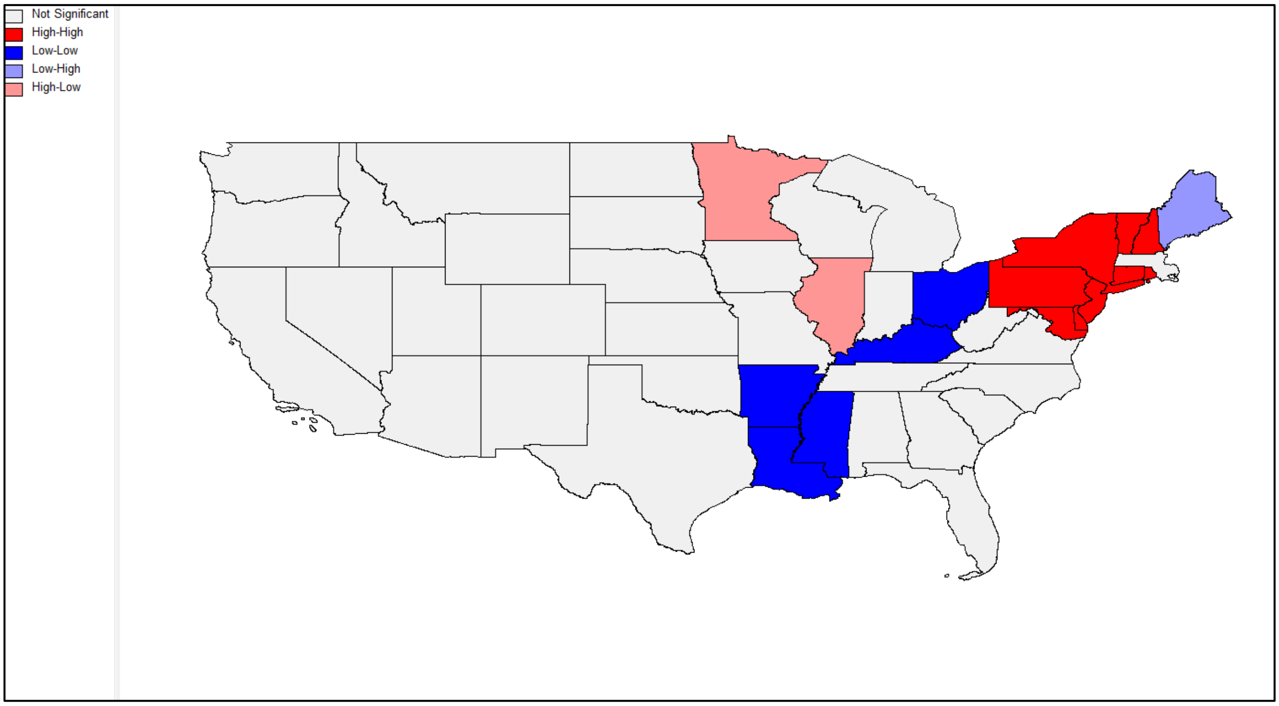


Figure 11. Cluster Map of the Share of Workers in the Information and Communication Technology Industry in 2007.

Spatial Patterns of HS Diploma and Higher Education Institutions

The spatial patterns of the percent of the workforce with a high school diploma or equivalent, the ratio of institutions within a state and the percent of the population that was white, non-Hispanic were also examined.

The spatial distribution of the percent of the workforce population with a high school diploma was spatially autocorrelated. However, the degree and significance at the high school level (Table 11) was less than the findings of this study at the bachelor's or higher degree level. There is little resemblance of the core of the statistically significant high and low clusters of high school diploma (Figure 12) to those high and low clusters of bachelor's and higher degree (Figure 5).

Given the geography of opportunity lens, it is important to consider the access and availability of higher education institutions within a state. The spatial distribution of higher education institutions, when accounting for state population, is barely statistically significant (Table 11) using the Moran's I. In interpretation of Figure 13 through the lens of geography of opportunity, the states at the core of the low-low cluster have the potential to be limited in opportunity and access to higher education institutions. The low-low cluster defines states that have fewer than average higher education institutions within the state boundaries and their neighbors also have a lower number of institutions per the population.

Table 11. Moran's I statistics for the spatial distribution of the percent of the workforce with a high school diploma or equivalent in 2004, the ratio of the workforce population to the number of higher education institutions in 2007 and the percent of the population that was white, non-Hispanic in 2007.

Independent Variable	Moran's I	p-value
HS Diploma	0.2868	0.006
Institutions	0.2654	0.010
White Population	0.3791	0.001

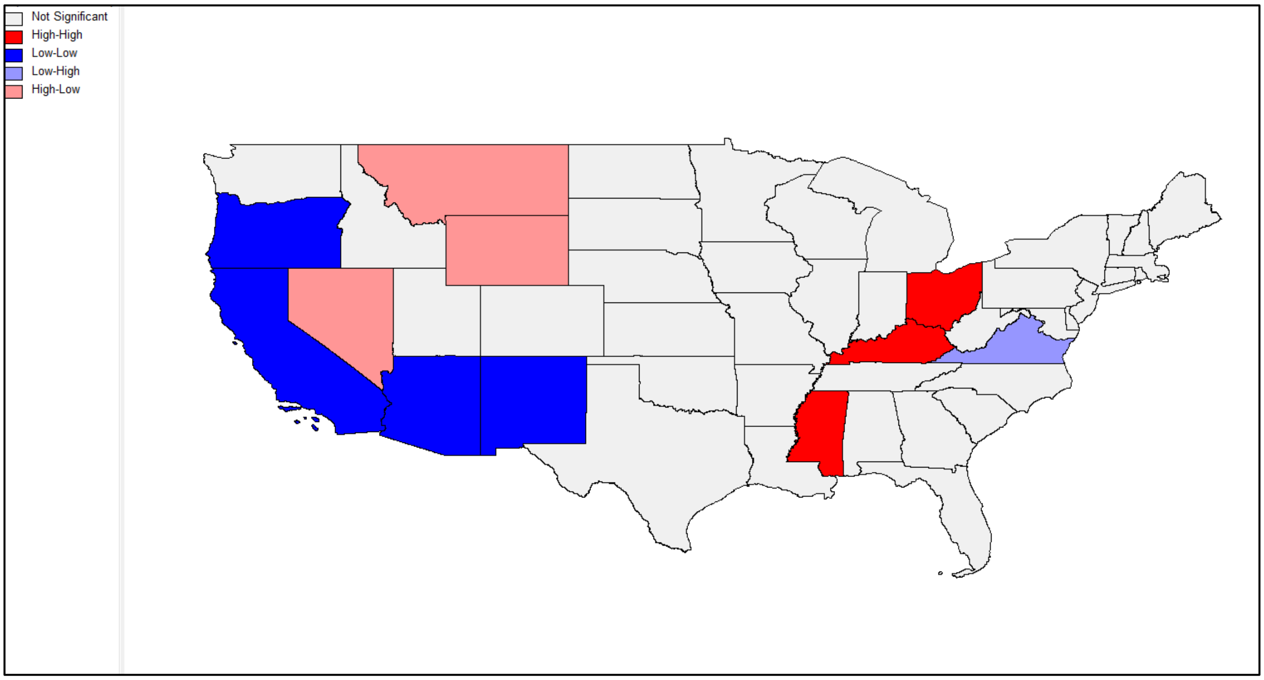


Figure 12. Cluster Map of the Percent of the Workforce with a High School Diploma or Equivalent in 2004.

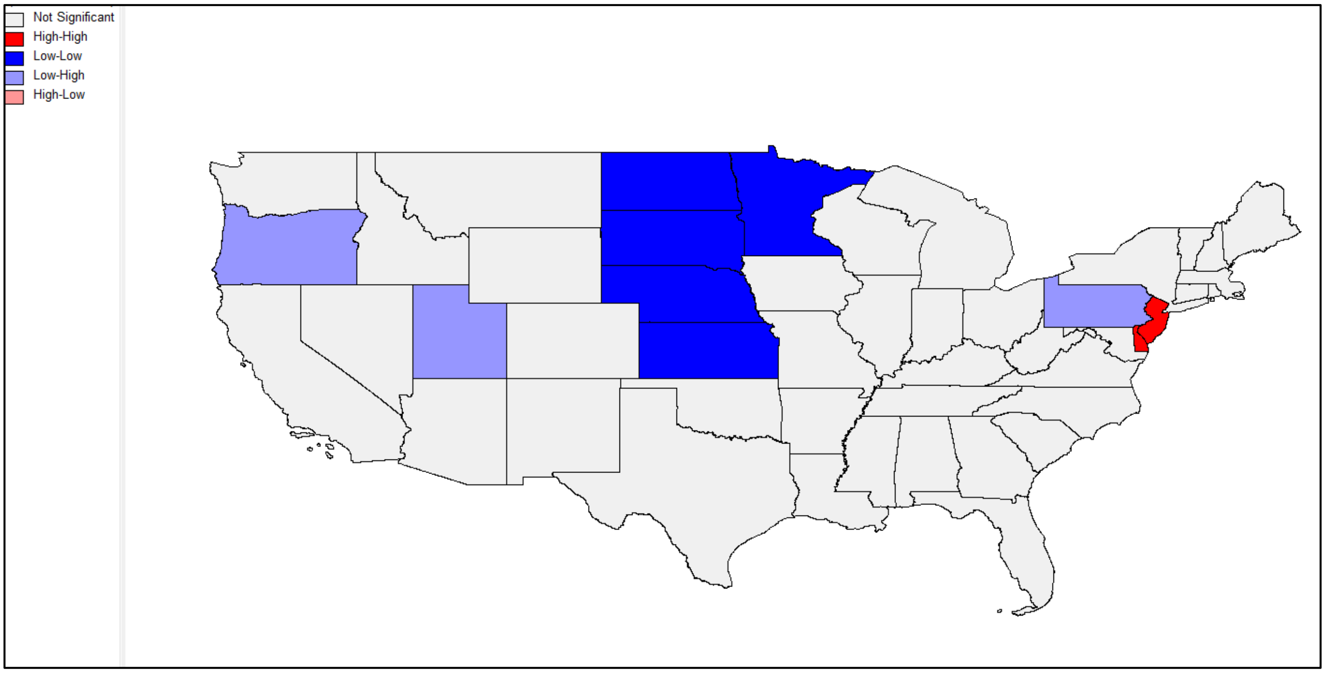


Figure 13. Cluster Map of the Population per Higher Education Institution in 2007.

Spatial Patterns of White Population

The spatial distribution of the percent of the population that is white, non-Hispanic is also spatially dependent at a statistically significant level (Table 11). The core of the clusters that have a high percentage of the population that is non-white (Figure 14) are reflected as low-low. The high-high clusters have high percentages of the population that is white, alone. Of note is the fact that the clusters of high minorities do not closely follow the depressed median family income states, low-low clusters in Figure 8. In fact, the same states that have statistically significant higher percentage of whites (high-high clusters) have statistically significant fewer institutions per population (low-low clusters) in Figure 13.

The findings from the first research question were used to inform the second research question of this study. Now that there this research has determined that the attainment of a bachelor's or higher degree is significantly, spatially dependent we can move forward to analyze a model used to better understand educational attainment. In addition, the findings from the examination of the spatial patterns will be used to assist with interpretation of the findings.

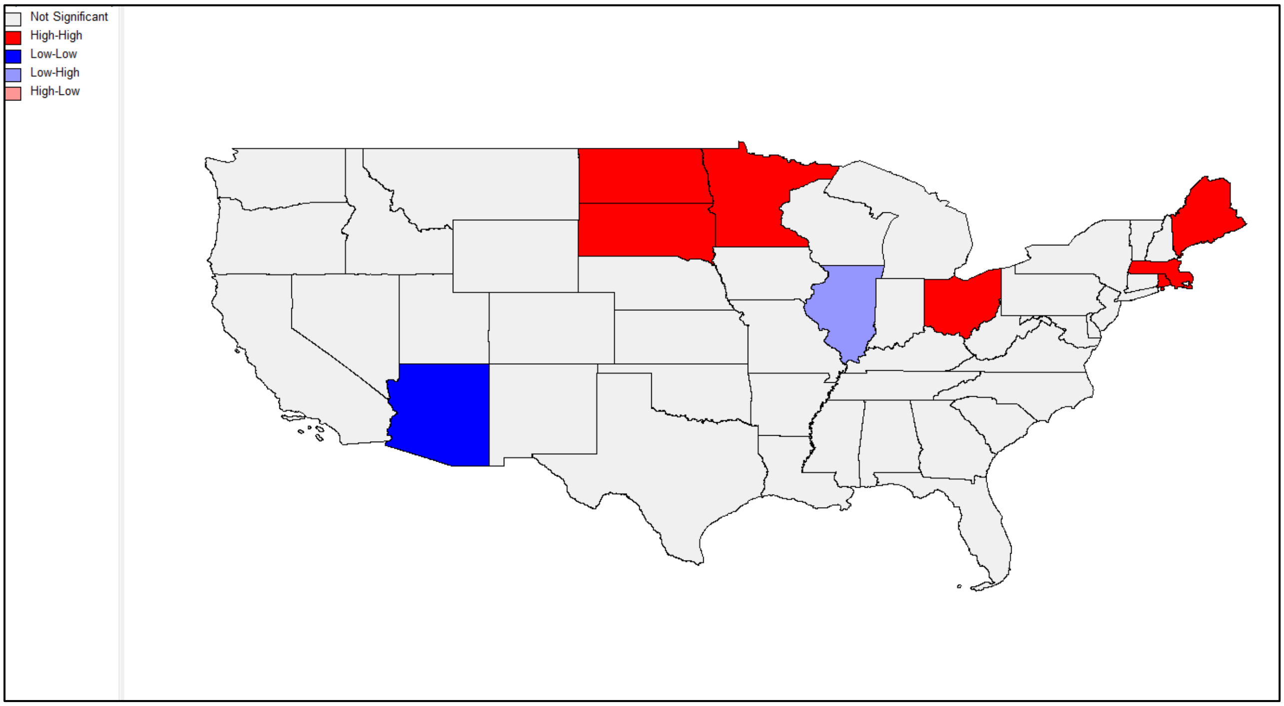


Figure 14. Cluster Map of the Percent of the Population that is White, non-Hispanic in 2007.

Research Question 2: The Relationship between Educational Attainment, Allocation of Funds and Economic Indicators in a Spatial Context

Given the spatial dependence of educational attainment, the second research question was justified. Therefore, the next section of this chapter addresses the second research question and sub-question of this study. How does considering the spatial context of educational attainment influence the relationship between allocation of funds, economic indicators and educational attainment? And, does a spatial autoregressive model provide improved results on a classic linear regression model in the analysis of educational attainment?

Further, to address the sub-question of this study, this research utilized a spatial autoregressive model. Even though a spatial lag model best fits with the integrated conceptual framework of this study that utilizes the construct of geography of opportunity as a lens, this research selected to explore the results using both the spatial lag and spatial error models.

Classic Linear Regression

Traditionally, studies of educational attainment use a classic linear regression model in the analysis of educational attainment. Therefore, I started by conducting analysis of a regression model utilizing eight independent variables to predict the percentage of the workforce with a baccalaureate or higher degree. I analyzed these variables using linear regression with the dependent variable being the percent of the workforce population with baccalaureate degree or higher. This equation was introduced as Equation 3, in Chapter 4 of this study. As a reminder, the equation for the classic regression model used in this study was:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + \varepsilon$$

Where,

Y = Percent of the population with a bachelor's degree in 2009

a = Constant

X_1 = State appropriations to higher education per FTE in 2007

X_2 = Federal postsecondary funds allocated to the state by the U.S. Dept. of Ed. in 2007

X_3 = Median family income in 2007

X_4 = Percent of workforce with a HS diploma in 2004

X_5 = Percent of White population in 2008

X_6 = Ratio of workforce population per higher education institution in 2007

X_7 = Share of workers in a goods-producing industry in 2007

X_8 = Share of workers in the information technology industry in 2007

ε = Error

In equation 3, Y is the dependent variable, and X_1-X_8 are the independent variables. a represented the constant and ε represented the error term. In reporting results of the regression, I report findings through the use of a table (Table 13). The table includes the all variables in the regression model with the statistical significance denoted by asterisk.

In this first regression, the explanatory variables returned a R^2 of 0 .902 and an adjusted R^2 of 0.882. Using the adjusted R^2 to interpret the results, this means that the model correctly predicted the dependent variable 88.2% of the time. In this model, several of the independent variables were statistically significant. As displayed in Table 12, the four statistically significant variables were median family income, the percent of the workforce with a high school diploma, the percent of jobs within in the state in the information and communication technology industry and the ratio of people per higher education institution within the state. Next, I will discuss and interpret the findings from the statistically significant variables.

Median family income was a strong predictor of educational attainment in this classic regression model. The coefficient for median family income can be interpreted to mean that for every $1,000 increase in median family income for the state, there is 0.3% increase in the percent of the population that has a baccalaureate or higher degree. At this level, this number can seem to mean that an increase in median family income will only have a small impact on the overall educational attainment level of the population but under this model these coefficients translate to a $10,000 increase in median family income will result in a 3% increase in the population with a bachelor's degree or higher, when holding the other variables constant. This percentage change equates to approximately 0.27 standard deviations. Poverty level is inversely related to the median family income, which was included in the model. The model was tested both ways and median family income had a greater predictive power than poverty level.

