

## ABSTRACT

Title of Document: RETURN ON INVESTMENT: AN EXAMINATION OF THE “SPILLOVER EFFECT” OF STATE FUNDING FOR HIGHER EDUCATION ON STATE ECONOMIC PERFORMANCE, A SPATIAL ANALYSIS

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Utilizing a conceptual framework that includes the endogenous growth theory and principal agent theory, this study investigates the relationship between state economic performance and state appropriations for public higher education, both within and across states. This examination is conducted utilizing advanced statistical modeling and data from the 48 contiguous United States over a period of ten years. The analytic model utilized in this study is a dynamic fixed effects panel (DFEP) which is estimated utilizing a Generalized Method of Moments (GMM) technique. Combining the DFEP model with GMM techniques facilitates an ability to account for issues such as unobservable state characteristics, endogeneity, serial correlation, heteroscedasticity, and time-specific effects. This technique utilizes lags of the dependent variable and independent variables to address the aforementioned issues.

This study adds to the literature surrounding the relationship between state economic performance and state appropriations for public higher education, by not only examining this relationship in the economic performance of neighboring states but also utilizing advanced statistical methodology.

The results discussed herein indicate that while using simpler statistical methods e.g. ordinary least squares regression, there is a positive statistically significant relationship between state economic performance and state appropriations for public higher education. However, this relationship becomes insignificant when utilizing the DFEP model estimated with GMM techniques. Furthermore while the results of this inquiry indicate that there was no statistically significant relationship between state appropriations and neighboring state economic performance, there is spatial correlation of state appropriations and gross state product across neighboring states.

There were several implications as a result of this study. One implication is that though the relationship between state appropriations for public higher education and state economic performance was insignificant this research provides a foundation for further research in this area. By introducing advanced methodology and suggesting a redefinition of how one measures the relationship between higher education funding and economic performance this study may inspire new research. Another implication is utilizing two disparate theories to develop a conceptual framework. Scholars who wish to examine relationships between other forms of state funding and state economic performance might also consider employing these theories as a foundation for their study. Lastly, spatial correlation was discovered in both state appropriations and state economic performance. The discovery of spatial correlation indicates that further research is

needed regarding the influence of higher education institutions and policy beyond state and regional borders.

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## CHAPTER ONE INTRODUCTION

### Introduction

State governments provided 76.1 billion dollars to higher education during the 2013 fiscal year (Grapevine, 2014). The rationale for this level of spending may be found in the benefits that higher education provides at an individual and societal level.

According to McMahon (2010), education has private, individual benefits as well as public, social benefits, also referred to as externalities. Individually, those who are beneficiaries of higher education have been shown to receive higher wages, and live healthier lives. For example, over the duration of their working lives college graduates earn on average 65% more than high school graduates, and 68% of bachelor degree recipients exercise vigorously at least once per week compared to 40% of high school graduates (Baum, Ma, & Payea, 2013). The public externalities include greater productivity, reduced crime, greater levels of civic engagement, and less reliance on public assistance (Baum et. al, 2013; IHEP, 1998; McMahon, 2010; Toutkoushian, & Shafiq, 2010). More specifically, 42% of bachelor degree recipients volunteered for organizations compared to 17% of high school graduates in 2012, 80% of four year college graduates voted in the 2012 election compared to 59% of high school graduates, and approximately 25% of high school graduates relied on Medicaid in 2011 compared to 9% of four year degree recipients.

One of the most integral benefits, however, of higher education is the role that it plays with respect to the country's economic vitality. According to Lane (2012), "Higher education plays an increasingly critical role in the economic competitiveness of local,

state, and national economies” (Lane, 2012, p. 1). Higher education’s contributions to economic competitiveness include public service, innovation through research and development (R&D), and education of the citizenry (Gais & Wright, 2012; Lane, 2012; McMahon, 2010). For example, university R&D collaboration with manufacturing firms is likely to have the highest short and long term influence on product innovation (Un, Cuervo-Cazurra , & Asakawa, 2010). Furthermore, by fulfilling their mission to educate, colleges and universities play an important role in increasing the nation’s stock of human capital.

Several scholars have argued that increased human capital and economic performance are inextricably linked (Abel&Dietz, 2012; Becker, 1962; Romer, 1990). One example of this relationship is through increased tax revenue. As indicated by Baum, Ma and Payea (2013), college graduates earn on average 65% more in salary, and pay on average 78% more in local, state, and federal taxes each year than their high school graduate counterparts.

The aforementioned benefits of higher education, especially the premium on the wages of college graduates and the associated tax revenue, represent the chief reasons of why states provide appropriations to higher education (Baum et al., 2013; Ehrenberg, 2004; Groen, 2004; Groen, 2011). As a result, the relationship between state economic performance and state appropriations for higher education has been examined in the literature (Baldwin & Borelli 2008; Baldwin, Borrelli, & New, 2011; Berry & Kaserman, 1993; Blankenau & Simpson, 2004; Curs, Bhandari, & Steiger, 2011; Deskins, Hill, & Ullrich; Garcia-Mila & McGuire, 1992; Quan & Beck, 1987; Vedder, 2004).

Although helpful in understanding the influence of state appropriations for higher education on state economic performance, the aforementioned studies produced mixed results. Some indicated that the relationship between state appropriations for higher education and state economic performance was positive (Baldwin & Borelli, 2008; Baldwin, Borelli, & New, 2011; Berry & Kaserman, 1993; Garcia-Mila & McGuire, 1992; Quan & Beck, 1987); others indicated the relationship to be negative (Deskens, Hill, & Ullrich, 2010; Vedder, 2004), and Blankenau and Simpson (2004) found there to be no relationship. Many of these studies were limited by only examining the relationship on a state by state basis, meaning that they only examined the relationship between a particular state's appropriations and that state's economic performance; thereby overlooking the possible influence of state appropriations for higher education in one state influencing the state economic performance in neighboring states. Consequently, there is a dearth of research with respect to the potential spillover effects of state appropriations for higher education. Spillover effects are the externalities, positive or negative, that extend to society (McMahon, 2010) or, in the case of this study, to neighboring states.

### Purpose

The purpose of this study is to address the aforementioned dearth of research by examining if state economic performance is influenced by state appropriations for public higher education, and if there is a spillover effect on the economic performance of neighboring states. Although previous literature has examined the relationship between economic performance and state higher education appropriations at the in-state level, the

question of whether or not state higher education appropriations in one state influence the economic performance of that state's neighbors has not yet been addressed.

### Research Questions

Two research questions are used to address the purpose of this inquiry:

- 1.) Is a state's economic performance related to that state's appropriations for public higher education?
- 2.) Is the economic performance in neighboring states related to a state's appropriations for public higher education?

### Conceptual framework

The examination of the relationship between state economic performance and state appropriations for public higher education is guided by the endogenous growth theory and the principal agent theory (PAT). The endogenous growth theory (EGT) is used in this study as opposed to human capital theory because it extends beyond the investment in human capital (Becker, 1962) and describes how the relationship between factors such as knowledge accumulation, innovation, and human capital are all related to economic performance. EGT is supplemented by the PAT, which describes a relationship in which one party, the agent, acts on behalf of another party, the principal, to carry out specific tasks. In this examination, institutions are the agents and state governments are the principals. The task is the education of the state's citizenry which leads to knowledge accumulation, innovation, and the enhancement of increased human capital. Together, these two theories help to explain how state economic performance could be related to state appropriations for public higher education.

Endogenous growth theory earned its name by economists treating factors such as innovation and human capital as endogenous to the economic growth process (Martin & Sunley, 1998). The theory has been used throughout the economics literature as a way to explain the relationship between economic performance and factors such as knowledge accumulation, innovation, and human capital within countries and across regions (Aghion & Howitt, 1998; Andersson & Karlsson, 2007; Martin & Sunley, 1998; Romer, 1986; Romer 1990).

The endogenous growth theory is used in this study because it establishes a context in which state economic performance can be influenced by the education of the state's citizenry. According to Lane (2012), the better educated a person is, the more they are able to contribute to the economic development of a region. Therefore, the "spillover" or flow of knowledge via the mobility and interaction between people could help explain why state appropriations for public higher education, and its provision and intent to increase knowledge accumulation, innovation, and human capital, might influence gross state product within and across states (Andersson & Karlsson, 2007).

While endogenous growth theory helps to explain the relationship between state economic performance and knowledge accumulation, innovation, and human capital, the theory was not designed to describe the context in which this occurs. The factors that contribute to economic performance such as knowledge accumulation, innovation, and increased human capital do not come to fruition by happenstance. The context in which these factors are brought to bear are through the aforementioned tasks of higher education institutions, including R&D, service, and most importantly, education of the citizenry. To that end, state governments play a critical role in financially supporting the education

of the state's citizenry by providing appropriations to public higher education. The context in which state governments provide this funding is through a unique relationship with institutions of higher education. The relationship can best be described by the principal agent theory (PAT). Therefore the principal agent theory is used to describe the context in which state governments support the education of the state's citizenry, which in turn leads to the knowledge accumulation, innovation, and increased human capital that is related to economic performance as per the endogenous growth theory.

The origin of PAT describes a scenario in which one party, the agent, acts on behalf of another, the principal, to carry out tasks that either require specialized knowledge or are too great for the principal to carry out alone (Moe, 1984; Ross, 1973). Principal agent theory has been utilized to examine relationships in various contexts including compensation, organizational behavior, and regulatory practices (Arnold, Neubauer, & Schoenherr, 2012; Garen, 1994; Mitnick, 1975; Verhose, 2005). PAT has also been used to further understand higher education governance, and the relationship between states and institutions (Lane & Kivisto, 2008; Titus, 2009).

As indicated above, economic performance is related to knowledge accumulation (Aghion & Howitt, 1998; Andersson & Karlsson, 2007; Martin & Sunley, 1998; Romer, 1986). However state governments, on their own, cannot manage the task of educating their citizenry so they entrust this responsibility to higher education institutions. Consequently, state governments provide higher education appropriations as a means for institutions to carry out the tasks that are related to economic performance that they cannot manage on their own. These tasks include the aforementioned R&D, public service, and the education of the state's citizenry. PAT is being utilized in this line of

inquiry because it helps characterize the principal-agent relationship between state governments and higher education institutions respectively.

One cannot use EGT and PAT individually to conceptualize how state appropriations for public higher education can be related to economic performance, however these two theories collectively form the conceptual framework for the study. EGT conceptually informs how knowledge accumulation, innovation, and increased human capital is related to economic performance. PAT provides the context for how state governments facilitate higher education institutions' ability to play a role in facilitating the education of the state's citizenry, R&D, and service that leads to such knowledge accumulation, innovation, and increased human capital; thereby enhancing the opportunity for increased state economic performance.

#### Research Design: Variables

Given this study's focus on state economic performance, the dependent variable is gross state product per capita. Gross state product, as the state equivalent to gross domestic product, represents the most comprehensive measure of a state's economic activity (Bureau of Economic Analysis, 2014). Furthermore it reflects the private and public benefits that are enhanced by education (Baldwin, Borelli, & New, 2011).

As indicated by the conceptual framework, economic performance is influenced by higher education in many ways. To better facilitate higher education's ability to contribute to economic performance state governments provide appropriations to institutions of higher education. Consequently, the main independent variable is state

appropriations for public higher education.

Table 1.1

Total state and local appropriations for public higher education degree granting institutions

	Public	Private	Total
2004	63,012,079,000	1,957,922,000	64,970,001,000
2013	73,812,850,000	1,976,193,000	75,789,043,000

Source: United States Department of Education National Center for Education Statistics (2007; 2015)

The focus of this study is on the state appropriations allocated to public higher education because the public sector receives the majority of the state funding for higher education. More specifically, table 1.1 indicates that approximately 97% of the total state and local funding appropriated both in 2004 and in 2013 went to public higher education. Moreover, the state appropriations to public higher education is the focal point because of the principal agent relationship and governance that exists between state governments and public higher education institutions (Lane & Kivisto, 2008; McClendon, Hearn, & Mokher, 2009; Titus, 2009). Within the context of the principal-agent relationship, the amount of appropriations that state governments provide to public higher education is influenced by several factors including, previous years' higher education appropriations (Hossler, Lund, Ramin, Westfall, & Irish, 1997); tuition (Koshal & Koshal; 2000; Strathman, 1994; Tandberg, 2010); enrollment (Morgan, Kickham, & LaPlant, 2001; Okunade, 2004), politics, such as the governor's political party or which party represents the majority of the state legislature (McClendon, Hearn, & Mokher 2009; Tandberg, 2010; Weets & Ronca, 2012), and other state expenditures (Delaney & Doyle, 2007;2011; Okunade, 2004). These variables are included in this study as they have been shown to be related to how much funding state governments allocate to public higher education.

Guided by endogenous growth theory, there are several other variables that are included as they have been shown to influence state economic performance. These variables include agriculture as a percentage of gross state product (Curs, 2011; Heckelman, 2013; Miller & Russek, 1997; Reed, 2009), manufacturing as a percentage of gross state product (Curs, 2011; Garcia-Mila & McGuire, 1992; Miller & Russek 1997), state personal, sales, and corporate tax revenue (Berry & Kaserman, 1993; Crain, 2003; Ojede & Yamarik, 2012, Reed, 2009); the labor force participation and unemployment rates (Reed, 2009; Miller & Russek, 1997), and educational attainment (Baldwin & Borelli, 2008; Baldwin, Borelli, & New 2011; Barro, 2002; Reed, 2009)

#### Research Design: Data

The examination described herein will use annual state-level panel data covering the 48 contiguous United States; Alaska, Hawaii and all U.S. territories such as Puerto Rico and Guam will not be included given the study's focus on neighbors and these territories are not contiguous. The panel data set will span 10 years, 2004-2013, as this represents the most recent decade of data that is available. 10 years of data for each state will result in 480 case observations. The data are amassed from various sources including the Bureau of Economic Analysis, National Center for Education Statistics (NCES), the U.S. Census Bureau, the Bureau of Labor Statistics, the National Association of State Budget Officers, the Klarner Politics Governor Dataset, and the Klarner Politics State Legislative Election Returns Dataset.

#### Research Design: Methodology

The final model utilized to address the research questions is the dynamic fixed effects panel (DFEP) model. As described below the DFEP model addresses the

limitations of naïve models such as the ordinary least squares or random effects panel data models, however such models are included for illustration purposes in chapter four.

Panel data analysis is being used in this research because it allows the researcher to observe multiple units of observation over multiple points in time, thereby creating a larger sample size and increased predictive power (Tandberg, 2010, Zhang, 2010). As such, panel data analysis has been identified as an effective method for examining policy studies (Volkwein & Tandberg, 2008; Zhang, 2010). Panel data models are deemed more informative and contain less multicollinearity, or correlation among independent variables, and they allow the researcher to control for within-unit differences in ways that cross-sectional methods cannot (Baltagi, 1995; Elhorst 2009; Zhang 2010). More specifically, the fixed effects model will allow the researcher to control for unobserved differences, also referred to as heterogeneity, between units of observation (Tandberg, 2010; Zhang, 2010). This unobserved heterogeneity may not change over time, also referred to as time invariant. For example, unobserved heterogeneity between states may be state culture or a politician's attitude towards higher education. Utilizing panel data and the dynamic fixed effects panel model should result in a reliable estimate of the relationship between state economic performance and state appropriations for public higher education.

As described earlier, there are differences within states that may influence the amount of appropriations that states provide to public higher education, thereby making state appropriations an endogenous variable. To properly address the bias associated with endogeneity this study will incorporate the use of instrumental variables in the dynamic fixed effects panel model (Bielby, House, Flaster, & DesJardins, 2013). According to

Bielby et al., 2013 incorporating instrumental variables into the analytic model will help reduce the bias of over or understating the relationship between the dependent and independent variables. This study will use lagged values of the dependent and main independent variables as the instrumental variables.