The percent of jobs in the informational and communication technology sector was also a statistically significant predictor in the percent of the workforce with a bachelor's or higher degree. For every 1% increase in the share of jobs in the information and communication technology industry, there is a 0.72% increase in the percent of the workforce with a baccalaureate degree. This is almost a 1 to three-quarter return, in other words for every four jobs created or maintained in this industry type, there are three more state resident with a bachelor's or higher degree, when holding the other variables constant.

The percent of the workforce with a high school diploma or equivalent was statistically significant. However, it had a negative relationship. This could be due to the fact that for if individuals choose not to attain a bachelor's or higher degree than they most likely retain the level of a high school diploma, GED or some equivalent level of education.

The ratio of the state population to the number of higher education institutions was also a statistically significant factor in this model. The coefficient is negative because this ratio accounts for population/institutions, therefore the more institutions within the state the smaller the ratio number. This coefficient can be interpreted to mean that the more institutions per population results in higher degree attainment. In theory this means that if you decrease the ratio of population per institution by 1,000 people then the percent of the workforce population with a baccalaureate or higher degree will increase by 0.79%.

Other variables that were considered in this model were not statistically significant. For this classic linear regression model there were four statistically insignificant variables. These variables included funds from both the federal and state government to postsecondary education within the state, the percent of the population that is White, non-Hispanic, and the percent of jobs in the goods-producing industry.

The governmental funding to higher education from the both federal and state levels were statistically insignificant in the educational attainment model. In fact, both of these variables had a slight negative relationship with percent of the workforce with a bachelor's or higher degree. Conceptually, federal funds from the U.S. Department of Education distributed to states for postsecondary education was not statistically significant most likely due to the fact that these funds are allocated in formulaic matter.

The percent of the population that is White, non-Hispanic was not statistically significant at the level used in this analysis but would be in a study that considered a threshold of $p \leq 0.10$ statistically significant. Even though race was not a significant factor in predicting the percent of the workforce with a baccalaureate or higher degree, it remained in the model because of the integrated framework lens of geography of opportunity. Even though the coefficients were not statistically significant, the race coefficient would be interpreted as for every 1% increase in the white population of a state, there would be a 5.9% increase in baccalaureate and advanced degrees within the state.

Table 12. Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, classic regression model

Variables	Coefficient	Std. Error	Sig. p-value
State Funds	-0.001	0.001	0.397
Federal Funds	-0.003	0.009	0.743
Median Family Income*	0.001	0.001	0.000
Percent with a HS Diploma*	-25.33	9.62	0.012
Percent of the White Population	5.91	3.41	0.091
Goods-Producing Industry	-20.24	14.33	0.166
Information Technology Industry*	72.10	25.78	0.008
Institutions*	-0.001	0.001	0.008
Constant	15.367	7.039	0.035

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Acknowledging the findings of spatial dependence in educational attainment, after reviewing the predictive power, coefficients and significance levels of the classic regression model; I conducted an analysis of the regression residuals. To examine the regression residuals, I used the local indicator of spatial association (LISA) statistic that I used to address research question 1. The Moran's I (0.236) of the regression residuals is statistically significant (0.007) indicating that there are clusters of high and low residuals. The global autocorrelation of the residuals violates the assumption that residuals are independently distributed. The LISA cluster map (Figure 15) displays the statistically significant cluster values and indicates the over and under-prediction of those observations. Red or high values mean large positive residuals. This alludes to model under-prediction. In the case of this study, model under-prediction means that the percent of the workforce population with a bachelor's degree or higher is higher than what would be expected after accounting for all eight independent variables listed in Table 1. Blue or low values indicate over-prediction, meaning that the percent of the workforce with a bachelor's degree or higher is lower than expected when considering the explanatory variables.

The next section looks at the predictive power of the spatial lag model to see if the consideration of the spatial context of the observations can improve the predictive power of the model and provide for a better fit. For comparative purposes, the spatial lag model will include the same explanatory or independent variables as the linear regression model above.

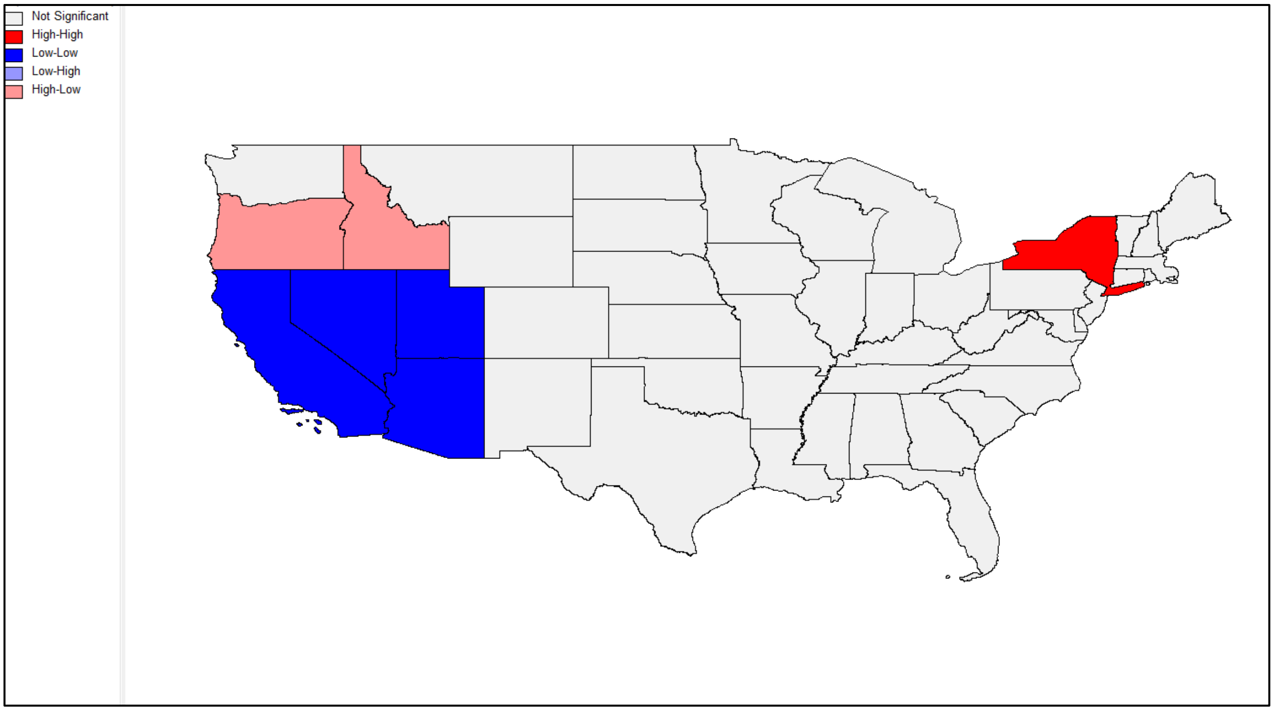


Figure 15. Cluster Map of the Classic Linear Regression Residuals. Blue indicates statistically significant clusters of over-prediction. Red indicates significant clusters of under-prediction.

Spatial Autoregressive Models

Spatial autoregressive models provide a framework to account for spatial autocorrelation and provide consistent parameter estimates. The spatial lag model was used to further explore research question 2, which asked would a spatial autoregressive model provide improved results on a classic linear regression model in the analysis of educational attainment? The spatial lag model was chosen over other spatial autoregressive models such as spatial error and spatial heterogeneity as a result of the theoretical and conceptual framework of this study, as well as the statistical relevance. In the classic OLS regression output, results were returned that showed that the spatial lag model would improve upon the classic regression model (Table 13). Although, the statistical findings showed the spatial error model to provide for the possibility for more improvement over the spatial lag model, the theoretical guiding of this study, in combination with the statistical results, confirmed that the spatially lagged dependent variable model would be appropriate. The integrated conceptual framework for this study considered the locational effects at the state level. This means that the dependent variable, in this case, the percent of the educational achievement in one state, impacts the dependent educational achievement in another state (Rey & Montouri, 1999). Given the framework, the spatial lag model works to theoretically accounts for spillover or neighborhood interactions (Anselin, 2005).

Table 13. Diagnostics for Spatial Dependence

Test	Value	p-value
Lagrange Multiplier (lag)	3.910	0.047
Lagrange Multiplier (error)	5.347	0.020
Robust LM (lag)	1.408	0.235
Robust LM (error)	2.845	0.091

The equation for the spatial lag model used is similar to the linear regression model used in equation 3. This spatial autoregressive model adds a spatial weight matrix for the percent of the workforce population with a bachelor's degree or higher in 2009, as presented in Equation 4. As a reminder, the resulting equation for the spatial lag model is:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + \varepsilon$$

Where,

Y = Percent of the population with a bachelor's degree in 2009

a = Spatially weighted constant

X_1 = State appropriations to higher education per FTE in 2007

X_2 = Federal postsecondary funds allocated to the state by the U.S. Dept. of Ed. in 2007

X_3 = Median family income in 2007

X_4 = Percent of workforce with a HS diploma in 2004

X_5 = Percent of White population in 2008

X_6 = Ratio of workforce population per higher education institution in 2007

X_7 = Share of workers in a goods-producing industry in 2007

X_8 = Share of workers in the information technology industry in 2007

ε = Error

In the spatial lag model, the explanatory variables returned a result of 91.1% for the percentage correctly predicted. This is an improvement of the classic regression model of approximately 1% indicating that the spatial lag model is slightly a better fit. The results of the regression are reported in Table 14.

In this model that considers location; median family income becomes a stronger predictor, whereas race becomes even less significant of a factor. Most of the variables remained relatively similar to the variable coefficients discussed above in the classic regression model and both spatial autoregressive models (Tables 14 and 15). The percent of the workforce in the information and communication industry appeared to have a similar influence on the percent of the workforce with a bachelor's or higher degree in both the classic linear regression and spatial lag models (Tables 12 and 14). Table 16 includes a comparison of the Akaike info criterion (AIC), the Schwarz criterion (SC) and log likelihood for both SAR models and the classic OLS model. The AIC is a relative measure of goodness of fit that assists with model selection (Anselin, 1988). In this study, it was used to compare the SAR models to the classic OLS model. The findings in Table 16 indicate that the spatial lag model (196.9) is preferred over the classic regression model (198.9). However, the spatial error model (190.2) improves upon or in this case is the preferred model over the spatial lag model. Similarly, the SC is used in model selection. The SC results confirmed that both the spatial lag (215.6) and spatial error (207.1) models improved upon the classic regression model (215.8), with the results indicating the spatial error model to be statistically preferred. Again, using the log likelihood in Table 16, the spatial error model (-86.1) is the statistically preferred model relative to the spatial lag model, while the spatial lag model (-88.4) also provides for a better fit over the classic regression model (-90.4).

Generally, there was not much difference in the classic linear regression model and the spatial autoregressive model variable coefficients. Although the spatial lag model did return an improved result of around 1%, the initial model included a number of strong predictors of educational attainment so the improved results from the spatial lag model were masked and relatively small. The spatial error model further improved results of another 1% on the spatial lag model and overall 2% on the classic model indicating that variables that were not considered in this model. This improved results could be coming from another variable not in this study model.

Table 14. Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, spatial lag model

Variables	Coefficient	Std. Error	Sig. p-value
State Funds	-0.001	0.001	0.241
Federal Funds	-0.003	0.008	0.674
Median Family Income*	0.001	0.001	0.000
Percent with a HS Diploma*	-28.10	8.31	0.001
Percent of the White Population	4.38	3.08	0.154
Goods-Producing Industry	-11.31	13.11	0.388
Information Technology Industry*	72.90	22.22	0.001
Institutions*	-0.001	0.001	0.003
Constant	13.182	6.177	0.032
Spatial Lag	0.149	0.072	0.037

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Table 15. Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, spatial error model

Variables	Coefficient	Std. Error	Sig. p-value
State Funds	-0.001	0.001	0.306
Federal Funds	0.001	0.007	0.951
Median Family Income*	0.001	0.001	0.000
Percent with a HS Diploma*	-34.70	9.55	0.001
Percent of the White Population	6.96	2.97	0.192
Goods-Producing Industry	-16.65	11.09	0.133
Information Technology Industry*	77.42	20.81	0.001
Institutions*	-0.001	0.001	0.014
Constant	18.270	5.887	0.001
LAMBDA	0.49	0.140	0.001

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Table 16. Comparison of the AIC and SC for the classic regression and spatial lag models.

	Classic OLS Regression Model	Spatial Lag Model	Spatial Error Model
Akaike info criterion (AIC)	198.967	196.915	190.273
Schwarz criterion (SC)	215.807	215.627	207.114
Log Likelihood	-90.483	-88.457	-86.136

Using the spatial lag model provided greater predictive power over the classic regression model and also decreased the spatial autocorrelation of the residuals. The Moran's I of the spatial lag model residuals was 0.204 with a significance of 0.04. Statistically significant clustering of similar residuals is still present in the spatial lag model (Figure 16). However, there is less correlation indicating that the spatial lag model is an improvement on the classic regression model.

The LISA cluster map of the residuals in the spatial lag model (Figure 16) displays the statistically significant cluster values and indicates the over and under-prediction of those observations. Red or high values mean large positive residuals. This alludes to model under-prediction. In the case of this study, model under-prediction means that the percent of the workforce population with a bachelor's degree or higher is greater than what would be expected after accounting for all eight independent variables listed in Table 1.

In this study, the core of the cluster that had higher values than what would be expected was the state of New York. The state of Oregon is a statistically significant High state neighboring Low states. Meaning that the residuals under-predict the percentage of the bachelor's and advanced degrees in Oregon, and the neighboring states have over-prediction. Blue or low values indicate over-prediction, meaning that the percent of the workforce with a bachelor's degree or higher is lower than expected when considering the explanatory variables. The cluster of states that had model over-prediction were Arizona, California, Nevada and Utah. The state of Alabama displayed statistically significant over-prediction and is surrounded by states that had model under-prediction.

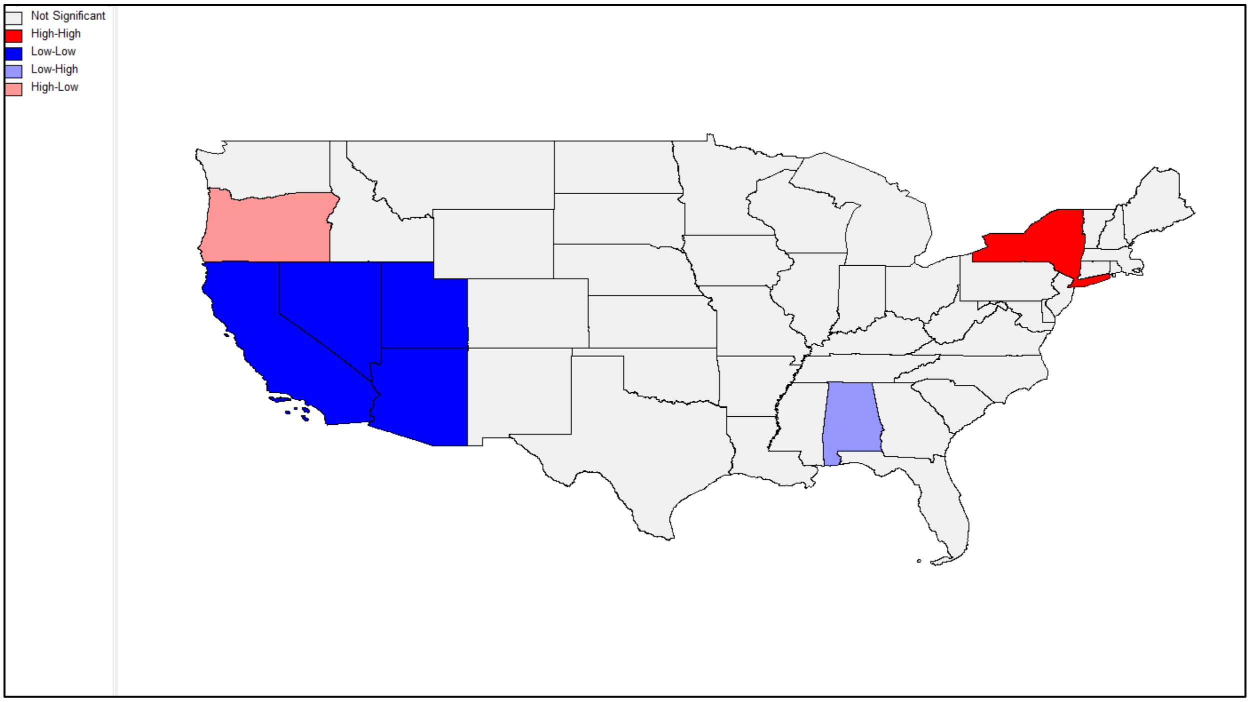


Figure 16. Cluster Map of the Spatial Lag Model Regression Residuals. Blue indicates statistically significant clusters of over-prediction. Red indicates significant clusters of under-prediction.

Summary of Findings

This chapter began with an exploratory spatial data analysis of educational attainment in the contiguous United States. This research found that the percent of the workforce population with a bachelor's or advanced degree was spatially dependent at a statistically significant level. Using the nearest-neighbors weight matrix, with the four nearest states, the research found that states with a percentage of the population with a bachelor's or higher degree have the propensity to be located next to and clustered with other states that have high values in degree attainment. Inversely, states with a low percentage of the population with a baccalaureate or advanced degree tended to be located nearby other states with lower levels of degree attainment. Both the high and low clusters were located in the Eastern portion of the United States. With the high percentage of bachelor's and advanced degree cluster located in the Northeast and the low percentage of baccalaureate or higher degree cluster occurring largely in the Southeast. The findings related to research question one, demonstrated that a spatial dependence is present in the distribution of baccalaureate and advanced degrees in the United States.

After utilizing ESDA methods to address research question 1, I concluded that proceeding to research question 2 was appropriate and warranted. The classic regression model provided a result that predicted correctly 88.2% of the time, using the adjusted R^2. In this model four variables were statistically significant. The statistically significant variables were median family income, the percent of the workforce with a high school diploma or equivalent, the share of jobs in the information and communication technology industry, and the population per higher education institution ratio. The variables that were included in the regression model that were not statistically significant were both federal and state appropriations to higher education, the percent of the population that was White, non-Hispanic, and the share of jobs in the goods-producing industry. The linear regression residuals were also spatially dependent indicating that a spatial autoregressive model would improve upon the overall model of educational attainment.

Finally, I presented the findings from the spatial autoregressive model. The research found that the spatial lag model improved upon the classic linear regression model by providing a result of 91.1% predicted correctly. The independent variable coefficients and the significance generally remained the same. The strong predictive power of the classic linear regression model, in part masked some of the benefit of employing a spatial lag model. In addition to the spatial model improving the predictive power, this model also produced a result with lower spatial dependence of the regression residuals. The next chapter furthers the discussion of the implications and the meaning of these findings.

CHAPTER SIX: DISCUSSION AND IMPLICATIONS

The purpose of this dissertation was to investigate and provide a foundation for the consideration of the spatial location in the analysis of educational attainment. The goal of the study was to provide an increased understanding and greater predictive power for baccalaureate and advanced degree attainment at the state level by using spatial analysis and to identify relevant factors in the analysis of educational attainment. The anticipated outcome was that by combining educational attainment data from the U.S. census with spatial analysis, researchers and policy makers would have another lens in which to analyze educational attainment through.

In this final chapter, I summarize the main findings of this research that relate to each research question. For each question, I present a discussion of the previously reviewed literature to determine if my findings are supported by the literature. Next, I discuss the findings from the perspective of the integrated conceptual framework that was presented in chapter 3. I conclude with the implications and directions for future research.

Research Question 1 Discussion

What are the spatial patterns of the distribution of educational attainment at the state-level for the contiguous United States?

To answer the first research question, I utilized the spatial statistics tools in exploratory spatial data analysis (ESDA). As part of ESDA, I first employed the use of maps, utilizing chloropleth mapping of the distributions of the percent of the workforce with a baccalaureate degree or higher in 2009. The maps are useful in visualizing and gaining an initial understanding of the distribution of educational attainment in 2009, yet do not provide ample tools for the determination of significant spatial effects.

To improve upon the limited ability of the maps to determine spatial effects, a spatial weight matrix was used to define the connection between places. This study utilized the k-nearest neighbors weight matrix, with k = 4. For this research, k =4 means that the dependent variable of the four nearest states to the state being analyzed will be weighted and considered.

The Moran's I statistic was used to detect global spatial autocorrelation. This research found that the percent of the workforce population a bachelor's or higher degree was statistically significant. Further analysis was done using the Moran's I scatterplot. The Moran scatterplot displays the value at a location versus the average values of its neighbors. The scatterplot was used to examine both global and local spatial associations. Finally, local indicators of spatial association (LISA) statistics were calculated to better identify the extent of spatial clustering and autocorrelation of similar values around the observations. This provided an indicator of spatial heterogeneity and the presence of educational attainment clusters at the state-level.

From my review of the literature, I predicted I would see a spatial dependence among baccalaureate or higher degree attainment at the state level. This expectation is from the literature as it is rooted in Tobler's First Law of Geography which states "near things are more related than distant things," (Tobler, 1970). The spatial distribution of educational attainment that was mapped was also expected. Based on the works of Morris & Monroe (2009) and Tate (2008; 2012) the educational attainment disparities in the United States seem to be concentrated in the in the Southeast, as well as, the Southern United States when compared to the entire contiguous United States, I assumed I would see disparities in the southern region of the country. From a historical perspective, the Southern states were largely rural agricultural based economy where the slave trade was employed to provide for this traditionally labor intensive industry. The abhorrent treatment of black slaves and limited educational opportunity for their posterity lasted another hundred years. While many Southern blacks have made incredible strides in education attainment and economic progress in the nearly fifty years since the Supreme court decision mandating equality the many years of transition have taken a toll on this traditionally disenfranchised yet sizable population (Morris & Monroe, 2009). Economically the South suffers from statistically significant clusters of low educational attainment because its economic composition is largely natural resources, old-line manufacturing and cyclical construction industry (Carnevale & Smith, 2012). These jobs did not require a highly educated workforce and therefore there has been less value for the populace to pursue academic education in these southern states (Hendrickson, 2012). This historical trend continues to improve especially in large urban pockets that unfortunately miss many rural areas of the South (Morris & Monroe, 2009). The uneven geography of opportunity from yesteryear has perpetuated the educational attainment disparities seen today.

My integrated conceptual framework using the lens of geography of opportunity was used to operationalize the interpretation of the findings. The concept of 'geography of opportunity' holds that not only are current opportunities influenced by the geographic location of individuals but also future opportunities and outcomes are affected by location (Galster & Killen, 1995; Rosenbaum, 1995). Through the concept of geography of opportunity, the opportunity for educational attainment would be influenced by geographic location. Examining the spatial distribution of educational attainment through the lens of geography of opportunity enabled this study to examine how geographic location can influence the perceived opportunity for educational attainment.

Spatial Distribution of Educational Attainment

By acknowledging the findings of prior literature, I present my findings for the spatial distribution of educational attainment. One major finding of this research was that the spatial distribution of educational attainment was not randomly distributed. Meaning that the highest percentages of the workforce with a baccalaureate degree or higher in 2009 was concentrated in some areas (mainly the Northeast) while the lowest attainment percentages were concentrated in other areas of the country, as apparent in Figure 3, a map of the contiguous United States. It appears that in part these high educational attainment clusters are located where there are large population centers. As mentioned by Morris & Monroe (2009), the state of Georgia appears to be more educated because of Fulton County, the county in which Atlanta is located, whereas the rest of the state is largely rural and undereducated. Given this acknowledgement of some of the errors that can occur when analyzing data at the aggregate state level, this is still an important and relevant finding as most policy decisions are made at the state level. To better understand the spatial distribution of educational attainment, the next section discusses the pattern and cluster findings of this research.

Patterns and Clusters

Mapping the spatial distribution of educational attainment for the contiguous United States provided a useful visualization and initial analysis in determining that educational attainment is not randomly distributed. However, in order to gain a more in depth understanding of the distribution and patterns further analysis was conducted. A spatial weight matrix of k-nearest neighbors, with k = 4, was used in order to define the connection between places. The Moran's I was used to detect global spatial autocorrelation. The Moran's I statistic indicated that there indeed was positive spatial autocorrelation. Using the Moran's I statistic, I was able to statistically confirm the descriptive findings made from the maps and tables (Figure 3 and Tables 3-4), that educational attainment was not randomly distributed and that this was a statistically significant finding. I found that states with a high percent of the workforce with a baccalaureate degree or higher have a propensity to be clustered close to other states with a high percentage for that variable. The opposite also tends to be true for the states with low percentages of educational attainment.

To further examine spatial clusters and autocorrelation, I employed LISA statistics. I found that there were statistically significant clusters, as projected in Figure 5. Of particular interest are the high-high and the low-low clusters. A high-high cluster is a group of states with the percent of the workforce with a baccalaureate degree or higher above the nationwide mean. Most of these states fall into the highest quartile as displayed in Figure 3. A low-low cluster indicates states with a low percent of the workforce with a bachelor's or higher degree adjacent to states that also have below the nationwide average educational attainment percentages.

The statistically significant high-high cluster confirms the descriptive finding in Figure 3. The states at the core of the high-high cluster were found to be Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, Rhode Island and Vermont. The fact that these states, most of which neighbor at least two of the other states on the list, have higher than average educational attainment percentages is not random. This could in part be because of the higher population centers, that explanation would also explain the only statistically significant outlier, Maine. The state of Maine is considered a state to have a lower than average percent of the workforce with a baccalaureate or higher degree near states with a high percentage of the workforce with a bachelor's degree or higher. The literature findings presented by Morris & Monroe (2009) suggest that high population centers tend to have higher educational attainment levels (Morris & Monroe, 2009; Tate, 2008; Tate, 2012), these research findings regarding Maine being low yet near high states due to population differences are consistent with the prior literature findings.

Employing the geography of opportunity as a lens for the analysis of the higher educational attainment, percentages in certain states could be higher because of the perceived opportunity that is present in those states. For example, the perceived opportunity and prevalence of high paying jobs in the Northeast, mostly from industries that require an educated workforce would act as an incentive for residents of those states to seek out the necessary education to be gainfully employed. This assumption is discussed in further detail under research question 2 as we include two industry variables in the classic and spatial regression models. Using the concept of geography of opportunity we can infer that as a result of the environment there is a greater perceived opportunity to earning a baccalaureate or higher degree among those states at the core of the high-high cluster. Intertwining this notion of the perceived opportunity with the other component of the integrated framework, the comprehensive economic framework for analyzing educational attainment, provides that this perceived opportunity has resulted in viewing decisions towards pursuing higher education as a beneficial choice for stakeholders in that geographic location.

A focal finding in this portion of the study was that spatial dependence does exist amongst states pertaining to baccalaureate degree attainment. This means that relevant factors present in one "spill over" to neighboring states for a clustering effect. The contribution of this information to the literature is that policy can be developed and shaped with the understanding that the impact will likely extend beyond state borders. States may also be encouraged to work together to ameliorate their common challenges and seize their shared opportunities.

The descriptive findings from Figure 3 are largely confirmed by the statistically significant low-low cluster presented in Figure 5. The states at the core of the low-low cluster are largely located in the Southern United States; however it spreads farther north into Ohio, part of the Midwestern region, then visualized through Figure 3. The states at the statistically significant core of the low-low cluster were Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, Ohio and Tennessee. The findings indicate that the adjacency and proximity of these low percentage states are not randomly distributed. This finding contributes to the literature by demonstrating that not only are states in the Southern United States part of the cluster of states that tend to have the lowest educational attainment, as traditionally thought (Morris & Monroe, 2009; Tate, 2008) but also states such as Ohio in the Midwest. Through the lens of geography of opportunity there is perceived to be less opportunity to obtain higher education in these core states. This in part might be due to market forces and the types of industry prevalent in these geographic locations. During the decision making process, the needs of the industry in that location are weighed and stakeholders might not place the same value on higher education as in the region where the high-high cluster exists. This again is further discussed under research question 2 where the consideration of the percent of the workforce in the information and communication technology industry is discussed.

In both the high and low cluster findings, other factors are influencing the educational attainment besides geographic location. This study examines government funding, median family income, percent of the population with a high school diploma, industry prevalence, the percent of the White, non-Hispanic population, and the ratio of institutions within the state as factors. The second research question uses those factors to build a regression model in order to predict the percent of the workforce with a bachelor's or higher degree. Before proceeding to the second research question it is important to explore the spatial distribution of some of those factors that are traditionally thought to influence educational attainment. Using the integrated framework comprehensive economic framework component as a guide for variable selection, the spatial distribution of the funding allocation to postsecondary education (representing government choice), economic indicator of median family income (representing choices and circumstances of parents/family), the percent of the workforce population with a high school diploma or equivalent (representing choices of the individual) were explored. In addition, using the geography of opportunity component of the integrated framework, the factors of the ratio of the institution, prevalence of industry and the percent of the White, non-Hispanic population within the state were also examined in the model.

Spatial Patterns of Allocation of Funds

Two types of higher education funding were explored. The first type was federal funding, examining the spatial pattern of funds distributed by the U.S. Department of Education to states that were allocated specifically to postsecondary education. Recognizing the varying population of states, the overall funding amount was a ratio based on the workforce population of the state. The second type of funding was state appropriations. This study used the state funding allocated to postsecondary education per full-time equivalent (FTE) students, in adjusted dollars. Both the federal and state allocation of funds to higher education appears to be random (Figures 6 and 7) and was statistically confirmed to be randomly distributed (Table 8).

Federal Funds

Conceptually, the finding that the federal funds from the U.S. Department of Education is not statistically significant fits with the systematic approach to distribution. The Department of Education distributes the federal dollars based on predetermined formulas (Kane, 1999; Hearn, 1998). This formulaic method seems to create equal opportunity independent of state residence. While the stated mission is to correct or limit inequalities, the formulaic approach does not have a strong impact on the percent of the workforce with a bachelor's or higher degree. The formulaic approach does not appear to be effective in promoting educational attainment.

State Funds

The finding that state funding of higher education is randomly distributed and does not follow a similar funding pattern of outcomes in terms of overall educational attainment displayed in Figure 7 is of particular interest. Earlier, I discussed the differences in perceived opportunity to obtain a baccalaureate or higher degree, using the geography of opportunity lens. However, with the finding that the allocation of state funds to higher education is randomly distributed and not necessarily aligned or correlated with educational attainment means that the differences in perceived opportunity, are just that, perceived, and at least from the governmental factor of funding not actual. This is not to say that overall, there is no actual opportunity differences, as I suspect that there are but that these opportunity differences are not based on state appropriations to higher education.

Spatial Patterns of Economic Indicators

Two economic indicators were considered, median family income and poverty. These factors were used to represent the family circumstances that were guided by the comprehensive economic framework portion of the integrated conceptual framework used in this study. Both of these variables were clustered as presented (Figures 8 and 9) and displayed statistically significant spatial dependence (Table 8). Given the literature on how family income influences educational attainment (Knight & Shi, 1996; Goldrick-Rab & Roksa, 2008; Baum 2010, Kaba, 2010) it is not unexpected that the clusters of low median family income states and the high median income family states (Figure 8) are visually similar to the cluster maps for educational attainment (Figure 5). Using the lens of geography of opportunity as a lens to interpret this finding, I can see clear opportunity differences based on geographic location and median family income. The distinct distribution differences of median family income correspond with the clusters of the percent of the population with a bachelor's or higher degree.

Spatial Patterns of Industry

Both types of industries considered in this model displayed statistically significant spatial dependence. The spatial distribution of the goods-producing industry and the information and communication technology industry were near inverse maps. The states in the core of the high-high cluster of the information and communication technology industry are similar to the high-high clusters of educational attainment. This finding means that the states with a high percentage of jobs in the information and communication technology industry also had higher percentages of the workforce population with a baccalaureate or advanced degree. The high-high clusters for the goods-producing industry were more spread out and not concentrated in one area. For example, states with high percentages of the jobs in the goods-producing industry were located in the South, Midwest and North.

Spatial Patterns of HS diplomas, White Population and Quantity of Institutions

The research found that the spatial distribution of high school diplomas was also statistically significant. This is not surprising since an educational attainment variable measuring bachelor's and advanced degrees (the dependent variable was statistically significant). However, it is important to note that the statistical significance of the percent of the workforce with a high school diploma was less than that of the baccalaureate or higher degree.

The distribution of the percent of the population that was White, non-Hispanic was also spatially dependent. The core of the low-low cluster was Arizona. This means that Arizona was found to be a statistically significant core of the cluster of states that had lower percentages of the population that was White, non-Hispanic, alone. The cluster of states with higher percentages of the white population where not isolated to one cluster but where all located in the northern half of the country.

The ratio of the workforce population to the number of institutions was spatially dependent at a statistically significant level. The uneven distribution of the quantity of institutions can create an environment with real opportunity disparities due to distance and transportation factors. If the residents of the states do not have access to higher education institutions, then there opportunity obtain higher levels of educational attainment are diminished. Surprisingly, this factor is significant in light of web-based and distance learning programs. I predict the significance of this factor will diminish in the future to be relatively insignificant.

Relation to the Geography of Opportunity

The findings from the first research question revealed an uneven geography of opportunity for educational attainment, as well as for some of the factors that influence educational attainment; and a "level" geography of opportunity for other factors. Using the concept of geography of opportunity we can infer that as a result of the environment there is a greater perceived opportunity to earning a baccalaureate or higher degree among those states at the core of the high-high cluster. Intertwining this notion of opportunity with the other component of the integrated framework, the comprehensive economic framework for analyzing educational attainment, provides that this information/opportunity has resulted in viewing decisions towards pursuing higher education as a beneficial choice for stakeholders in that geographic location. “Perceptions might match reality perfectly, but reality varies geographically. Or reality might not vary geographically, but the perceptions of it do,” (Galster & Killen, 1995). This notion that current and future opportunities and outcomes are influenced by location is powerful. Regardless of whether it is actual, there is a perceived difference in the opportunity to obtain a baccalaureate and/or an advanced degree in the United States. Individual (and family) location or proximity to various geographic attributes influences the perceptions and realities. These perceptions and realities are informed by the social circles in which those individuals view themselves as part of. This creates a mechanism for different opportunity based on the linkages and relationships that are developed by proximity; thus creating relative opportunity, as opposed to absolute opportunities within that geographic location.