Research question two, regarding the potential influence of state appropriations for public higher education on neighboring states' economic performance, is addressed utilizing exploratory spatial data analysis (ESDA) and a dynamic fixed effects panel model with a spatially weighted variable for state appropriations for public higher education.

Because it is the initial step in spatial analysis, ESDA is used to determine if the values in the dependent variable are correlated, also referred to as spatially dependent, across units of observation (LeSage & Dominguez; 2012; Ye & Wu, 2011). In this examination, ESDA is used to determine whether or not the gross state product per capita in one state is spatially dependent with the gross state product per capita in neighboring states. If the results of ESDA indicate that gross state product per capita is spatially dependent across neighboring states then a spatial weighted variable is used in the dynamic fixed effects panel model.

According to LeSage and Dominguez (2012), spatial regression analysis is a research method that allows the researcher to examine the spillover effect that explanatory variables may have on the dependent variable. For example, in a study that examined the impact of a country's location on its economic growth, Moreno and Trehan (1997) utilized spatial regression analysis and found that a country's growth rate is positively influenced by the economic growth in nearby countries. Baicker (2005)

examined to what extent state spending, particularly on Medicaid, influenced the state spending on the same program in neighboring states. Utilizing a spatial method Baicker (2005), found that state spending on Medicaid in one state has a significant influence on the state spending on Medicaid in neighboring states. In this line of inquiry a spatial regression analysis would facilitate an examination of whether or not gross state product is influenced by state appropriations to public higher education in neighboring states.

### Limitations

There are several possible limitations to note with respect to this study. The first limitation is the use of secondary data. There are inherent risks associated with secondary data in that the integrity of the analysis relies upon the integrity in the way the data was collected and reported (Wells, Lynch, & Siefert, 2011).

Second, there may be missing data. Unreported data will limit the power associated with conducting the panel data analysis. Although steps have been taken to collect all of the data necessary, it is possible that all cases and data points will not be available. This is a limitation commonly found in secondary data analysis (Chen & DesJardins, 2008). Because spatial data analysis will require the use of a strongly balanced data set, variables with missing data will not be included in the analysis.

### Implications

There are potential implications that are expected as a result of this study. While both research questions examine the relationship between state economic performance and state appropriations for public higher education, both may inform the discussion around funding for higher education in different ways. For example, research question one may primarily inform the discussion of state funding on a state by state basis,

however research question two may inform the discussion in a broader, more regional context. Because research question two incorporates a spatial design, the findings and implications of the research will have to be discussed in a way that may inform how neighboring states choose to provide funding for higher education.

The next chapter will provide a deeper discussion of the bodies of literature that help to inform this study.

## CHAPTER TWO LITERATURE REVIEW

### Introduction

This chapter is organized into several sections including the research questions, an examination of the factors that contribute to state economic performance, and the factors that influence state funding for higher education. A review of the literature that has examined the relationship between economic performance and appropriations for higher education is discussed followed by an explanation of the conceptual framework, and a description of the variables that are incorporated into the study.

### Research Questions

- 1) Is a state's economic performance influenced by that state's appropriations for public higher education?
- 2) Is the economic performance in neighboring states influenced by a state's appropriations for public higher education?

### State Economic Performance

State economic performance has been chosen as the focal point in this study because of its indication of the nation's economic vitality, and because funding for higher education is being examined at a state level. As indicated by the research questions, this examination is designed to study the relationship between state economic performance and higher education funding, with a specific focus on this relationship among neighboring states. To better understand this relationship, it is instructive to review what other factors, e.g. educational attainment, are also related to state economic performance.

Most of the evidence on the relationship between educational attainment and economic performance has shown that educational attainment and enhanced human

capital are positively associated with state economic performance. Several scholars have found that state economic performance has been associated with greater proportions of a state's citizenry with a college education (Baldwin & Borelli 2008; Baldwin, Borelli, & New, 2011; Barro 2002; Bhatta & Lobo, 2000; Reed, 2009). The studies cited herein are helpful in describing the relationship between economic performance and educational attainment, however they contained several limitations. For example, prior studies used economic theories such as the human capital theory (Baldwin & Borelli, 2008; Baldwin et al., 2011) and production function theory (Bhatta & Lobo, 2000) as their conceptual framework. Human capital theory is described as influencing future income through activities that imbed resources (e.g. education and training) into people (Becker, 1962; Romer, 1986). Simply stated, activities that enhance one's knowledge and ability facilitates their potential for increased earnings. The production function describes the relationship between labor, capital, and output, typically with respect to manufacturing production (Douglas, 1976; Reed, 2009). Unfortunately, the human capital and production function theories do not capture the role of the state government with respect to how they facilitate knowledge acquisition through state appropriations. To address the limitations of the previous conceptual frameworks, this study will incorporate the endogenous growth theory and the principal agent theory. Together these theories not only help to describe the relationship between knowledge acquisition and economic performance, but also the relationship between state governments and higher education institutions which facilitates knowledge acquisition. Another limitation of the aforementioned studies is that many of these studies (Baldwin & Borelli, 2008; Baldwin et. al., 2011; Bhatta & Lobo, 2000) utilized cross sectional data. This limits the

researcher's ability to draw conclusions about relationships between the variables over time, and take into account unobserved differences between the states. A panel data model, which is used in this line of research, allows a more reliable inference from the data based upon multiple observations on the unit of analysis (states) over a longer period of time (Tandberg, 2010; Zhang, 2010).

In addition to educational attainment, an overall increase in a state's labor force participation rate has also been positively related to state economic performance (Curs, 2011; Heckelman, 2013). State unemployment rates, however, are negatively related to economic performance (Miller & Russek, 1997). Both Heckelman (2013) and Miller and Russek (1997) utilized a panel data method which includes multiple observations on the unit of analysis (states) over a period of time (Tandberg, 2010; Zhang, 2010).

Heckelman (2013) also used a spatial regression model. Spatial regression allows the researcher to examine if there is any relationship across units of observation e.g. states (LeSage & Dominguez, 2012; Ye & Wu, 2011). This methodology was applicable given the focus of Heckelman (2013) in examining the rate of economic growth across states. Miller and Russek (1997) utilized a panel data set and a fixed effects regression model to perform their analysis. A fixed effects regression model allows the researcher to take into account the unobservable differences in state characteristics, without an assumption that those unobservable characteristics are not related to any of the other variables being utilized in the model (Titus, 2009; Zhang, 2010). The methodology utilized by Miller and Russek (1997) and Heckelman (2013) were applicable to their research questions. While the methodology was appropriate, Heckelman (2013) did not provide a conceptual model. Doing so would have helped to ground the study in a body of literature and add

context to its findings. Although their research had limitations, the findings by Heckelman (2013) and Miller and Russek (1997) are helpful in understanding the relationship between state economic performance and the labor and unemployment rates.

In addition to educational attainment and the labor force participation rate, taxes play a critical role in state economic performance. However, the relationship between taxes and economic performance is found to be inconsistent throughout the literature. For example, personal income taxes have been shown to have no impact on economic performance (Ojede and Yamarik, 2012), as well as a weak relationship with economic performance (Berry & Kaserman 1993). An increase in personal income tax has also been related to decreases in state economic performance (Reed, 2009). Similar to personal income taxes, the relationship between economic performance and sales tax has also been inconsistent. Research has shown that state sales tax has been positively (Reed, 2009) and negatively (Miller & Russek, 1997; Ojede & Yamarik, 2012) related to state economic performance. Unlike personal income tax and sales tax, corporate taxes have been found to be consistently, positively related to economic performance (Miller & Russek, 1997). Ojede and Yamarik (2012) examined the influence of tax policy on short and long term economic performance utilizing a panel data model that contained data on the 48 contiguous United States between 1967-2008. However, Ojede and Yamarik (1997) did not include a conceptual framework in their study. Though the limitations of some studies e.g. (Miller & Russek, 1997) have been previously discussed herein, the limitations of other studies e.g. (Berry and Kaserman, 1993) are discussed in greater detail in a later section. Overall, these studies indicate that the relationship between

personal income tax and sales tax with economic performance may be positive, negative, or insignificant while corporate taxes are positively related to economic performance.

Finally, both the manufacturing and agricultural industries have been shown to be related to state economic performance. Several of the aforementioned authors have shown the relationship between the manufacturing and agricultural industries to be positive (Bureau of Economic Analysis, 2014; Curs, 2011; Heckelman, 2013; Miller & Russek 1997).

The literature discussed in this section has strengths as well as limitations. One of the strengths of the previous research was that many of the studies (Baldwin & Borelli, 2008; Baldwin et. al., 2011; Miller & Russek, 1997, Reed, 2009) utilized a conceptual framework that drew upon the economics literature, which was appropriate given their focus on economic performance. However the frameworks were limited as they only helped to describe the relationship between knowledge acquisition and economic performance. This study will build upon the previous literature by combining concepts from both the endogenous growth theory and the principal agent theory. Combined, these theories will not only help to explain the relationship between knowledge acquisition and economic performance, but also help to define the relationship that state governments have with higher education institutions that helps to facilitate knowledge acquisition among the citizenry.

Another overarching limitation of these studies, with the exception of Heckelman (2013), was that they did not examine the relationship of economic performance across units of observation (e.g. states). This type of analysis is known as spatial correlation (Ye & Wu, 2011). It is plausible that state economic performance may be correlated across

states, therefore not taking into account possible economic performance across states, also referred to as economic spillover, appears to be an oversight. As indicated by research question two, this study seeks to examine the relationship between state appropriations for public higher education and the economic performance of neighboring states. By its design this study will address the lack of spatial considerations in previous research.

Building upon this section's discussion of factors that influence state economic performance, the next section is used to examine variables that influence state appropriations for higher education.

#### State Appropriations for Public Higher Education

As indicated by the research questions, the purpose of this study is to investigate the relationship between state economic performance and higher education funding, with a specific focus on the possible spillover effect of this funding onto neighboring state economies. This relationship is examined within the context of both the endogenous growth theory and the principal agent theory. Overall, the endogenous growth theory explains the relationship between knowledge accumulation and economic performance and the principal agent theory best explains the relationship between state governments and higher education institutions. In the state government and higher education institution relationship, state governments provide appropriations to higher education institutions so that they can fulfill the task of educating the state citizenry. This funding helps to facilitate the relationship between knowledge accumulation and economic performance. There are several factors that may influence the amount of funding that state governments provide to higher education. Beginning with state economic conditions, the literature

reviewed in this section will focus on those factors that influence the amount of appropriations state governments provide for public higher education.

*State economic conditions*

Despite the principal agent relationship between state governments and institutions, there are many aspects of a state's economic condition that influence how policymakers provide funding for higher education. One of the key elements that influences the amount of funding made available to public higher education is the previous year's budget, and more specifically previous levels of appropriations (Hossler, Lund, Ramin, Westfall, & Irish, 1997). Hossler et al. (1997) posit that their conceptual framework was influenced by studies that examined the relationship between state financial aid and tuition, and those that have examined the influence of state demographic and economic factors on higher education funding. The conceptual framework and variables utilized by Hossler et al. (1997) were appropriate given their examination of state factors and attributes of postsecondary education that help to explain state funding allocations for public institutions. However, the methodology utilized by Hossler et al. (1997) was limited by the authors' use of only three years of data. Extending the methodology utilized by Hossler et al. (1997) to include a more robust dataset and panel data analysis would help to draw more meaningful inferences from the data, such as an understanding of the relationships between the variables over time. In addition to the previous year's allocations, tax revenue and per capita income have also been shown to influence the amount of funding provided to higher education.

Increases in per capita tax revenue has been associated with higher levels of higher education funding, while a decline in per capita income has been associated with

decreases in state appropriations (Humphreys, 2000; Koshal & Koshal, 2000; Lowry, 2001). There are several limitations to note with respect to the literature cited herein. In his examination of the relationship between state appropriations for higher education and state business cycle conditions, Humphreys (2000) did not include a conceptual framework. Clearly articulating a conceptual framework would provide a foundational basis for the research thereby strengthening the interpretation of the findings. Humphreys (2000) analyzed data on 50 states between 1969 and 1994, and included variables that captured state economic conditions e.g. total personal income and higher education demand and total and FTE enrollment per state. While Humphreys (2000) utilized a panel data model, it is unclear whether or not a fixed- or random-effects regression model was used. Koshal and Koshal (2000) examined the relationship between tuition and state appropriations for higher education and the influence of several other variables including per capita tax revenue, two year college enrollment, and political power of the state legislature with respect to higher education appropriations. Koshal and Koshal (2000) did not use a conceptual framework however. In so doing, the authors would have been able to ground their research in a body of literature that would help the reader contextualize the results. Furthermore, while Koshal and Koshal (2000) controlled for variables such as per capita tax revenue, two year enrollment, and political power they did not control for any state expenditures. This limits the authors' ability to appropriately interpret the findings with regard to those variables that influence state funding for higher education. Finally, Koshal and Koshal (2000) utilized only one year of cross sectional data. The study would have been improved by utilizing a panel data structure, a more comprehensive dataset, and fixed or random effects regression analysis. In addition to

Humphreys (2000) and Koshal and Koshal (2000), Lowry (2001) also examined those factors that influence the amount of funding that state governments provide to higher education. Lowry (2001) collected data on all public four year institutions across the 50 United States for the academic year 1994-95. The study by Lowry (2001) was limited by the author's omission of a conceptual framework, and by only using one year of data. The limitation of cross sectional data presents an opportunity for future research to understand the relationship of factors such as political influences and higher education funding over a longer period of time. Though these authors (Humphreys, 2000; Koshal & Koshal, 2000; Lowry, 2001) all found similar results with respect to the relationship between tax revenue and per capita income with higher education appropriations, the studies all had limitations. Most significant, were the exclusion of a conceptual framework, and the use of cross sectional data.

As stated earlier in this chapter, state governments enter into a relationship with higher education institutions in which they provide funding to the institutions so that the institutions can provide education to the state citizenry. The amount of funding, however, that state governments are able to provide within the context of this principal agent relationship is predicated on several factors.

As demonstrated throughout this section, one of the major variables that influences the amount of funding provided to higher education is the economic condition of the state. Literature has shown that in addition to the previously discussed factors (e.g. personal income levels and tax revenue) that increased unemployment, increased Medicaid funding, more citizens below the Pell grant level, and increased general fund expenditures are negatively related to the amount of funding that is provided to public

higher education (Delaney & Doyle, 2007; Delaney & Doyle, 2011; Koshal & Koshal, 2000; McClendon et al., 2009; Tandberg, 2010; Weerts and Ronca, 2012). Overall the literature indicates that if the citizens of the state are not only unemployed but also underemployed that the overall economic health of the state is depressed, and subsequently higher education receives less funding. Furthermore, there are some factors e.g. Medicaid that compete with higher education funding, and at times of weakened economic strength states will decrease the amount of funding provided to higher education so that other budgetary items e.g. Medicaid are funded. The cyclical nature of balancing higher education funding along with other state budgetary items is known as the balance wheel.