Choices made by government, meaning the social investments and spending in education, as represented by the federal and state allocation of funds to postsecondary education do not seem to follow the uneven geography of opportunity patterns within the contiguous United States. In actuality, the allocation of funds, both from the state and federal governments do not seem to be contributing to the locational variance in opportunity. This finding comes as an unexpected departure from much of the popular rhetoric that implies limited funding hampers educational attainment. However, it is important to keep in mind that this study is just a snapshot in time. Just as economic conditions have changed significantly in the last four to six years in many communities and states, it is reasonable to assume that the impact of the various funding levels has also changed. These findings also should not lead one to assume that government funding could be slashed drastically without a negative impact. It is also reasonable to presume that funding thresholds exist likely varied by a multitude of attributes (population, urban/rural, median family income and etc.) of a state. Further research is needed to calculate adequate funding levels for each state to ensure the higher education goals of each state can be met.

The spatial distribution and core of the high and low clusters for median family income are closely related to the spatial distribution and clusters for educational attainment. These findings indicate that there is an uneven geography of opportunity for educational attainment and earning potential. Also these findings demonstrate that lower levels of median family income can influence the perception of opportunity within the state at a statistically significant level. The greater statistical significance in educational attainment for median family income data versus poverty level speaks directly to the heterogeneous relationships or linkages when considering the various levels of median family income compared to data derived from poverty level statistics.

Similar to median family income, the spatial distribution of the percent of jobs in the information and communication technology industry are positively related to educational attainment. As mentioned above, if there are not employment opportunities that require a bachelor's or advanced degree, and pay commensurately to that requirement within the state, residents may not view obtaining a bachelor's or advanced degrees as beneficial. Also, the access or lack thereof that residents have within a state to higher education also influences their opportunity and future educational attainment outcomes.

Individuals within a specific geography are certainly influenced by the geography of opportunity. However, as a result of varying linkages and relationships for these individuals the information/values/culture they use to make their choices may vary from others within the same geographic location. For political and governmental purposes an area or location might be defined as one space, however, individual perceptions of the location might vary significantly (Smith, Goodchild,& Longley, 2011). For instance, historically Virginians have considered themselves as Southerners. However, the culture, information and values of many Virginians are largely different from “Southerners” in states such as Georgia, Alabama or Mississippi.

The next section of this chapter provides a discussion of research question 2. This section addresses how the factors mentioned above and used in this model influence educational attainment. This question than expands to see if a spatial autoregressive model provides a better “fit” over classic linear regression in the analysis of bachelor degree attainment and then provides a discussion of those findings.

Research Question 2 Discussion

How does considering the spatial context of educational attainment influence the relationship between allocation of funds, economic indicators and educational attainment?

Does a spatial autoregressive model provide improved predictive powers over a classic linear regression model in the analysis of educational attainment?

To answer these research questions, I compared a classic linear regression model with a spatial autoregressive model to explore the relationship these independent variables have with educational attainment and also to determine which model had the greatest predictive power. The spatial autoregressive model selected for this study was the spatial lag model. This model is appropriate when examining spatial interactions resulting from diffusion and/or spillover. The spatial lag model assumes that the dependent variable in one location is influenced by the dependent variable in a near location (Anselin, 1999).

How the Conceptual Framework Guides Question 2

The integrated conceptual framework leaned on the comprehensive economic framework to guide the variable selection for the model. Enabling this research to examine and interpret the relationships between educational attainment, geographic location, funding, income, industry, quantity of institutions and race.

Factors Impacting Educational Attainment

Variable selection for the models used in the analysis of educational attainment was based upon the comprehensive economic framework component of the integrated conceptual framework that was used in this study. The comprehensive economic framework, as presented by

Haveman & Wolfe (1995) views educational attainment as dependent on three choice factors. The state allocation of funds to postsecondary education per FTE is considered part of the choices made by government category. Median family income is placed into the choices and circumstances of families (and/or parents). The third factor is the choices made by individuals. This factor assumes that individuals have considered the benefits and made choices that best reflect their own interest (Havement & Wolfe, 1995). Within this category there is the percent of the workforce population that had obtained a high school diploma or equivalent in 2004. This variable was used as baseline because a baccalaureate or higher degree cannot be obtained if a high school diploma, GED, or some equivalent degree has not been obtained first. A choice made to pursue higher education assumes that individuals' view that to be the most beneficial option and that they will be best served by making that choice. To capture why the choice to pursue higher education may be of most benefit, a variable in regards to industry was also considered in the model. This market force or industry variable was the share of jobs that were in the information technology and communication industry within the state. In keeping with the lens of geography of opportunity, this research also included race and quantity of institutions as factors and variables in the model to account for opportunity differences.

Government Funding

The study results can further the discussion within the literature that government funding does not play a large role in educational attainment (Goldrick-Rab & Roksa, 2008; Evans et. al., 2010). The federal funds from the U.S. Department of Education, when accounting for state population, were not of statistical significance and did not add to the model. The state allocation of funds to higher education, added more to the estimation of educational attainment than the federal funds. However, the state appropriations to higher education per FTE, adjusted, were still statistically insignificant.

It was interesting to note that there is a negative relationship between educational attainment and state allocation of funds per FTE, in adjusted dollars. Meaning that as the state allocation of funds per full-time student equivalent increased, the percent of the workforce with a bachelor's degree or higher decreased and vice versa. The statistically insignificant findings showed that for every decrease in $1,000 per FTE resulted in a 0.1% increase in the workforce population with a bachelor's degree or higher. Of course, this finding needs to acknowledge that there is a minimum threshold where a decrease in funding ceases to have any positive result for the percent of the workforce with a bachelor's or advanced degree. However, this finding is interesting because it shows that state appropriations in higher education do not equate to higher educational attainment. Of particular note is the state of Vermont. Vermont had the lowest adjusted state appropriate per FTE ($2,413) but was in the top quartile for the percent of the population with a bachelor's or higher degree (34.7%). Whereas, the state of New Mexico is in the highest quartile of state appropriations per FTE ($8,631), yet, the lowest quartile for the percent of the workforce with a bachelor's or higher degree (25.5%).

The importance of funding could vary geographically when looking at specific regions or states, as opposed to funding at the national level. Analyzing funding at the national level might mask the significance of funding to higher education at the state level. Another important consideration of this study is that it is a snapshot of funding and outcomes two years later. It does not account for any ongoing funding shifts and the funding of education at the elementary and secondary levels. It would also be useful to examine the preparation level of students entering college and the funding level. For the example presented above, expanding further beyond the statistical findings there are substantial opportunity differences between the state of Vermont and New Mexico. The opportunity differences are likely due to the different linkages/connections for individuals and overall influence their choices.

Economic

For median family income, I anticipated that I would find in this research study that as the median family income within the state increased so would the percent of the workforce population with a bachelor's or higher degree. This assumption was grounded in the literature that shows that low income students are less likely to complete a college education than high income students (Baum, 2010; Knight & Shi, 1996; Goldrick-Rab & Roksa, 2008; Baum 2010, Kaba, 2010). In my results, I found that median family income was positively and significantly related to educational attainment. The findings suggest that for every $10,000 increase in median family income there is a 3% increase in the workforce population with a bachelor's or higher degree. Realistically a $10,000 increase in the median family income is not something that will occur in the short-term, especially when adjusting for inflation. In fact, $10,000 is more than one standard deviation of the national average. However, the findings from this research suggest a more gradual increase of $3,000 would result in almost a 1% increase in the percent of the workforce population with a bachelor's or higher degree.

The finding that median family income has such a strong influence on educational attainment fits directly into the integrated conceptual framework and the notion of geography of opportunity. Individuals from different economic backgrounds within one geographic location have varying opportunities. The difference in opportunities results from the information provided from linkages and connections that influence choice. Even though individuals within one location might have the same opportunity based on background (schools attended, gpa) the median family income influences external information resulting in different choices. In addition to the different opportunities within one location based on median family income, there are also different opportunities for individuals with the same median family income based on their geographic location. Even though this study considered the inflation-adjusted median family income, there are large lifestyle differences between an individual making $50,000 in Arizona versus an individual making $50,000 in New York or California. In this sense, the geography of opportunity might favor the Arizonan with a $50,000 median family income because they will have more relative opportunities (based on social circles and connections) than an individual in California or New York with a median family income of $50,000. This is an interesting notion that needs to be further researched because even though the opportunity based on industry and market demand might be higher in certain regions, the median family income can act as a mitigating or limiting opportunity factor.

Industry

For industry, I examined two variables. The first was the share of jobs in a goods-producing industry, and the second was the share of jobs in the information and communication technology industry. A classification of both of these types of industries is provided in Chapter 3. Given the literature on how market forces play a role in the education of citizens within an area (Waldorf, 2007; Evans et. al., 2010) I was not surprised to find that the higher the percent of the jobs within the information and communication technology industry, an industry that is traditionally thought of as requiring educated workers, the higher the overall educational levels of the workforce population. This research returned statistically significant results for the information and communication technology industry, and the results from the goods-producing industry produced statistically insignificant results. The percent of jobs in the information and communication technology industry within a state can equate to greater opportunities. As individuals within the state see more employment opportunities, they will make choices that reflect the needs of those jobs. Also, since jobs in this industry tend to pay more, the median family income may be greater. From the findings of this research, it appears that both the prevalence of jobs in the information and communication technology industry, and median family income are strong predictors in educational attainment. Using the findings relating to the factor, state leaders can promote and industry friendly environment through limited regulations and taxes so that industries want to come to or stay in the state. The industry in a particular geographic area has a greater linkage to the higher education needs for an area. As Metcalfe (2008), pointed out in the study of British Columbia, Canada, historical zones benefit from early development of the region. This is the case in the Northeast United States where business center of New York through Massachusetts has historically been well established. Therefore the connections and relationships available to individuals and families are well developed, in some cases, even generational, which influences the opportunities and subsequent choices made by these individuals and families. It is also important to mention and realize that not all states have a labor market that necessitates a bachelor's or advanced degree to maintain a high standard of living since the job market and consequently the cost of living within the state differ. However, in general, states will need higher levels of educational attainment to be competitive in this new global economy and marketplace.

Institutions

The quantity of institutions was a variable that was used in this model. The number of institutions, relative to the state population was a statistically significant finding. This is interpreted to mean that the more availability to higher education institutions, the more likely the state residents will seek higher education degrees. Conceptually, this is justifiable under the lens of geography of opportunity but in an increasingly global society, with more online and distance learning course options this might not be the case for long. Tate (2008) demonstrated that an unequal distribution of opportunity geographically leads to uneven educational outcomes. Using this construct and the institutional variable, an unequal distribution of institutions within a state can lead to uneven educational attainment at the state level. In this instance, the opportunity relates directly to access by using the logic that if an individual wanted to choose to attend college, however, there were no educational institutions accessible within that geographic location the outcome would be different then if there were higher education institutions within the same geographic area. Even though the number of institutions in each state would seem to be important especially given the geography of opportunity lens as a means to determine access or lack thereof to institutions of higher education, realistically, there is not a need for physical classrooms or institutions with the prevalence of online and other types of distance learning, in addition to satellite campuses. In the future, the lack of opportunity will be based more upon limited information about these distance higher education programs and less upon limited access to physical campus locations. Meaning the opportunity from an institutional access stand point will be based more on the information individuals acquire through linkages and connections rather than the opportunity provided by access to physical campuses.

Race

To account for race, this study used the percent of the population that was White, non-Hispanic, only. The research findings did not return a statistically significant result for the percent of the White population. This study finding contributes to the literature by showing, in a modern, relatively diverse society; the percent of the population that is white is not as strong of a predictor of the educational attainment level of the state population. In fact according to the research findings, now other factors such as income and industry are more strongly associated with influencing educational attainment then whiteness. This study differs from the findings in previous literature using the geography of opportunity where race is a factor (Briggs, 2005; Tate, 2008, Morris & Monroe, 2009; Tate, 2012) in part due to the scale of the study. In prior studies, researchers examined specific metropolitan areas while this study takes into consideration the continental United States, where residents of rural areas have limited education and economic opportunities as well.

Classic Linear Regression Model v. Spatial Lag Model v. Spatial Error Model

The spatial dependence of the distribution of educational attainment can be interpreted to mean that there are “spillover effects” in educational attainment from one state to another. The classic linear regression model, spatial lag model and the spatial error models returned high results for educational attainment. The classic regression model also had statistically significant spatial dependence of the residuals. In other words, the over and under-prediction in the linear regression model was not randomly distributed among the states. Therefore, this research operationalized the spatial autoregressive models to see how that improved the model fit. The limited improvement of the spatial lag model could in part be masked by the strong predictive power of the linear regression model and the number of independent variables used, relative to observations. In addition to improving the predictive ability, the spatial lag model also reduced the spatial dependence of the residuals. The spatial error model further improved upon the classic regression and spatial lag models. This could be interpreted to mean that other variables that were not considered in this study could be important in better understanding the educational attainment study. Also, the findings from the spatial error model indicate that the state scale might not be the best measurement of educational attainment.

One finding that was clear from examining the residuals, for both the linear regression and spatial lag models was that the variables used in the model analysis, do not accurately predict the educational attainment of the western states; specifically, Arizona, California, Nevada and Utah. The residuals in these four states show that the model used in this study resulted in statistically significant over-prediction. In other words, given the independent variables, these western states should have had higher levels of bachelor's and/or advanced degree among the workforce population. The reasoning behind the residuals could in part be due to other variables not considered in this model have a strong influence on educational attainment regionally.

Implications and Contributions

The use of global information science is certainly not new as a means of discovery or research. Almost from the beginning of time explorers, map makers and researchers alike have noted that people of various geographic locations tend to share common characteristics and culture. Despite the historical relevance and potential for greater understanding of geospatial information in higher education, research is limited (Tate, 2012). To date the analysis generally focuses on the microcosms and neighborhood level analysis. Although these findings are often significant and fascinating, state, regional and national policy decisions are based on statewide needs and information. This research sought to add to the paucity of data analysis at the macro level.

This research was able to distinguish significant geographic location effects on educational attainment from funding, economic and industry effects. In particular, spatial concentration of educational attainment was proven to be significant. Several important policy implications were derived from these findings. These policies relate to the following issues: a) allocation of funds to postsecondary education, b) consideration and promotion of industry, and c) acknowledging spillover effects from adjacent states. I discuss each of these policy issues below.

The results of this research suggest that funding alone will not increase educational attainment. The study data of allocation of state funds to postsecondary education per FTE, adjusted for cost of living and inflation, and educational attainment have a negative relationship. In other words, throwing money at the problem is not going to fix it; nor is tightening the proverbial belt going to exacerbate the problem. Thus, public policies need to not assume a direct linear relationship between increasing funds to higher education and having a more educated workforce population. Especially when looking towards the state of Vermont example of being the lowest allocations of state funding per FTE, yet in the highest quartile of educational attainment. Therefore, an important policy implication is the need to look beyond government funding as it is not explanation for limited educational attainment nor is it a solution to increasing attainment among the workforce population. The findings from this study show that increasing the number of higher education institutions within the state can improve attainment more so than simply appropriating more money per full-time equivalent student. In the Vermont example, the state allocates $2,413 per FTE yet 34.7% of the workforce population has a bachelor's or advanced degree. This begs the question, what is the government funding level or dollar amount threshold for degree attainment or is it completely commensurate with industry reward?

These models and analysis document that there must be an economic cost value driver to motivated individuals to make the choice/ effort for a college degree. The geography of opportunity for individuals to attain a college degree appears in fact to be a state/ local economy where they perceive a return on their investment of time, money and effort will be realized. This may be a difficult sell in areas where the industry does not require or financially reward the college educated.

In lieu of increasing public funding towards higher education as a means to increase educational attainment, research findings suggest that promoting the information technology and communication industry within a state can increase educational attainment levels. Another avenue would be to provide industry friendly regulations and tax structures. Attracting industries that need highly educated workers not only draws educated workers to the state but it also increases the perceived opportunity for current residents. This newly perceived employment opportunity can shift the benefit to pursuing higher education. Promoting industry through public policies also allows educated individuals to remain within the state potentially limiting some of the brain-drain as there are new perceived and actualized opportunities afforded to residents within the state.

A long-range policy implication that is derived from this research relates to acknowledging the spatial component of educational attainment. Considering the potential for spillover effects and the influence that adjacent states can have, it is imperative that public policies not think of the states as isolated and independent of one another. This research suggests that states with partnerships, working in conjunction with one another to raise educational attainment through strategies of promoting industry within a region will have greater successes then states that work in isolation because of the spatial dependence of educational attainment. Recognizing spillover effects can work to also limit brain-drain as there will be increased opportunity (both in perception and reality) within the state and the region.

Directions for Future Research

The focus of this research was a spatial analysis of educational attainment. However, throughout this study, an underlying theme was the concept that nothing is random. This study highlighted the fact that the spatial relationship of educational attainment needs to be further explored as a means to more properly understand and improve upon predictive models so that efficient policy decisions can be made to improve educational attainment levels of the workforce population in the United States.

When considering avenues and ultimately recommendations for future research, the one word that seems so poignantly apparent from my research is *perception.* While perception may seem like an odd concept for the very real challenges of education attainment, market forces or the economics of higher education, yet, the issue of stakeholders' perceptions relates to perceived policy breakdowns. However, these often-widespread perceptions are not always grounded in empirical accuracy.