In regards to the balance wheel model, Shelley and Wright (2009) posit that state governments provide more funding to higher education than other state budgetary items e.g. Medicaid when state finances are strong. However when state finances are weak the state diminishes higher education funding greater than they diminish the funding to other state budgetary items (Delaney & Doyle, 2007; 2011; Shelley & Wright, 2009). Shelley and Wright (2009) utilized the incremental theory of government spending as the theoretical framework for their analysis as the theory indicates that government spending is predicated on the previous year's budget but with minor changes to account for changes in state conditions (Shelley & Wright, 2009). Shelley and Wright (2009) also utilized a fixed effects panel data model, which contained data on 45 states between 1986 and 2005. Shelley and Wright appropriately included variables that helped to represent the demand for higher education e.g. the proportion of school aged population and variables that helped represent the economic vitality of the state e.g. the statewide

unemployment rate. A major limitation of this study, however, is that the authors did not take into account any relationship in the higher education appropriations across neighboring states. This is a limitation because the policy decisions of one state (e.g. budgeting) may influence the policy decisions of a neighboring state through policy diffusion (Shipan & Volden, 2008).

Similar to Shelley and Wright (2009), Delaney and Doyle (2007;2011) also examined the notion of the balance wheel funding model for higher education. The two studies conducted by Delaney and Doyle were very similar, however they differed in regards to the data structure. In 2007 Delaney and Doyle utilized a panel data structure that contained data on the 50 United States between 1991-1999, however in 2011 Delaney and Doyle utilized a panel data structure that contained data on 49 states between 1985-2004. Because of the longer timespan Delaney and Doyle (2011) had a more robust dataset. In both studies the authors utilized a fixed effects regression model that controlled for the unique unobservable differences between the states e.g. state culture. Furthermore, Delaney and Doyle (2011) improved upon their 2007 study by controlling for other economic and political factors that influence higher education funding e.g. per capita income, the proportion of Republicans in state houses, and political party of the state governor. One major drawback of both Delaney and Doyle (2007; 2011), however, is that the authors did not take into account any relationship in state funding amounts across states. Because state policy decisions such as budgeting can be influenced by neighboring states, this appears to be an oversight. This study will address this limitation by considering the spatial relationship between state funding for public higher education and neighboring state economies.

Taken together, the studies in this section indicate that the amount of funding that state governments provide to higher education institutions is influenced by the overall economic condition of the state. The literature indicates that aside from basing decisions on the previous year's budget, greater financial support for higher education is positively associated with greater economic performance. Likewise, during times of economic decline, higher education funding seems to be reduced greater than other state budgetary items. Overall, the aforementioned studies were helpful in understanding how the economic condition of the state may be related to higher education funding. However, the limitations discussed herein are addressed in this study. These limitations include the use of cross sectional data or limited timeframes (Hossler et al., 1997; Koshal & Koshal, 2000; Lowry, 2001) and not grounding the research in any conceptual framework (Humphreys, 2000; Koshal & Koshal, 2000; Lowry, 2001). Several studies (Delaney & Doyle, 2007; Delaney & Doyle, 2011; Humphreys, 2000; Shelley & Wright, 2009) addressed the limitation of cross sectional data by utilizing panel data and fixed or random effects analysis, however they did not take into account any potential relationships across the units of observation, also referred to as spatial correlation. The study described herein will build upon such studies by incorporating a spatial analysis design, which will determine if there is any relationships across states, with respect to economic performance. Taking into account any spatial relationships across the units of observation will hopefully provide another layer of understanding of to what extent if any, state economies are inextricably linked. Furthermore, taking into account any relationships across states will allow the researcher to determine whether or not the

public higher education funding provided by one state not only benefits that state but also neighboring states.

Under the umbrella of the principal agent relationship between state governments and higher education institutions, there are other factors beyond the state's economic condition, such as institutional enrollment, that play a role in influencing the amount of funding that is provided to public higher education. The next section is used to examine such factors.

### *Institutional Factors*

Beginning with enrollment, this section is used to examine the institutional factors that influence the amount of state funding provided to public higher education.

Research has shown that institutional enrollment has been positively related to higher education funding (Humphreys, 2000; Lowry, 2001; Morgan, Kickham, & La Plant, 2001; Okunade, 2004). Though they did not specify whether they used a fixed or random effects regression model, Morgan et al. (2001) utilized panel data that contained data on 49 states between 1986 and 1995 to examine state support for higher education. Morgan et al. (2001) grounded their study in a political economy model. According to the political economy model, policy (e.g. higher education funding) is explained by both political and economic considerations, and influenced by supply and demand of government services (Barrilleaux & Miller, 1988). The variables included in the model by Morgan et al. (2001) seemed applicable given their conceptual model. For example, the authors not only included enrollment as a variable which helps to indicate the demand for higher education but also they included the number of full time faculty and staff per 100 students to help indicate the supply of higher education. There were some variables

that seemed excluded from the study that would seem applicable to the supply and demand model. For example, the authors did not include any proxy for a proportion of two year or four year institutions. One strength of the study was the panel data structure, however Morgan et al. (2001) was limited by not taking into account any relationships across states. Because states are at times influenced by other states when it comes to policy decisions, research on state policy should take into account relationships across states. Incorporating a spatial design to test for relationships across states would have enhanced the methodology utilized by Morgan et al. (2001). Though Morgan et al. (2001) and Okunade (2004) came to the same conclusion regarding the positive relationship between enrollment and public higher education funding the studies were conducted differently. Okunade (2004) utilized the competing interests theory as the conceptual framework for his study as he considered the crowding out of higher education funding by other state budgetary items. The study by Okunade (2004) is limited because of the author's use of cross sectional data. While Okunade (2004) collected data from the 50 United States, the data only covered the fiscal years of 1993-94 and 1994-95. The study was also limited by the exclusion of certain variables e.g. K-12 education expenditures. Because Okunade (2004) utilized the competing interests theory as the conceptual framework, it would make sense that the variables utilized in the study should be related to competing interests. Therefore, the reader would expect that Okunade (2004) utilized variables that reflected the competing budgetary interests of the state. Furthermore, Okunade (2004) did not use any controls for the state economic condition. There were no variables such as unemployment rate, tax revenue, per capita income, etc. This appears to be a limitation as prior research on state funding for higher education (Humphreys, 2000;

Koshal & Koshal, 2000) indicated how the economic vitality of the state can influence funding. While the literature cited herein has limitations, overall it appears that enrollment is positively related to higher education funding. However, enrollment in the different sectors of higher education may influence funding in different ways. For example, increased enrollment in the private higher education market has been negatively as well as positively associated with higher education funding.

According to McClendon et al. (2009) increased enrollment in the private sector has been associated with decreased appropriations. McClendon et al. (2009) examined the influences of state appropriations for higher education, with a specific emphasis on examining the role of political factors. McClendon et al. (2009) utilized panel data covering a period of two decades, from 1984 through 2004 and a fixed-effects regression model. The conceptual framework in this study was based upon three bodies of literature including postsecondary finance, postsecondary organization and governance, and comparative state politics. McClendon et al. (2009), used these bodies of literature to build a conceptual framework consisting of five different factors that help to explain the variance in state funding for higher education. According to McClendon et al. (2009), the purpose of this conceptual framework was to integrate and examine state political influences with previously studied factors. The conceptual framework used in this study is fairly comprehensive. Although political influence was the primary focus of their research, McClendon et al. (2009), provided a solid framework that embodied many of the other influences on state appropriations e.g. state demographics and the state economy. The variables utilized by McClendon et al. (2009) seemed appropriate for their analysis, however they did not include any variables that controlled for other state

expenditures e.g. Medicaid, corrections, etc. Previous literature (e.g. Okunade, 2004; Shelley & Wright, 2009) indicated that state funding for higher education can be influenced by other state budgetary priorities therefore this appears to be a limitation. Furthermore, McClendon et al. (2009) did not account for any correlation among states with respect to higher education funding. Because of the primary focus on political factors it would seem appropriate to account for relationships across states given the notion of policy diffusion, which is the influencing of neighboring states on policy decisions (Shipan & Volden, 2008).

Inconsistent with the findings by McClendon et al. (2009), the results of a study by Tandberg (2010) found that enrollment in the private sector was positively associated with higher education funding. Tandberg (2010) examined the determinants of state funding for higher education, utilizing data on all 50 United States between 1985 and 2004. The fixed effects panel data analysis utilized by Tandberg (2010) was not only appropriate but also a significant improvement over previous studies e.g. (Okunade, 2004) that also sought to examine the determinants of state funding for higher education but utilized cross sectional data. The data and methodology utilized by Tandberg (2010) was strong in that the author accounted for several factors that have been demonstrated throughout the literature to have an influence on funding e.g. higher education enrollment and the economic condition of the state. Furthermore, Tandberg (2010) also contributed to the body of literature regarding higher education funding by controlling for several political influences such as interest groups and controlling party of the state legislature. Tandberg (2010) grounded his study in a fiscal policy framework. According to the fiscal policy framework, politicians make fiscal decisions based upon their own self-

interests, as well as the political, economic, and demographic environment surrounding them (Tandberg, 2010). However, Tandberg (2010) did not account for the surrounding environment, because the study did not account for any relationships in the variables across states. In light of the fiscal policy framework, and the notion of policy diffusion, not accounting for spatial relationships across units of observation (e.g. states) overlooks the potential influence that neighboring governments can have when it comes to policy decision such as higher education funding. The study described herein will address this limitation by examining the relationship of economic performance and higher education funding across states.

Institution type is another factor that has been related to how much funding is provided to higher education. For example, greater proportions of private institutions within a state have been associated with decreased (Lowry, 2001) as well as increased (Thiele, Shorette, & Bolzendahl, 2012) funding. Funding levels have also fluctuated with respect to whether or not an institution is considered a research institution. For example, states seem to provide more funding to institutions with integrated medical schools (Lowry, 2001). However, literature also suggests that comprehensive and research institutions are more likely to see decreases or slower growth compared to community colleges (Weerts & Ronca, 2012). Overall, the findings on institutional sector, and private institutions in particular are mixed. However greater proportions of research institutions seem to wield a significant positive influence on the amount of funding that is made available to higher education. This is sensible given the mission of research institutions, the endogenous growth theory, and the impact of knowledge, innovation, and R&D on economic performance. While the limitations of Lowry (2001) have been

previously discussed, there are limitations pertaining to Thiele et al. (2012) and Weerts and Ronca (2012) that must also be explored. Thiele et al. (2012) never indicated that their study was grounded in a specific conceptual framework. Thiele et al. (2012) examined the relationship between state legislators' educational backgrounds and their state's spending on higher education. One of the major limitations of their study is that the analysis was based off of one year of data. As indicated by the authors this cross sectional method limits the ability to discern any relationship between the explanatory and outcome variables over time. In light of their cross sectional approach, Thiele (2012) et al. indicate that their final model had to be parsimonious, therefore several key determinants of higher education funding were omitted. For example, they did not include any controls for the economic condition of the state e.g. per capita income, nor did they include any controls for other state budgetary items e.g. K-12 education or corrections. These limitations are addressed in this study, as the panel data structure will allow for a larger dataset which will facilitate the use of more independent variables. Furthermore the use of panel data in this study will facilitate a more confident understanding of the relationship between the outcome and explanatory variables over time.

Weerts and Ronca (2012) examined factors that helped to explain the difference in state support for higher education across states, institutions, and different sectors of higher education. To answer their research questions, Weerts and Ronca utilized a comprehensive theoretical framework, consisting of five constructs. The constructs include a state's fiscal solvency, competing priorities, demographic factors, institutional characteristics, and the political climate of the state. Overall, Weerts and Ronca indicate

that the variables used to address their research fit within each of the constructs of their theoretical framework. The use of the five constructs was very helpful in this study and the impact of each construct on state appropriations was properly supported by literature. Weerts and Ronca (2012) utilized a panel data analysis, consisting of data from 1984-2004. Weerts and Ronca utilized institutions as the unit of analysis rather than states. The authors use both fixed effects and random effects models to address their research questions. The difference between these models is that in the random effects model there is an additional assumption that the unobserved differences between the units of observation e.g. campus culture cannot be correlated with the explanatory variables (Titus, 2009; Zhang, 2010). The data and methodology utilized by Weerts and Ronca (2012) was appropriate given their research question and conceptual framework. The authors accounted for several of the factors that influence state funding for higher education. One drawback regarding the study however was that the authors did not consider spatial dependency among the units of analysis. For example, if institutional type influences the amount of funding that an institution receives, there may be spatial dependency across units of observation if several research or private institutions are located in a similar geographic region. Though the unit of observation is states rather than institutions, this line of research will address concerns of spatial correlation in the outcome variable across the units of observation.

In addition to enrollment and institutional type, tuition is another variable that influences the amount of funding that state governments provide to higher education. Research has shown that tuition and state funding for higher education have been negatively related (Koshal & Koshal, 2000; Okunade, 2004; Strathman, 1994; Tandberg,

2010). The limitations regarding Koshal and Koshal (2000), Okunade (2004), and Tandberg (2010) have been previously discussed. Strathman (1994) examined the relationship between out-migration e.g. the gross number of people leaving the state, tuition, and state appropriations for public higher education. Strathman, did not indicate a specific conceptual model or theoretical framework that guided the study. Some of the variables included in Strathman (1994) were consistent with previous studies. For example, Strathman (1994) controlled for the state economic status by including per capita income. However, Strathman (1994) did not control for other state budgetary items such as healthcare or corrections. Since the study conducted by Strathman (1994) was examined at a state level rather than an institutional level, it is not clear why Strathman (1994) included faculty salary, or the number of students per faculty ratio. Another limitation of Strathman (1994) is that the study was conducted utilizing one year of data, therefore the relationship between appropriations, tuition and migration could not be inferred over time, furthermore unobserved differences (heterogeneity) between the states could not be examined. These limitations are addressed in this study by utilizing a panel data model which will facilitate the use of more variables that will account for the influences on state funding for higher education, and unobserved differences between states.

There are many factors that influence the amount of funding state governments provide for higher education. This section was used to examine the influence of enrollment and tuition on state funding for higher education. Enrollment seems to be positively associated with higher education funding (Humphreys, 2000; Lowry, 2001; Morgan, Kickham, & La Plant, 2001; Tandberg, 2010), while tuition has consistently

been shown to be negatively related to higher education funding (Koshal & Koshal, 2000; Okunade, 2004; Strathman, 1994; Tandberg, 2010). While the literature discussed herein has been helpful in advancing the body of knowledge surrounding higher education funding there are several limitations that need to be addressed. For example, Strathman (1994) did not include a conceptual framework, and several authors (Okunade, 2004; Koshal & Koshal, 2000; McClendon et al., 2009; Strathman, 1994) did not control for state expenditures e.g. K-12 education or corrections funding which have been shown to influence the amount of appropriations that are provided to public higher education. Another limitation includes not controlling for state economic factors such as the statewide unemployment rate or tax revenue (Okunade, 2004). A few studies utilized cross sectional data (Okunade, 2004; Strathman, 1994), and the studies that utilized advanced methodology such as panel data analysis (McClendon et al., 2009; Tandberg, 2010) were limited in that they did not take into account any relationships in the variables across states. These limitations are addressed in this study. The study described herein includes a conceptual framework that will combine the endogenous growth and principal agent theories. Factors that influence state economic performance such as the statewide unemployment rate and tax revenue are accounted for. Furthermore, state budgetary items that influence state appropriations for higher education such as K-12 education and corrections will also be accounted for. Most importantly, utilizing panel data, this study will address the question of the relationship between a state's appropriations for public higher education and the economic performance of neighboring states.

#### *Governance and Political Influence*

The principal agent theory utilized in this study provides a context for the relationship between state governments and higher education institutions, in which state governments provide funding to higher education institutions. Within the context of this principal agent relationship there are factors such as governance and political influences that may dictate the amount of funding that states provide to higher education. Research has found that postsecondary governing boards have either had no significant relationship with higher education funding (McClendon et al., 2009) as well as a negative relationship with higher education funding (Lowry, 2001).