The topic of education attainment is rich with potential for further study and clarification. The widespread perception is that college attainment is necessary for sustainability in the knowledge-based economy; in a broad sense it is likely true, yet a definition of precisely what and how much education is overdue. In an effort to improve transparency, I propose studies to assess the type and quantity of education needed in various geographic areas for current industry and potential economy development. Once a clearer picture of the labor-market requisite is defined analysis should lead to options that draw on best practices for education attainment policy development in various regions. As an example, reason that the labor-market knowledge involved micro robotics or computer engineers, dynamic policies could anticipate these needs and assist stakeholders in development, recruitment and promotion of such fields of study. Along the lines of industry and labor market necessities, future studies could not only look at industry types but also the unemployment rates. There is clear evidence that an increase in the unemployment rate drives college enrollment but does that result in attainment increases?

The leadership and populace in every state, region and metropolitan area desires to have a robust, prosperous economy and generally aim to craft laws, policies and tax codes to meet their perceptions. Considering the outcomes of such crafting, on occasion it is apparent that a sort of *Silo Mentality* exists when leaders fail to recognize neighborhood effects and spillover. Local perceptions of being an independent silo are rarely accurate or realistic in the marketplace especially given the mobility of the highly educated workforce. The notion that what goes on outside the silo does not affect the area of the silo is misguided. In fact, education and market opportunity in neighboring states generally influence the state, region, and even metropolitan area. Studies of *silo mentality* scenarios would be useful to help stakeholders be mindful of such pitfalls. In addition to more research on the *silo mentality*, research on the influence of changes in space and time would provide for a greater understanding. Future research would be wise to address how the interaction of space and time in reference to local economies, as in for instance the spatial Markov chain, influence educational attainment.

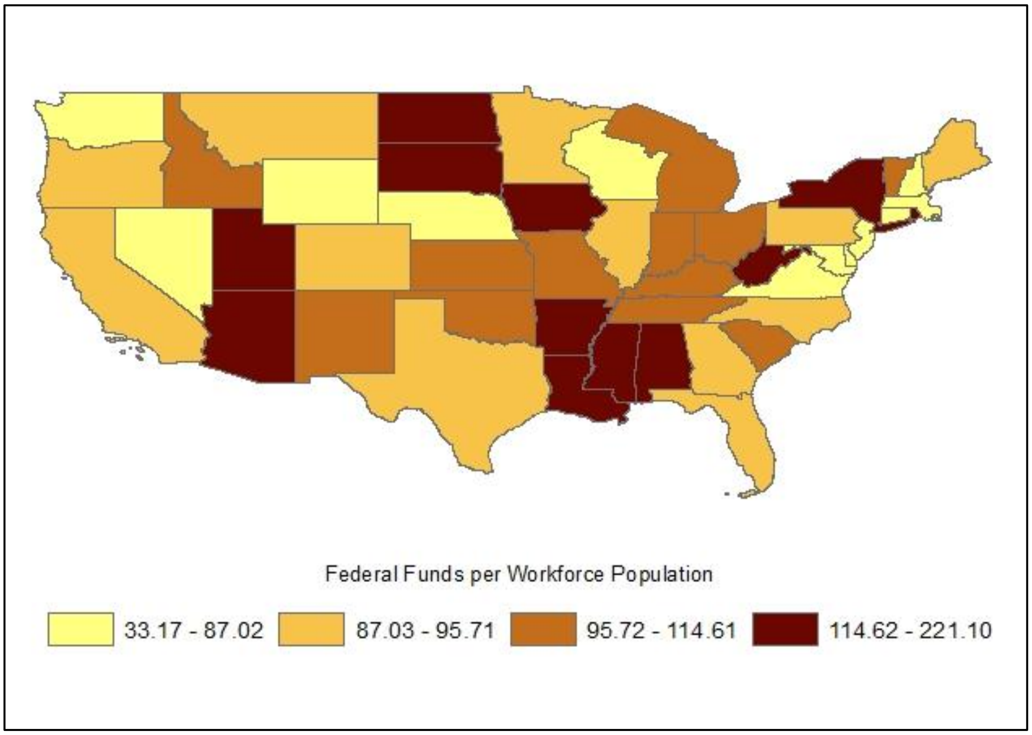
Colleges and universities in the United States are a heterogeneous group that generally shares a common mission to enhance student development and learning in value added knowledge. While all contribute to the education of the students enrolled in their institutions the leadership of these facilities engage in very different spending patterns. Analysis to identify which institutional services and/ or programs that is empirically referenced aid in educational attainment. In addition what sort of geographic reference exists for these potential studies.

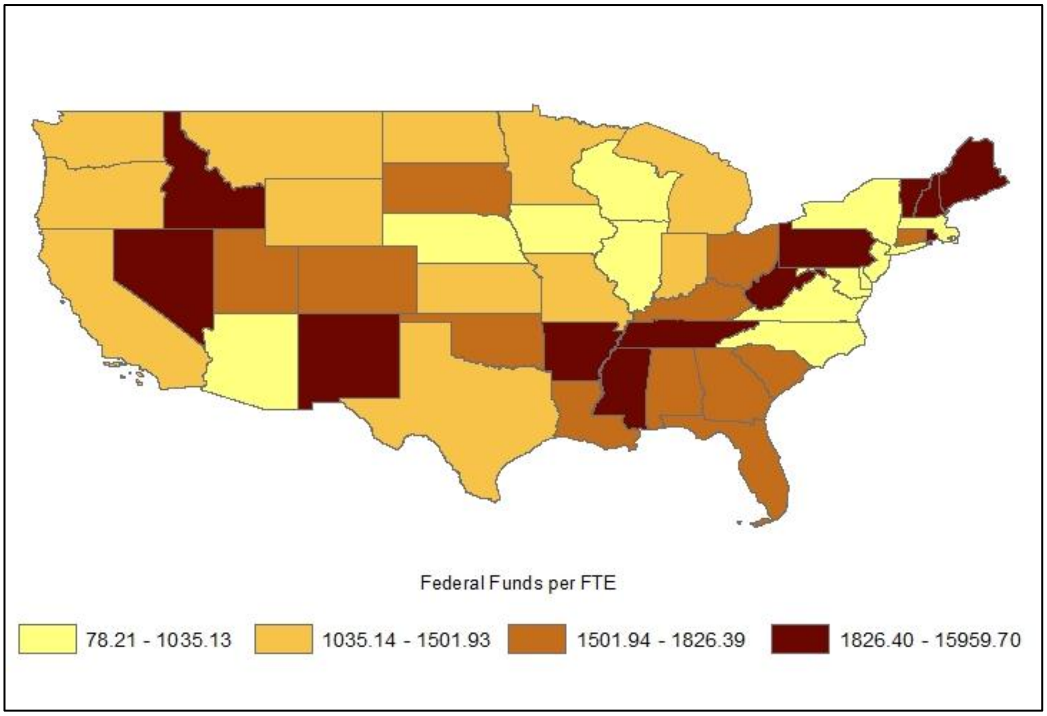
There exists approximately ten to one cost ratio between the most expensive private, very high research institution and the least expensive community college option. Many stakeholders perceive that a better or more marketable education is attained at more expensive universities. Research to determine the market-place outcome value compared to income expense in context to geographic areas would be beneficial to students, policy analysts and educational leaders. In other words, are the premium prices paid at some universities effective of excessive as well as the inverse assessment for more affordable colleges.

A few questions can be derived from the limitations of this research. Although this study intentionally did not examine workforce mobility, future research could consider the workforce mobility of residents in adjacent states to determine if market forces and tax structures influence the state of residence and employment. A second question that could be addressed in future research is to examine if the spatial distribution and patterns of educational attainment maintain a similar pattern when examining the data at the county-level, as opposed to the state-level.

APPENDIX A: RESULTS USING FEDERAL FUNDS PER FTE

Comparison of the spatial distribution of federal funds per workforce population and federal funds per full-time equivalent student.

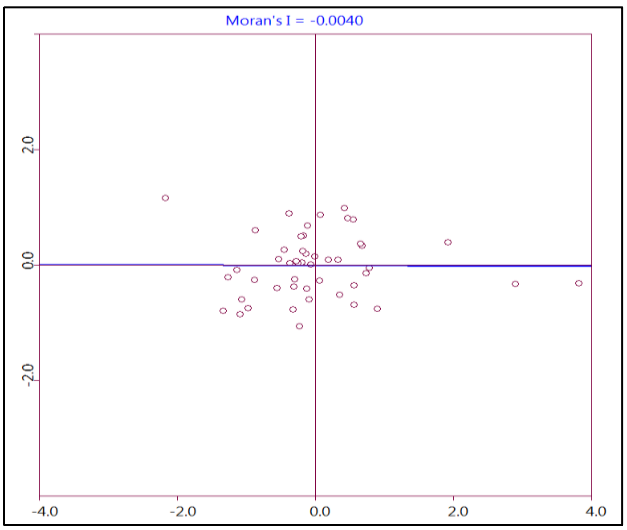




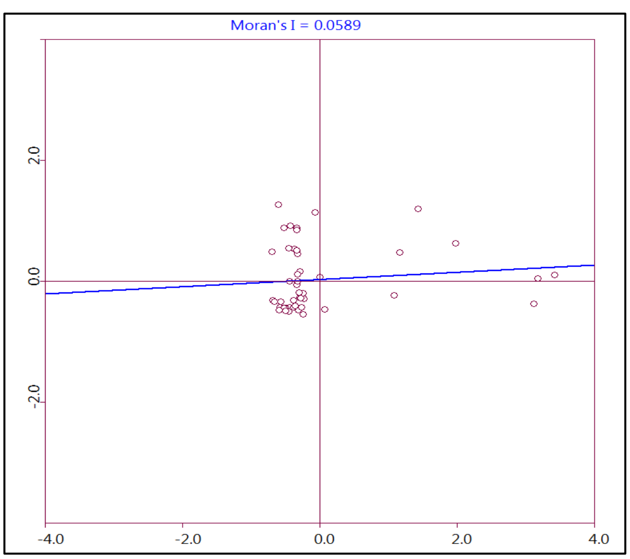
Moran's I statistics and scatterplot for federal funds allocated to postsecondary education from the U.S. Department of Education.

Federal Funds	Moran's I	p-value
Per Workforce Population	-0.004	0.59
Per FTE	0.058	0. 19

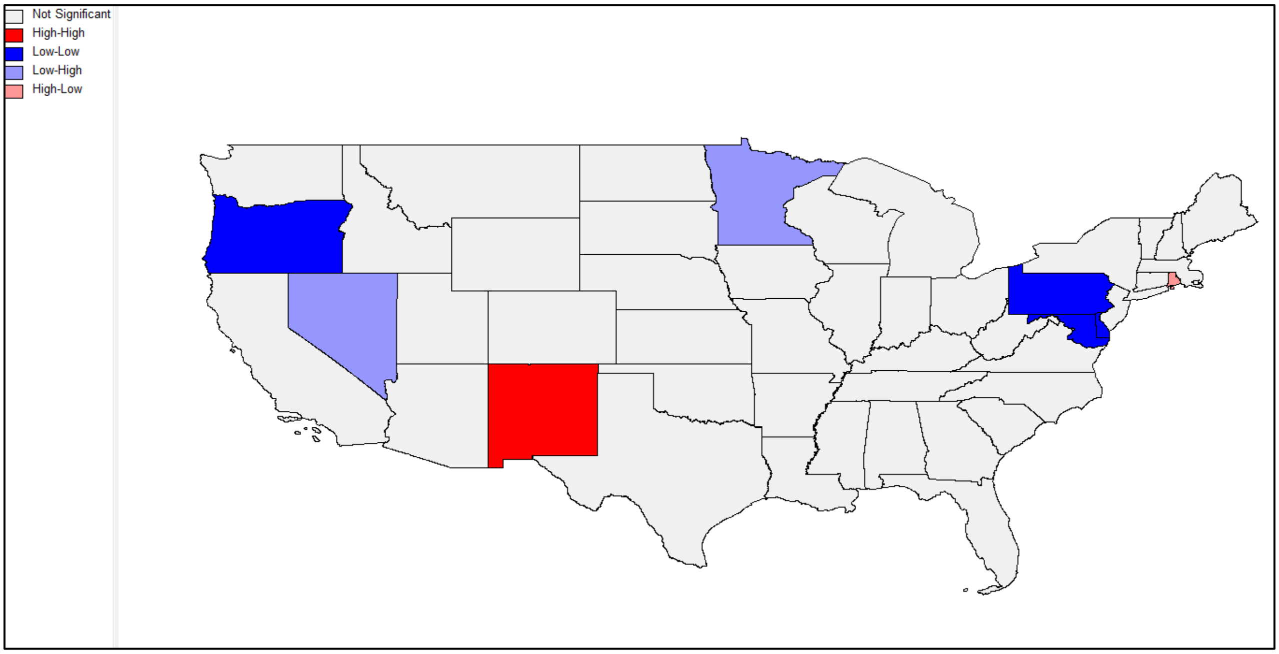
Federal Funds per Workforce Population



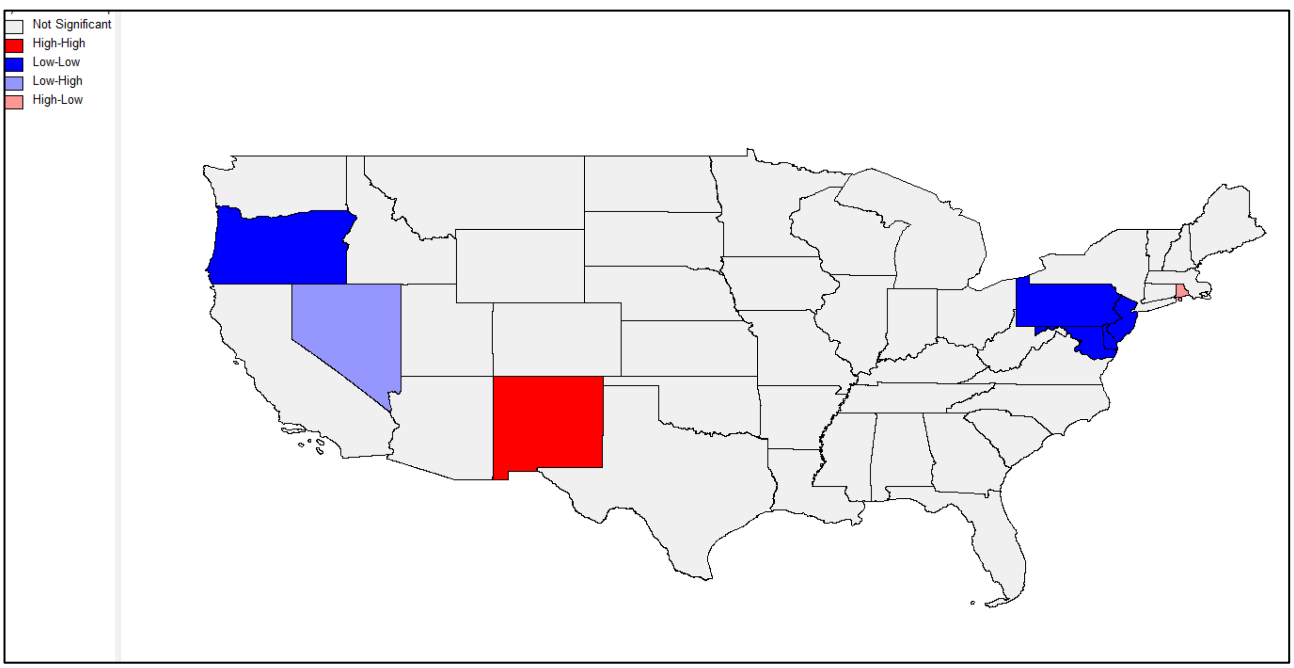
Federal Funds per FTE



LISA Cluster Map of Federal Funds per the Workforce Population.



LISA Cluster Map of Federal Funds per FTE.



Classic regression model results comparison of federal funds allocated by the U.S. Department to postsecondary education per the workforce population and per FTE.