In addition to the aforementioned postsecondary governing boards, literature has shown that the governor's political party has also been associated with higher education funding. For example, both a Democrat and Republican governor have been negatively associated with funding (McClendon et al., 2009; Okunade, 2004; Tandberg, 2010).

Overall these studies indicate that, within the context of the principal agent relationship between state governments and higher education institutions, that centralized governing boards and the governor's political party influence the extent to which state governments provide funding for higher education. More specifically, it appears that the relationship between the governor's political party and higher education funding has been negative (McClendon et al., 2009; Okunade, 2004; Tandberg, 2010) while the relationship between centralized governing boards and higher education funding has been inconsistent (Lowry, 2001; McClendon, 2009).

The literature cited in this section indicates that governing boards and the governor's political party are among the factors that must be taken into consideration along with the principal agent relationship between state governments and higher

education institutions. The literature cited in this section has several limitations which has been extensively discussed in previous sections. These limitations include not controlling for competing state budgetary expenditures (Okunade, 2004; McClendon et al., 2009), the use of cross sectional data (Koshal & Koshal, 2000; Thiele, 2012), and not grounding the study in any conceptual framework (Koshal & Koshal, 2000; Thiele, 2012). Some studies (McClendon et al., 2009; Tandberg, 2010) address previous shortcomings in the literature by utilizing panel data, however there is an overarching limitation in these studies in that they did not take into account any relationships in the variables across states. Given the notion of policy diffusion and the political influence that neighboring states can have on policy decisions, research that examines state policy should take into account relationships in the variables across states. The study described herein will address the aforementioned limitations. The limitations of previous literature are addressed in this research by grounding the study in a conceptual framework, controlling for state budgetary items that influence higher education funding, utilizing panel data, and most importantly, examining the relationship between neighbors' appropriations to public higher education and state economic performance.

### The Relationship Between State Economic Performance and State Appropriations for Higher Education

The purpose of this study is to examine the relationship between higher education funding and neighboring state economic performance. The endogenous growth theory provides a foundation for understanding the relationship between higher education attainment and economic performance. However, there are costs associated with increasing higher education attainment. Therefore, state governments, within the context

of the principal agent relationship, provide funding to higher education institutions so that they can provide education to the state citizenry. Building upon the previous sections, this section is used to review the extant literature that has examined the relationship between state economic performance and state appropriations for higher education.

One of the chief reasons state governments provide support to higher education is the role that the industry plays with respect to the country's economic vitality and the development of human capital (Baum et al., 2013; Feller, 2004; Koo & Kim, 2009a; Luke, Ventriss, Reed, & Reed, 1988; Lane, 2012). Therefore, a good amount of scholarship has been devoted to examining to what extent the funding for higher education is related to economic performance.

Several scholars have found the relationship between economic performance and higher education funding to be positive (Baldwin & Borelli, 2008; Baldwin, Borelli, & New, 2011; Berry & Kaserman, 1993; Garcia-Mila, McGuire, 1992; Quan & Beck, 1987) while others have found the relationship to be negative (Deskins, Hill, & Ulrich, 2010; Vedder, 2004), and a study by Curs, Bhandari, and Steiger (2011) produced mixed results. While the findings contained in the aforementioned literature have been mixed, so have the conceptual frameworks. For example, some authors utilized a production function (Garcia-Mila & McGuire, 1992; Quan & Beck, 1987) which describes the relationship between labor, capital, and output with respect to manufacturing production (Douglas, 1976; Reed, 2009). Other authors utilized the human capital theory (Baldwin & Borelli, 2008; Baldwin, Borelli, & New, 2011) which describes how future income can be influenced by activities that imbed resources into people (Becker, 1962; Romer, 1986). Finally, some authors (Berry & Kaserman, 1993; Curs, Bhandari, & Steiger,

2011; Deskins, Hill, & Ulrich, 2010; Vedder, 2004) did not utilize any conceptual frameworks or theoretical models. Aside from conceptual frameworks, the studies also differ in regards to their methodology. Several authors utilized cross sectional data in their analysis (Baldwin & Borelli, 2008; Baldwin et al., 2011; Vedder, 2004) which analyzes data collected at a point in time, while others utilized panel data (Curs, Bhandari, & Steiger, 2011; Garcia-Mila & McGuire, 1992; Deskins, Hill, & Ulrich, 2010). Panel data analysis includes a larger dataset that has observations on the units of analysis over time, and utilizes fixed or random effects models that take into account unobserved differences across the units of observation (e.g. states). While the aforementioned studies were helpful in understanding the relationship between higher education funding and economic performance, a majority of them had one overarching limitation: they failed to account for the spillover effect of higher education funding onto neighboring state economies. For this reason, the main purpose in this study is to examine the relationship between higher education funding and state economic performance, with a specific focus on neighboring state economies. Beginning with Quan and Beck (1987), the aforementioned studies are examined in more detail in the pages to follow.

Focusing on the northeast and Sunbelt regions of the United States, Quan and Beck (1987) examined the influence of education expenditures on employment, wage rates, and income. As indicated above, Quan and Beck employed a production function framework for their study. The authors posit that the inputs of educational expenditures were related to the productivity of the labor force which in turn was related to the state wage rate and employment. Though the authors utilized a production function

framework, it would seem that the human capital theory would make a more applicable framework because of the authors' focus on the relationship between education expenditures, wage rates, and income. According to the human capital theory, investing in education as a human resource should lead to a greater financial return e.g. wage rates and income (Becker, 1962; Romer, 1986). The authors found that in the northeast, higher education spending was positively, significantly associated with state per capita income and employment. However, in the sunbelt region the authors found that higher education funding was negatively related to state per capita income and employment. The control variables used by the authors cover a majority of the key influences on higher education appropriations and economic performance including population, taxes, general expenditures, and personal income. However, they did not control for other factors such as political influences, enrollment, and tuition; doing so would have strengthened this study as these factors have been shown to influence the extent to which legislatures provide funding for higher education. There are two limitations of Quan and Beck (1987) that are addressed in this study. The first limitation is the authors' examination of only 32 states. A larger, panel data set encompassing the 48 contiguous United States will facilitate the ability to draw national inferences from the data, rather than an emphasis on certain regions. Secondly, Quan and Beck (1987) is limited by not examining spatial relationships. Given their focus on the relationship between educational expenditures, wage rates, and income and the migration of skilled labor it would seem appropriate to examine spatial dependency across states. This limitation is addressed by this study's use of spatial analysis.

Utilizing a panel dataset that contained data on the 48 contiguous United States across a 15-year time frame, Garcia-Mila and McGuire (1992) examined the influence of educational expenditures on economic performance. The authors contend that their study helps to inform policy around mitigating the negative economic effects of a poorly educated labor force. Garcia-Mila and McGuire (1992) utilized the production function as their conceptual framework. The production function framework was applicable to this study because it describes the relationship between the inputs of labor and capital, and output with respect to manufacturing production (Douglas, 1976; Reed, 2009). In Garcia-Mila and McGuire (1992) educational expenditures along with private capital, labor, and highway capital were considered as the inputs and gross state product was considered as the output. The authors posit that education can increase the productivity of the state therefore the production function was appropriate for this study. The authors found that education expenditures were positively associated with gross state product. The results of this study are limited as the authors did not disaggregate higher education funding from K-12 funding. As such, the results in regards to the influence of higher education funding, are not specified and these findings should be considered with caution. Another limitation of the study is that the authors indicate people are mobile between states and “the education provided by one state benefits other states...” (p.236), however they do not account for spillover effects in their analysis. Spillover effects are the externalities, or benefits, of education such as economic growth that extend to society (McMahon, 2010). Spillover effects in the case of Garcia-Mila and McGuire (1992) would be the education that people receive in one state but take to another state as they migrate, thereby contributing to the economy of a new state. To account for spillover

effects the authors could have utilized spatial analysis. Spatial analysis allows the researcher to examine if there is any correlation in the outcome variable across units of observation (LeSage & Dominguez, 2012; Ye & Wu, 2011). For example, Garcia-Mila and McGuire (1992) could have utilized spatial analysis to see if gross state product in one state was correlated across neighboring states. If so, it could be possible that the gross state product in one state was influenced by factors such as the educational expenditures in neighboring states. In a similar fashion, this study will examine if there is any correlation in economic performance across neighboring states that may be explained by higher education funding. Moreover, Garcia-Mila & McGuire (1992) did not include a theoretical model or conceptual framework; doing so would help the reader understand how the authors contextualized the study. In addition to these limitations, the authors also failed to account for endogeneity. Endogeneity occurs when one of the factors (e.g. educational expenditures) within the system being investigated (e.g. state) is influenced by other factors within the same system e.g. (tax revenue) (Bielby, House, Flaster, & DesJardins, 2013). In their study, Garcia-Mila and McGuire (1992) examined the influence of educational expenditures. However, the amount of funding that state governments provide to education is influenced by several other factors e.g. tax revenue (Humphreys, 2000; Koshal & Koshal, 2000; Lowry, 2001). Therefore, not accounting for endogeneity could potentially produce unreliable findings. This limitation of the methodology is addressed by the methodology in this new line of research.