Variables	Coefficient	Std. Error	Sig. p-value
Federal Funds per Workforce Population	-0.003	0.009	0.743
Federal Funds Per FTE	-0.001	0.001	0.408

Variables of Statistical Significance using the Workforce Population	Variables of Statistical Significance using FTE
Median Family Income	Median Family Income
Percent with a HS Diploma	Percent with a HS Diploma
Information Technology Industry	Information Technology Industry
Institutions	Institutions

Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, using federal funds per FTE, classic regression model

Variables	Coefficient	Std. Error	Sig. p-value
State Funds	-0.001	0.001	0.408
Federal Funds	-0.005	0.007	0.495
Median Family Income*	0.001	0.001	0.000
Percent with a HS Diploma*	-23.83	9.56	0.017
Percent of the White Population	6.34	3.41	0.070
Goods-Producing Industry	-19.01	14.38	0.193
Information Technology Industry*	79.64	27.40	0.006
Institutions*	-0.001	0.001	0.007
Constant	13.838	6.437	0.037

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, using federal funds per FTE, spatial lag model

Variables	Coefficient	Std. Error	Sig. p-value
State Funds	-0.001	0.001	0.065
Federal Funds	-0.003	0.008	0.674
Median Family Income*	0.001	0.001	0.000
Percent with a HS Diploma*	-26.18	7.97	0.001
Percent of the White Population	4.70	2.93	0.108
Goods-Producing Industry	-4.51	13.20	0.732
Information Technology Industry*	91.29	23.16	0.000
Institutions*	-0.001	0.001	0.009
Constant	9.740	5.65	0.084
Spatial Lag	0.212	0.079	0.007

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Predictors of the Percent of the Workforce Population with a Bachelor's Degree or Higher, using federal funds per FTE, spatial error model

Variables	Coefficient	Std. Error	Sig. p-value
State Funds	-0.001	0.001	0.290
Federal Funds	-0.002	0.006	0.669
Median Family Income*	0.002	0.001	0.000
Percent with a HS Diploma*	-33.39	9.87	0.001
Percent of the White Population	6.91	2.97	0.020
Goods-Producing Industry	-15.30	11.53	0.184
Information Technology Industry*	81.01	22.45	0.001
Institutions*	-0.001	0.001	0.018
Constant	17.831	5.583	0.001
LAMBDA	0.49	0.140	0.001

*denotes independent variables with a statistical significance of $p \leq 0.05$.

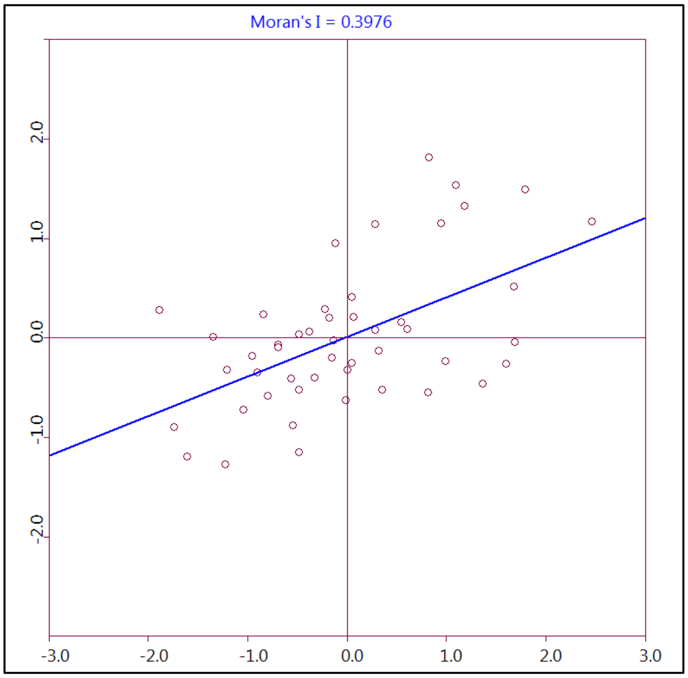
APPENDIX B: RESULTS USING VARIOUS SPATIAL WEIGHT MATRICES

Moran's I statistics using different spatial weight matrices for the dependent variable, percent of the workforce population with a bachelor's or higher degree.

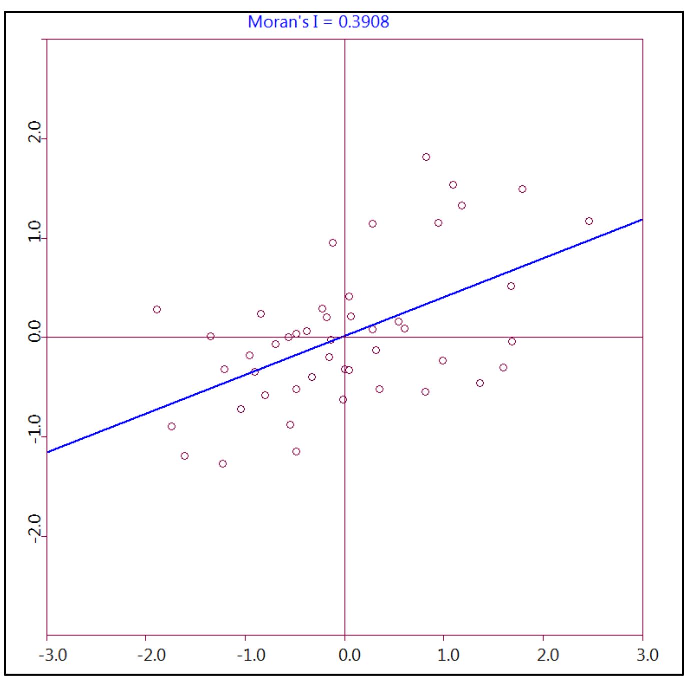
Spatial Weight Matrix	Moran's I	p-value
Rook's Contiguity	0.3976	0. 001
Queen's Contiguity	0.3908	0.002
K-Nearest Neighbors - 3	0.4790	0.001
K-Nearest Neighbors - 5	0.4387	0.001
Greater Distance – 303.24 miles	0.3201	0.002
Greater Distance – 402.40 miles	0.3466	0.001

Moran's I Scatterplots of the Different Spatial Weight Matrices

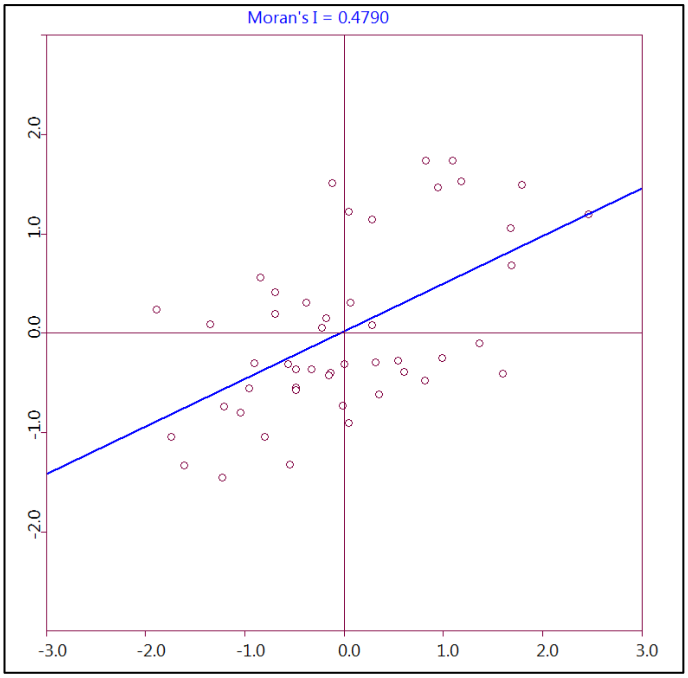
Rook's Contiguity Weight Matrix



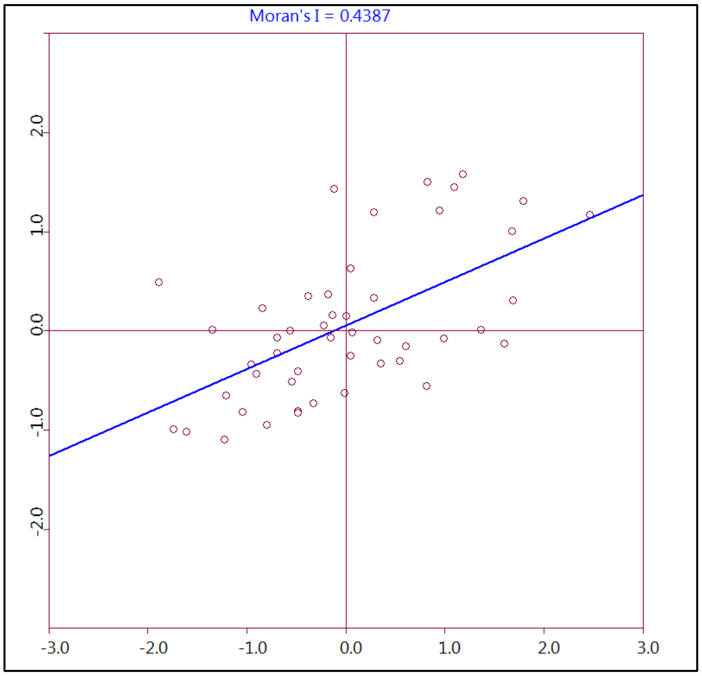
Queen's Contiguity Weight Matrix



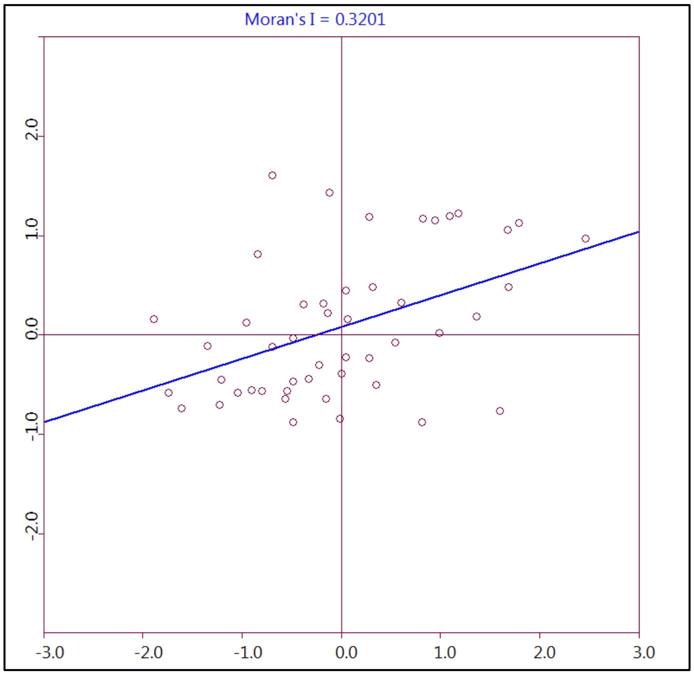
K-Nearest Neighbors -3 – Weight Matrix



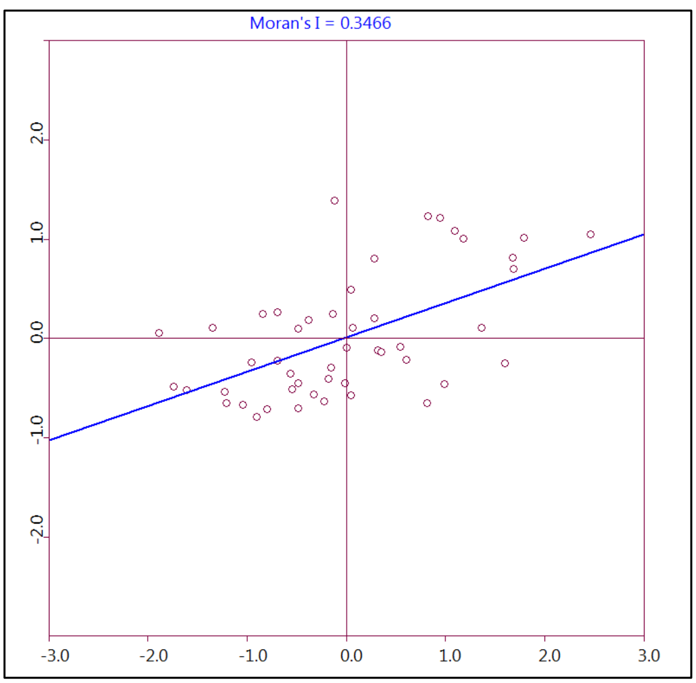
K-Nearest Neighbors -5 – Weight Matrix



Greater Distance – 303.24 miles – Weight Matrix

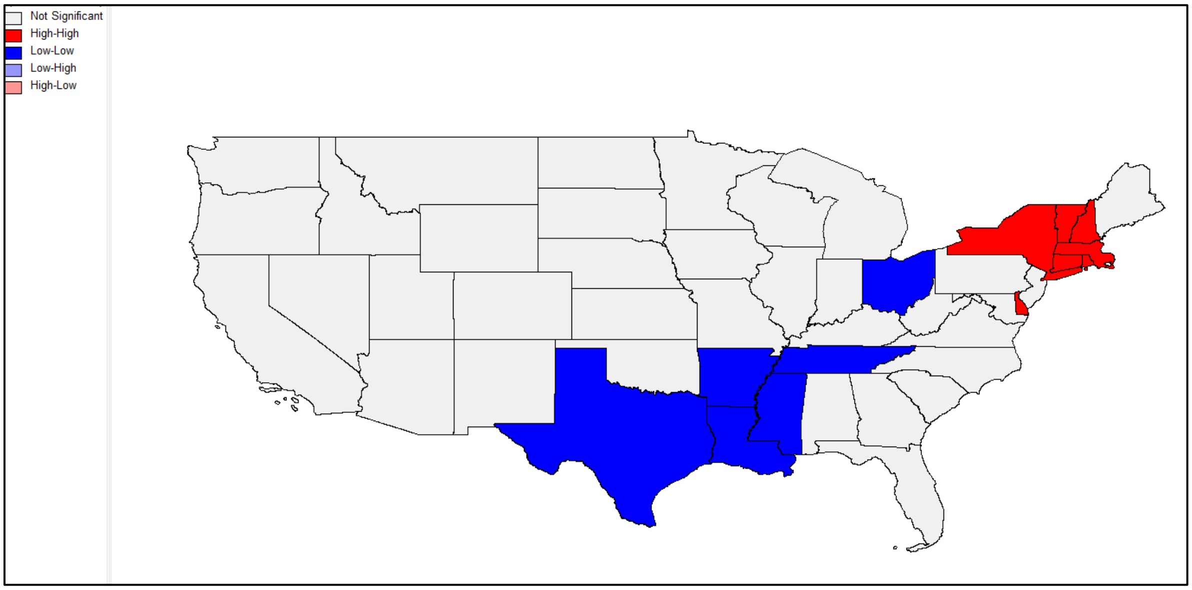


Greater Distance – 402.40 miles – Weight Matrix

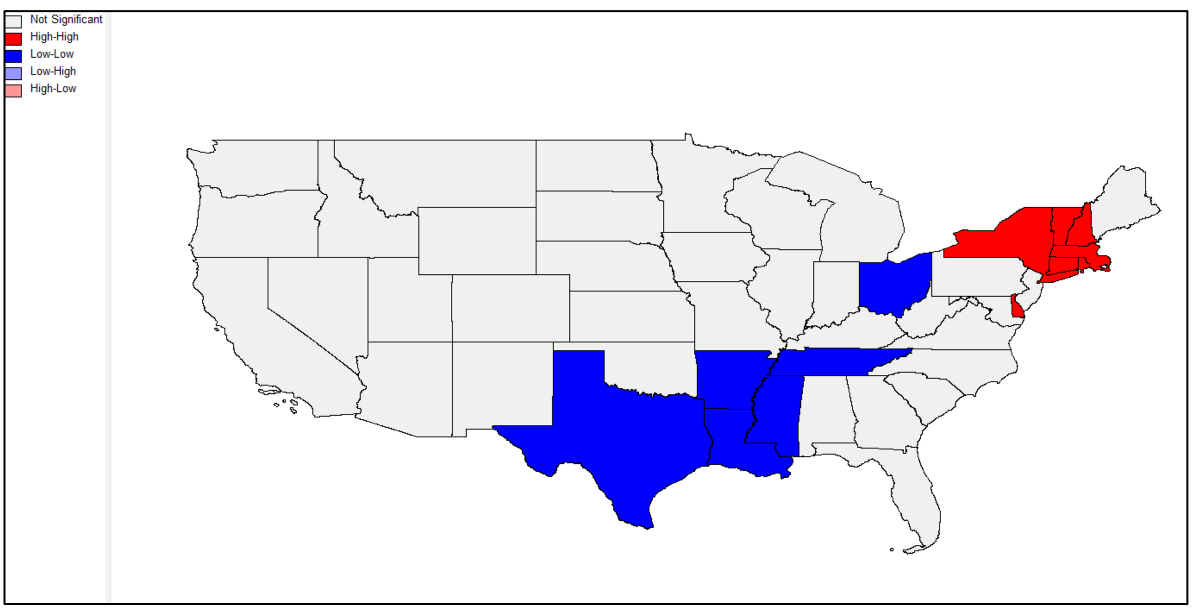


LISA cluster maps for the various spatial weight matrices

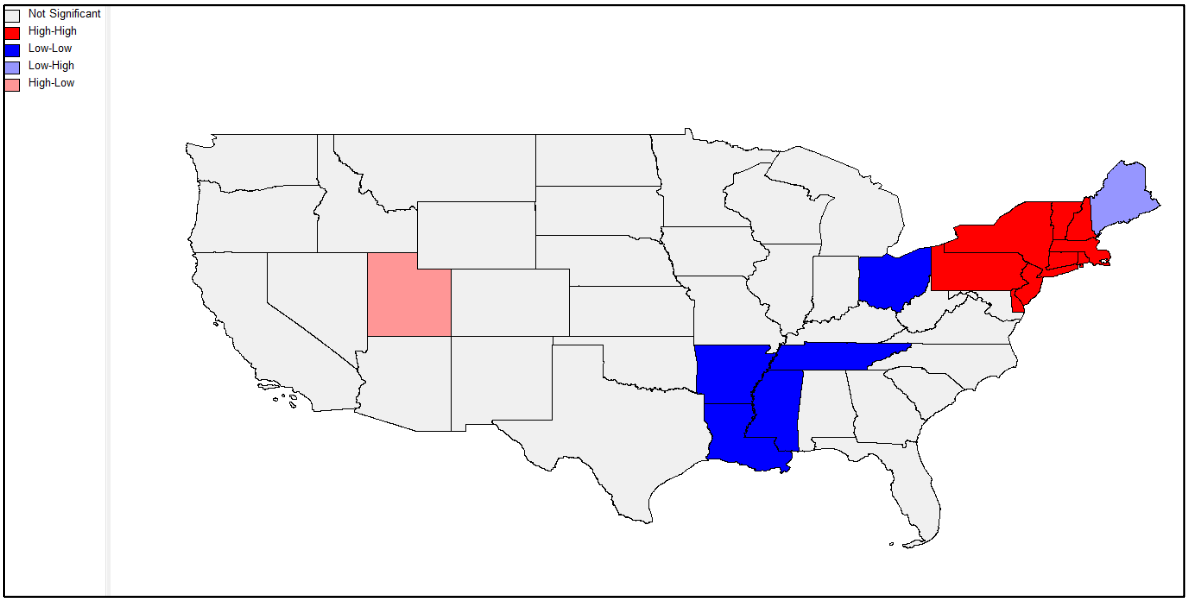
Rook's Contiguity



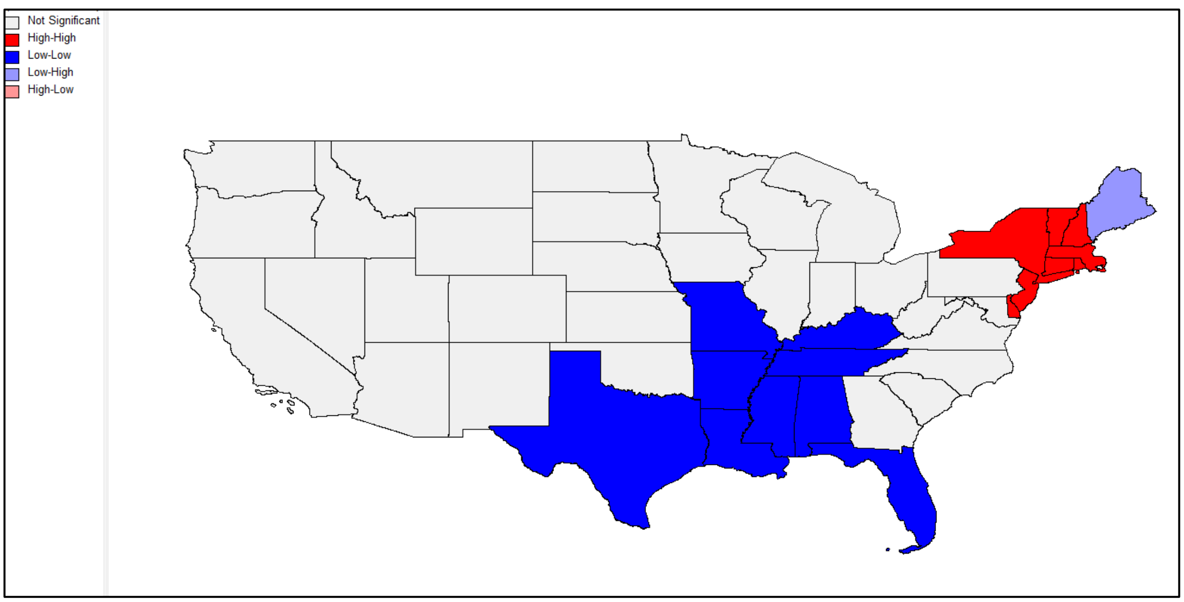
Queen's Contiguity



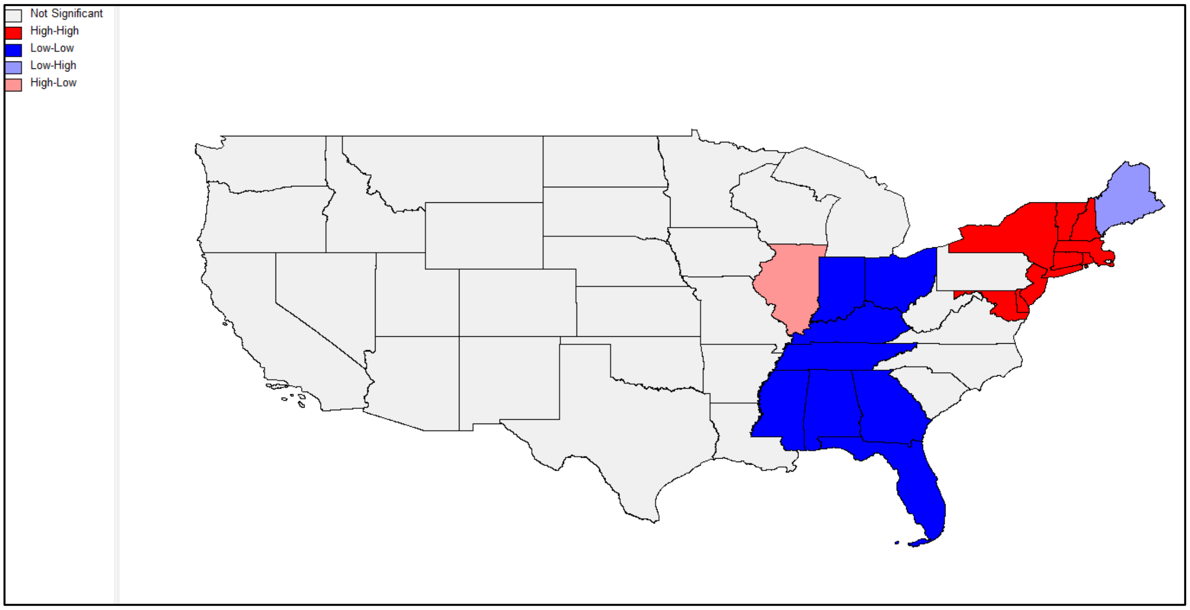
K-Nearest Neighbors – 3



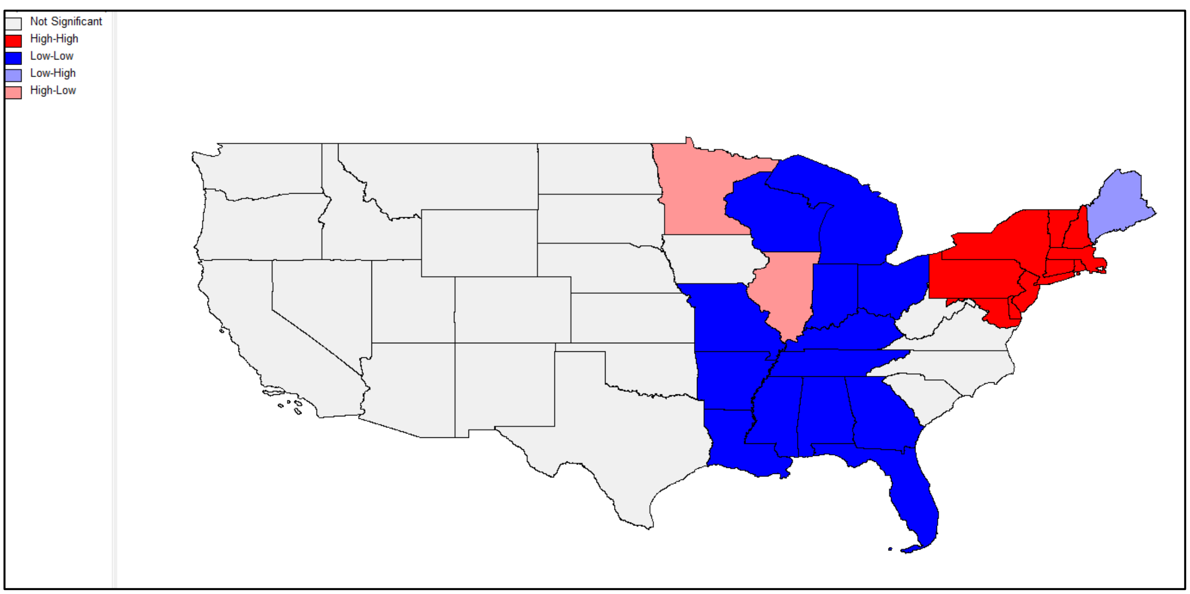
K-Nearest Neighbors – 5



Greater Distance – 303.24 miles



Greater Distance – 402.40 miles



Econometric Model Results

Rook's Contiguity

Variables	Coefficient Lag	Coefficient Error	Sig. p-value Lag	Sig. p-value Error
State Funds	-0.001	-0.001	0.268	0.310
Federal Funds	-0.003	0.004	0.672	0.949
Median Family Income*	0.001	0.001	0.000	0.000
Percent with a HS Diploma*	-25.92	-29.55	0.002	0.003
Percent of the White Population	4.35	7.76	0.195	0.159
Goods-Producing Industry	-14.56	-16.828	0.281	0.155
Information Technology Industry*	73.12	89.518	0.001	0.000
Institutions*	-0.001	-0.001	0.001	0.040
Constant	13.651	15.134	0.031	0.012
Spatial Lag	0.101	---	0.211	---
LAMBDA	---	0.152	---	0.002

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Queen's Contiguity

Variables	Coefficient Lag	Coefficient Error	Sig. p-value Lag	Sig. p-value Error
State Funds	-0.001	-0.001	0.274	0.290
Federal Funds	-0.004	-0.008	0.630	0.911
Median Family Income*	0.001	0.002	0.000	0.000
Percent with a HS Diploma*	-25.84	-29.38	0.002	0.003
Percent of the White Population	4.55	7.49	0.175	0.180
Goods-Producing Industry	-15.08	-16.21	0.266	0.171
Information Technology Industry*	73.09	91.56	0.001	0.000
Institutions*	-0.001	-0.001	0.001	0.030
Constant	13.922	15.508	0.029	0.011
Spatial Lag	0.089	---	0.270	---
LAMBDA	---	0.466	---	0.002

*denotes independent variables with a statistical significance of $p \leq 0.05$.

K-Nearest Neighbors – 3

Variables	Coefficient Lag	Coefficient Error	Sig. p-value Lag	Sig. p-value Error
State Funds	-0.001	-0.001	0.259	0.270
Federal Funds	-0.003	0.002	0.672	0.746
Median Family Income*	0.001	0.001	0.000	0.000
Percent with a HS Diploma*	-27.52	-32.84	0.001	0.000
Percent of the White Population	4.88	7.22	0.119	0.158
Goods-Producing Industry	-13.71	-17.82	0.303	0.110
Information Technology Industry*	73.79	81.41	0.001	0.000
Institutions*	-0.001	-0.001	0.002	0.017
Constant	13.996	16.683	0.025	0.004
Spatial Lag	0.102	---	0.136	---
LAMBDA	---	0.422	---	0.001

*denotes independent variables with a statistical significance of $p \leq 0.05$.

K-Nearest Neighbors – 5

Variables	Coefficient Lag	Coefficient Error	Sig. p-value Lag	Sig. p-value Error
State Funds	-0.001	-0.001	0.246	0.247
Federal Funds	-0.004	-0.001	0.573	0.780
Median Family Income*	0.001	0.001	0.000	0.000
Percent with a HS Diploma*	-26.96	-36.66	0.001	0.000
Percent of the White Population	4.11	6.69	0.207	0.192
Goods-Producing Industry	-12.45	-12.369	0.356	0.271
Information Technology Industry*	71.36	82.79	0.001	0.000
Institutions*	-0.001	-0.001	0.001	0.036
Constant	13.590	18.948	0.0313	0.001
Spatial Lag	0.126	---	0.116	---
LAMBDA	---	0.603	---	0.000

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Greater Distance – 303.24 miles

Variables	Coefficient Lag	Coefficient Error	Sig. p-value Lag	Sig. p-value Error
State Funds	-0.001	-0.001	0.293	0.210
Federal Funds	-0.002	-0.003	0.734	0.963
Median Family Income*	0.001	0.001	0.000	0.000
Percent with a HS Diploma*	-26.15	-33.35	0.002	0.000
Percent of the White Population	5.73	8.19	0.066	0.088
Goods-Producing Industry	-18.91	-23.02	0.150	0.066
Information Technology Industry*	71.19	80.06	0.002	0.000
Institutions*	-0.001	-0.001	0.002	0.045
Constant	14.63	18.37	0.024	0.002
Spatial Lag	0.044	---	0.552	---
LAMBDA	---	0.335	---	0.050

*denotes independent variables with a statistical significance of $p \leq 0.05$.

Greater Distance – 402.40 miles

Variables	Coefficient Lag	Coefficient Error	Sig. p-value Lag	Sig. p-value Error
State Funds	-0.001	-0.001	0.247	0.618
Federal Funds	-0.002	-0.005	0.783	0.490
Median Family Income*	0.001	0.001	0.000	0.000
Percent with a HS Diploma*	-27.11	-43.54	0.001	0.000
Percent of the White Population	5.17	9.68	0.096	0.040
Goods-Producing Industry	-13.77	-19.98	0.302	0.090
Information Technology Industry*	70.79	73.99	0.001	0.000
Institutions*	-0.001	-0.001	0.002	0.099
Constant	12.17	21.63	0.065	0.000
Spatial Lag	0.137	---	0.122	---
LAMBDA	---	0.648	---	0.000

*denotes independent variables with a statistical significance of $p \leq 0.05$.

REFERENCES

Abbot, A. (1997). Of time and space: The contemporary relevance of the Chicago School. *Social Forces, 75*, p. 1149-1182.

Anselin, L. (1987). Model validation in spatial econometrics: A review and evaluation of alternative approaches. *International Regional Science Review, 11.*

Anselin, L. (1988). *Spatial econometrics: Methods and models*. Kluwer Academic Publishers, Dordrecht.

Anselin, L. (1993). *The Moran Scatterplot as an ESDA tool to assess local instability in spatial association.* Paper presented for the GISDATA Specialist Meeting on GIS and Spatial Analysis.

Anselin, L. (1994). Exploratory spatial data analysis and geographic information systems in *New Tools for Spatial Analysis*, p. 45-54. Luxembourg: Eurostat.

Anselin, L. (1999). The future of spatial analysis in the social sciences. *Geographic Information Systems, 2*, 67-76.

Anselin, L. (2005). *Exploring spatial data with GeoDa: A workbook*. Center for Spatially Integrated Social Science.

Archibald, R.B. (2002). The financial aid system: How it works and how well it works in *Redesigning the Financial Aid System*. Baltimore: Johns Hopkins Press. pp. 49-74.

Astin, A.W. & Oseguera, L. (2002) Degree Attainment Rates at American Colleges and Universities.Los Angeles: Higher Education Research Institute,UCLA.

Barro, R.J. & Lee, J. (2001). International Data on Educational Attainment: Updates and Implications. *Oxford Economic Papers 3*, p. 541-563.

Bartash, J. & Mantell, R. (September 20, 2010). U.S. recession ended June 2009, NBER finds: Downturn of 18 months ranks as longest since Great Depression. *The Wall Street Journal Digital Network, Market Watch*. Retrieved on April 9, 2011 from: http://www.marketwatch.com/story/us-recession-ended-june-2009-nber-says-2010-09-20

Baum, S. (1995). *The Federal Role in Financing Higher Education: An Economic Perspective.*

Baum, S. (2010). Non-Financial Barriers to College Enrollment and Success [PDF document]. Retrieved from website: http://econ.msu.edu/seminars/docs/Nonfinancial%20barriers_Baum_June%202010.pdf

Bautsch, B. & Williams, R. (2010). Recommendation Nine in *The College Completion Agenda*. The College Board

Bendavid, N. & Hook, J. (April 9, 2011). Last Minute Deal Averts Shutdown. *The Wall Street Journal*. Retrieved on April 9, 2011 from: http://online.wsj.com/article/SB10001424052748704503104576250541381308346.html?mod=WSJ_Home_largeHeadline

Berube, A. (2010). Educational Attainment. In *State of metropolitan America: On the front lines of demographic transformation* (chapter VI). Retrieved from http://www.brookings.edu/~/media/Files/Programs/Metro/state_of_metro_america/metro_america_report.pdf

Betts, J.R. & McFarland, L.L. (1995). Safe port in a storm: The impact of labor market conditions on community college enrollments. *The Journal of Human Resources, 30*(4), p. 741-765.

Black, D., Kolesnikova, N., & Taylor, L. Earnings functions when wages and prices vary by location. *Journal of Labor Economics, 27*(1), p. 21-47.

Briggs, X. (2005). (Ed.). The geography of opportunity: Race and housing choices in metropolitan America. Washington, DC: Brookings Institution Press.

Callan, P. (2002). Coping with Recession: Public Policy, Economics Downturns, and Higher Education. *National Center for Public Policy and Higher Education*.

Cameron, S.V. & Heckman, J.J. (2001). The Dynamics of Educational Attainment for Black, Hispanic, and White Males. *The Journal of Political Economy, 109*(3), p. 455-499.

Carnevale, A.P., Smith, N., & Strohol, J. (2010). Help Wanted: Projections of jobs and education requirements through 2018. Retrieved June 25, 2011 from the Center on Education and the Workforce at Georgetown University website: http://cew.georgetown.edu/jobs2018/

Carnevale, A. P. and Smith, N. (2012). *A Decade Behind: Breaking Out of the Low-Skill Trap in the Southern Economy*. Retrieved from the Center on Education and the Workforce at Georgetown University website at http://cew.georgetown.edu/south/

Carter, D. (2003). Secondary analysis of data. In F.K. Stage, & K. Manning, *Reseach in the College Context: Approaches and Methods* (pp.153-168). New York: Brunner-Routledge.

Chan-Yeung, M., Yeh, A.GO., Tam, C.M., Kam, K.M., Leung, C.C., Yew, W.W. & Lam, C.W. (2005). Socio-demographic and geographic indicators and distribution of tuberculosis in Hong Kong: a spatial analysis. *The International Journal of Tuberculosis and Lung Disease, 9* (12), p. 1320 – 1326.

Cheah, H.M. (2010). National strategies to build a technology workforce. *International Encyclopedia of Education, 3*, p. 66-72.

Cheslock, J. & Gianneschi, M. (2008). Replacing State Appropriations with Alternative Revenue Sources: The Case of Voluntary Support. *Journal of Higher Education*. 79(4), pp. 208-229.

Claessens, S., Evenett, S., & Hoekman, B. (2010). (Ed.) Rebalancing the Global Economy: A Primer for Policy. London: Centre for Economic Policy Research.

Conley, D. (2001). Capital for college: Parental assets and postsecondary schooling. *Sociology of Education*, 74, p. 59-72.

Coppock, J.T. & Rhind, D.W. (1991). The History of GIS. *Geographical Information Systems: Principles and Applications, 1*, p. 21-43.

Crissey, S.R. (2009). Educational Attainment in the United States: 2007. U.S. Department of Commerce, Current Population Reports.

Dall'erba, S. (2005). Distribution of regional income and regional funds in Europe 1989-1999: An exploratory spatial data analysis. *The Annals of Regional Science, 39*, p. 121-148.

Deil-Amen, R. & Turley, R. (2007). A review of the transition to college literature in sociology. *Teachers College Record, 109*(10), p. 2324-2366.

de los Santos, A.G. & Sutton, F.A. (2012). Swirling College Students. *The Community College Journal of Research and Practice.*

DiMaggio, P. & Mohr, J. (1985). Cultural Capital, Educational Attainment and Marital Selection. *The American Journal of Sociology, 90*(6), p. 1231-1261.

Dujardin, C. Peeters, D. & Thomas, I. (2009). Neighbourhood effects and endogeneity issues. CORE website retrieved May 17, 2012 from www.ecore.be/DPs/dp_1254903898.pdf

Elman, C. & O'Rand, A.M. (2004). The race is to the swift: Socioeconomic origins, adult education and wage attainment. *American Journal of Sociology, 110*, p. 123-160.

ESRI (2012). *ArcGIS*. Environmental Systems Resource Institute, Redlands, CA.

Evans, M.D.R., Kelley, J., Sikora, J., Treiman, D.J. (2010). Family scholarly culture and educational success: Books and schooling in 27 nations. *Research in Social Stratification and Mobility.*

Flores, C.A. (2008). *Residential segregation and the geography of opportunities: A spatial analysis of heterogeneity and spillovers in education* (Doctoral dissertation). Austin, TX.

Fotheringham, A.S., Brundeson, C., & Charlton, M. (2002). *Geographically weighted regression: The analysis of spatially varying relationships*. London: John Wiley & Sons Ltd.

Galster, G.C. (2012). Urban opportunity structure and racial/ethnic polarization. In W.F. Tate (Eds.), Research on schools , neighborhoods and communities: Toward civic responsibility (p. 29-46). Lanham, Maryland: American Educational Research.

Galster, G.C. & Killen, S.P. (1995). The geography of metropolitan opportunity: A reconnaissance and conceptual framework. *Housing Policy Debate, 6*(1), p. 73-102.

Griswold, C.P. & Marine, G.M. (1996). Political Influences on State Policy: Higher-Tuition, Higher-Aid, and the Real World. *Review of Higher Education*. 19(4). Summer. pp. 361-389.

Goetz, S.J. & Rupasingha, A. (2003). The returns on higher education: Estimates for the 48 contiguous states. *Economic Development Quarterly, 17*(4), p. 337 - 351.

Goldrick-Rab, S. & Roksa, J. (2008). *A federal agenda for promoting student success and degree completion.* Washington, D.C.: Center for American Progress.

Goodchild, M.F. (1987). A spatial analytical perspective on geographical information systems. *International Journal of Geographical Information Systems, 1*(4), p. 327-334.

Goodchild, M.F. (1992). Geographical information science. *International Journal of Geographical Information Systems, 6*(1), p. 131-145.

Goodchild, M.F., Anselin, L., Appelbaum, R.P. (2000). Toward spatially integrated social science. *International Regional Science Review, 23*(2), 139 – 159.

Goodchild, M.F. (2007). Citizens as sensors: The world of volunteered geography. *GeoJournal*, 69, p. 211- p.221.

Hauptam, A.M. & Kim, Y. (2009). *Cost, commitment, and attainment in higher education. An international comparison*. Boston, MA: Jobs for the Future.

Haveman, R. & Wolfe, B. (1995). The determinants of children's attainments: A review of methods and findings. *The Journal of Economic Literature, 33*(4), 1829-1878.

Hearn, J.C. (1998). The growing loan orientation in federal financial-aid policy: A historical perspective. In R. Fossey & Bateman, M. (Eds.), Condemning students to debt: College loans and public policy (pp. 47-75). New York: Teachers College Press.

Hendrickson, M. (2012). *Are the 10 Poorest U.S. States Really Republican?* Retrieved July 31, 2012 from http://www.forbes.com/sites/markhendrickson/2012/06/07/are-the-10-poorest-u-s-states-really-republican/

Heller, D. E. Ed. (2002). *Condition of access: Higher education for lower income students* (pp. 59-72). Westport, CT: Praeger Publishers (ACE/Oryx Series on Higher Education).

Hossler, D., Lund, J.P., Ramin, J., Westfall, S. & Irish, S. (1997). State Funding for Higher Education: The Sisyphean Task. *The Journal of Higher Education, 68*(2), p. 160-190.

Immigration Policy Center (2011). The U.S. economy still needs highly skilled foreign workers. Retrieved from the American Immigration Council website at www.immigrationpolicy.org

Isard, W. (1956). *Location and space economy*. Cambridge, MA: MIT Press.

Johnson Jr., O.D. (2012). Toward a theory of place: social mobility, proximity, and proximal capital. In W.F. Tate (Eds.), Research on schools , neighborhoods and communities: Toward civic responsibility (p. 29-46). Lanham, Maryland: American Educational Research.

Johnstone, D. B. (2004). The Economics and Politics of Cost Sharing in Higher Education: Comparative Perspectives. *Economics of Education Review*. 23, p. 403-410.

Kaba, A.J. (2010). Educational attainment, population increase and the progress of African Americans. *The Journal of Pan African Studies, 3*(9).

Kain, J.F. (2004). A pioneer's perspective on the spatial mismatch literature. *Urban Studies 41*:7-32.

Kalogirou, S. (2010). Spatial inequalities in income and post-graduate educational attainment in Greece. *Journal of Maps*, p. 393-400.

Kane, Thomas (1999) "How We Pay for College" in *The Price of Admission*. Washington DC: Brookings Institution Press, p. 20-43.

Kavroudakis, D., Ballas, D., & Birkin, M. (2012). A spatial microsimulation approach to the analysis of social and spatial inequalities in Higher Education attainment. *Applied Spatial Analysis and Policy*.

Knight, J. & Shi, L. (1995). Educational attainment and the rural-urban divide in China. *Oxford Bulletin of Economics and Statistics*, 58(1), p. 83 -117.

Lauer, C. (2002). A model of educational attainment: Application to the German case. Center for European Economic Research.

Lee, S. Y. (2009). Bias from misspecified spatial weight matrices in SAR models: Theory and simulation studies.

Lee, J., Edwards, K., Menson, R., & Rawls, A. (2011). *The College Completion Agenda, 2011 Progress Report Executive Summary*. The College Board.

Le Sage, J. (1999). *The Theory and Practice of Spatial Econometrics*. University of Toledo.

Lingenfelter, P. (2010). Probing policy resistance to liberal education: Why the chasm? Can it be bridged? And who loses if we miss? [PDF document]. AAC&U Panel Presentation and Discussion retrieved from website: http://www.sheeo.org/about/paulpres/AACU%201-22-10%20Liberal%20education.pdf

Longley, P. & Batty, M. (Eds). (1996). *Spatial analysis: Modelling in a GIS environment*. John Wiley & Sons.

Lupton, R. (2003). Neighbourhood Effects: Can we measure them and does it matter? CASEpaper73, London: CASE: London School of Economics

Manski, C. F. (1993). Identification of endogenous social effects: The reflection problem. Review of Economic Studies, 60, 531–542.

Massey, D. B. (1984). *Spatial divisions of labour: Social structures and the geography of production*. London: Macmillan Education.

Matthews, D. (2010, September). *A Stronger Nation through Higher Education*. A Lumina Foundation special report.

McKeon, H.P. (2003). Controlling the Price of College. *The Chronicle of Higher Education*.

Metcalfe, A. (2008). The geography of access and excellence: Spatial diversity in higher education system design. *The International Journal of Higher Education and Educational Planning,58* (2), 205-222.

Miller, H.J. (2004). *Tobler's first law and spatial analysis*. University of Utah Forum.

Morenoff, J. & Sampson, R.J. (1997). Violent crime and the spatial dynamics of neighborhood transition: Chicago, 1970 – 1990. *Social Forces, 76*, p. 31-64.

Morris, J.E. & Monroe, C.R. (2009). Why Study the US South: The Nexus of Race and Place in Investigating Black Student Achievement. *Educational Researcher, 38*(1), p. 21-36

McPherson, P. & Shulenburger, D. (2008). *University tuition, consumer choice and college affordability. Strategies for addressing a higher education affordability challenge.* A NASULGC Discussion Paper.

Openshaw, S. (1994). *Two exploratory space-time-attribute pattern analysers relevant to GIS.* Chapter 5 in Spatial analysis and GIS. CRC Press.

Ousley, C. (2010). *A geographic-information-systems-based approach to analysis of characteristics predicting student persistence and graduation* (Doctoral dissertation). The University of Arizona.

Pastor, M. (2001). Chapter 14: Geography and Opportunity in America Becoming: Racial Trends and Their Concequences, 1.

Pederson, D.O. (2009). *Previous and current efforts at cost containment*. Letter to Deans and Directors.

Pickles, J. (Ed.) (1995). *Ground truth: The social implications of geographic information systems*. New York: Guilford Press.

Pitzl, M. (April 8, 2011). Brewer signs off on a slashed budget. *The Arizona Republic*. Retrieved on April 10, 2011 from: http://www.azcentral.com/arizonarepublic/news/articles/2011/04/08/20110408statebudget-sign0408.html

Rafanelli, M., Klensin, J.C., & Svensson, P. (1989). *Statistical and scientific database management*. Berlin: Springer.

Redding, S. (2003). Distance, skill deepening and development: Will peripheral countries ever get rich? *Journal of Development Economics, 72*(2), p. 515-541.

Rey, S.J. & Montouri, B.D. (1999). US regional income convergence: A spatial econometric perspective. *Regional Studies, 33*.2, p. 143-156.

Rhind, D.W. (1981). Geographic Information Systems in Britain. In *Quantitative Geography: A British view*. London: Routledge.

Rhind, D.W. (1988). Personality as a factor in the development of a new discipline. The case of computer-assisted cartography. *The American Cartographer, 15*(3), p. 277-289.

Rhind, D., Openshaw, S., & Green, N. (1989). *The analysis of geographical data: data rich, technology adequate, theory poor*. Proceedings of the 4th international conference on Statistical and Scientific Database Management.

Rios-Aguilar, C., Cantwell, B., Deil-Amen, R. & Wissler, C. (in progress). Neighborhoods matter: Conceptualizing and estimating neighborhood effects in educational research using geospatial methods.

Rosenbaum, J.E. (1995). Changing the Geography of Opportunity by Expanding Residential Choice: Lessons from the Gautreaux program. *Housing Policy Debate, 6*(1), p. 231-269.

Rosenbaum, J.E., Reynolds, L., & Deluca, S. (2002). How do places matter? The geography of opportunity, self-efficacy and a look inside the black box of residential mobility. *Housing Studies, 17*(1), p. 71-82.

Rosenberg, M.S. & Anderson, C.D. (2011). PASSaGE: Pattern analysis, spatial statistics and geographic exegesis. Version 2. *Methods in Ecology and Evolution, 2*(3), p. 229 – 232.

Rusk, D. (2003). *Cities without suburbs* (3rd ed.). Washington, D.C.: Woodrow Wilson Press.

Sampson, R.J. (2000). On the social development of antisocial behavior: A review essay. *Social Development*, 9, p. 565-568.

Scott, P. (2008). Higher education: An overview. *International Encylopedia of Education, 3rd Ed.*, p. 217-228.

SHEEO. (2008). *State Higher Education Finance FY 2008*. Retrieved from the State Higher Education Executive Officers website at www.sheeo.org

SHEEO. (2012). State Higher Education Executive Officers. Retrieved on February 11, 2012 from http://www.sheeo.org/

Slaughter, S. & Rhoades, G. (2004). *Academic capitalism and the new economy*. Baltimore: Johns Hopkins University Press.

Southall, P. (2006, February 10). Students should apply for financial aid. Retrieved September 15, 2007 from the Texas Higher Education Coordinating Board, Press Release website: http://www.thecb.state.tx.us/reports/PDF/1144.PDF

Small, M. (2008). Four reasons to abandon the idea of 'The Ghetto'. City and Community,7(4), 389-98.

Smith, M., Goodchild M., & Longley, P. (2011). Geospatial analysis: A comprehensive guide to principles, techniques and software tools. Retrieved from the website: http://www.spatialanalysisonline.com/

Sutton, F.A. (2008). *Student Loans: Financial Aid or Financial Peril? The implications of debt and default on future workforce participation*.

Tate, W.F. (2012). *Research on schools , neighborhoods and communities: Toward civic responsibility*. Lanham, Maryland: American Educational Research.

Tate, W. F. (2008). Geography of Opportunity: Poverty, Place and Educational Outcomes. *Educational Researcher, 37*(7), p. 397- 411.

Tate, N.J. & Unwin, D.J. (2009). Teaching GIS&T. *Journal of Geography in Higher Education, 33*, S1, S1-S6.

Tobler, W.R. (1970). A computer moving urban growth in the Detroit region. *Economic Geography, 46*, 234-240.

Tomlinson, R.F., Calkins, H.W., & Marble, D.F. (1976). *Computer handling of geographic data: An examination of selected Geographic Information Systems*. Natural Research Series XIII. Paris: The UNESCO Press.

Turner, S. (2002). Connecting Higher Education and the Labor Market. *Change*. July/August. pp. 32-39.

Turner, A. (2006). *Introduction to neogeography*. Sebastopol, CA: O'Reilly Media.

Ullah, A. & Giles, D.E.A. (1998). *Handbook of Applied Economic Statistics*. CRC Press.

U.S. Department of Education. (2006). A Test of Leadership - The Future of U.S. Higher Education. The Secretary of Education's Commission on the Future of Higher Education.

United States Department of Education. (2010). *Mission*. Retrieved from http://www2.ed.gov/about/overview/mission/mission.html?src=ln

U.S. Department of Education, National Center for Education Statistics. (2011). *Digest of Education Statistics, 2010.* Retrieved on June 27, 2012 from http://nces.ed.gov/fastfacts/display.asp?id=98

United States Department of Education. (2010). State Funding History Tables [Data file]. Retrieved from http://www2.ed.gov/about/overview/budget/history/index.html.

United State Environmental Protection Agency. (2004). *Developing spatially interpolated surfaces and estimating uncertainty*. Retrieved from the website: http://www.epa.gov/airtrends/specialstudies/dsisurfaces.pdf

Varga, A. (1998). *University research and regional innovation: a spatial econometric analysis of academic knowledge transfers*. Boston, MA: Kluwer Academic.

Voss, P.R., Long, D.D., Hammer, R.B., & Friedman, S. (2006). County child poverty rates in the US: a spatial regression approach. *Popul Res Policy Rev, 25*, p. 369-391.

Waldorf, B.S. (2007). *Brain drain in rural America*. Paper presented at American Agricultural Economics Association Annual Meeting.

Wang, L. & Gan, Y. (2008). Residential mobility, neighborhood effect and educational attainment of blacks and whites. Retrieved May 17, 2012 from http://econweb.tamu.edu/common/files/workshops/PERC%20Applied%20Microeconomics/2008_10_15_Yingning_Wang.pdf

Wellman, J.V., Desrochers, D.M., & Lenihan, C.M. (2008). *The growing imbalance: Recent trends in U.S. postsecondary education finance*. Washington, D.C.: Delta Cost Project.

Wilson, W. (1987). *The truly disadvantaged: The inner city, the underclass, and public policy*. Chicago: University of Chicago Press.

Wilson, W. (1996). *When work disappears: The world of the new urban poor*. New York: Knopf.

Wodtke, G.T., Elwert, F., & Harding, D.J. (2012). Poor families, poor neighborhoods: How family poverty intensifies the impact of concentrated disadvantages on high school graduation.