Berry and Kaserman (1993) found that higher education spending was positively, significantly related to economic development. One strength of the methodology is that Berry and Kaserman (1993) controlled for taxes which could influence state economic

performance. However, they did not account for factors such as enrollment, population, and political leadership which could influence the extent to which state governments provide support for higher education. Berry and Kaserman did not provide any conceptual framework for this study. Including a conceptual framework would have helped the reader understand how Berry and Kaserman (1993) framed their study thereby providing a context for the research questions, methodology, and results.

While the aforementioned studies (Berry & Kaserman, 1993; Garcia-Mila & McGuire, 1992; Quan & Beck, 1987) concluded that higher education funding was positively related to economic performance, a study by Vedder (2004) indicated that higher education funding was negatively related to economic performance. More specifically, Vedder argued that his findings indicate that a 10 percent increase in state appropriations for higher education is associated with an almost four percent decline in economic performance. One of the limitations of this study is that Vedder did not include a conceptual framework. Therefore, there was no clear indication of what theories were used to guide the study. Furthermore, Vedder examined the association of state and local spending and personal income per capita between 1977 and 2002 utilizing cross-sectional data. Cross sectional data, because it only captures a snapshot in time, limits the researcher's ability to draw inferences on the relationships between the variables over a longer period of time. In addition, cross sectional data does not allow the researcher to take unobserved differences across the units of observation into account. Lastly, Vedder did not examine the relationship of higher education funding and economic performance across neighboring states. Given the notion that people can migrate from one state to another, and utilize their education to contribute to the receiving state's economy,

research examining the relationship between higher education funding and economic performance should account for such spillover effects. These limitations are addressed in this study by utilizing a conceptual framework, a panel data structure, and accounting for spillover effects between higher education funding and neighboring state economic performance.

Utilizing the human capital theory, Baldwin and Borelli (2008) investigate the relationship between state per capita income and funding for education. Specifically, they examine the ability of education funding to directly and indirectly influence state per capita income through the mediating effects of college attainment rates. However they did not examine the spillover effect across states. Baldwin and Borelli (2008) utilized the human capital theory for this study because it describes how future income can be influenced by education (Becker, 1962; Romer, 1986). In the study by Baldwin and Borelli (2008), education funding would be the activity that facilitates human capital development through knowledge and innovation, while income is measured by state per capita income. Baldwin and Borelli (2008), examined the relationship between state per capita income and educational expenditures across the 48 contiguous states, over an 18-year time period from 1988-2005. Though this would appear to be a significant period of time, Baldwin and Borelli (2008) utilized cross sectional data at several intervals i.e. 1988-89 to 2004-05 and 1997-98 to 2004-2005. The methodology would have been improved by utilizing a panel data structure. A panel data structure that included year to year observations for each variable would have better controlled for the within unit variations of the variables throughout the entire time period as opposed to snapshots in time. Extending the analysis conducted by Baldwin and Borelli (2008) to examine year to

year cases rather than snapshots in time would facilitate a richer interpretation of the data through increased sample sizes and power. This study also appears limited by the exclusion of several variables. There are variables that influence not only state economic performance but also the extent to which state governments provide funding for higher education across these 48 states that should have been included. Without controlling for variables such as labor force participation, unemployment, enrollment, and other state expenditures the model seems limited.

Building upon (Baldwin & Borelli, 2008), Baldwin, Borelli, and New (2011) also examined the influence of state funding for higher education on economic performance. Similar to their previous study, Baldwin et al. (2011) utilize the human capital theory as the foundation for their study. The findings of Baldwin et al. (2011) are similar to Baldwin and Borelli (2008) in that higher education spending is positively associated with economic performance, however this may be due to the similarities in methodology. Similar to Baldwin and Borelli (2008), Baldwin et al. (2011) examined the 48 contiguous states between 1988 and 2005 utilizing averages for the variables and two snapshots in time. Rather than utilizing this cross sectional methodology, the study would have been strengthened by utilizing a panel data structure. Including observations for each variable throughout the entire time period would increase the sample size and power of the model, thereby allowing the researcher to draw more reliable conclusions from the data. Similar to Baldwin and Borelli (2008), Baldwin and Borelli (2011) is also limited by the control variables. The authors did not include control variables such as the state unemployment rate, other state expenditures, political leadership, etc. Finally, neither Baldwin and Borelli (2008) or Baldwin et al. (2011) conducted any spatial analysis. According to

LeSage and Dominguez (2012), spatial regression analysis allows the researcher to examine if there is any correlation in the outcome variable across units of observation. For example, Baldwin et al. (2011) could have utilized spatial analysis to see if gross state product in one state was correlated across neighboring states. If so, it could be possible that the gross state product in one state was influenced by factors such as the higher education funding in neighboring states. The limitations described herein, e.g. the cross sectional analysis, lack of control variables, and exclusion of spatial analysis are addressed in this study. For example, this study will include a panel data model that will include observations of the variables each year throughout the entire time period of examination. Furthermore, this study will also include variables that will help control for those variables that not only influence state economic performance e.g. unemployment rate but also higher education funding e.g. political leadership within the state. This line of inquiry will also include exploratory spatial data analysis which is the first step in examining if there is any correlation in the dependent variable across units of observation.

A recent study by Deskins Hill and Ulrich (2010) addresses some of the aforementioned shortcomings of previous literature such as cross-sectional data, and a lack of spatial analysis (Baldwin & Borelli 2008; Baldwin et al., 2011; Garcia-Mila & McGuire, 1992; Quan & Beck, 1987; Vedder, 2004). Deskins et al. (2010) examined the spillover effects regarding the relationship between state provided education funding and economic performance utilizing state level panel data and a fixed-effects regression model. Deskins et al., (2010) included data on the 48 contiguous states between 1992-2000 and 2002. One strength of this methodology is that the authors were able to take

advantage of a large dataset which contained approximately 500 observations. This facilitated their ability to draw more reliable inferences from the analysis than the cross sectional analysis utilized in previous literature e.g. (Vedder, 2004). Furthermore, the authors utilized a fixed-effects regression model which controlled for unobserved differences between the states (e.g. state culture, attitudes towards higher education, etc.).

Another strength of Deskins (2010) is that the authors aggregate the funding for K-12 and higher education in one of the models, but disaggregate K-12 and higher education funding in another model. This allowed Deskins et al. (2010) to isolate the relationship of higher education funding from that of K-12 funding with economic performance. For example, the model with combined K-12 and higher education funding resulted in a negative relationship between funding and state economic performance. However, when examined by itself, K-12 funding had no statistically significant relationship with state economic performance. The authors suggest that this finding is compelling, because it indicates that in the combined model the negative relationship between economic performance and education funding is driven by the appropriations for higher education.

One of the major drawbacks from previous research e.g. (Garcia-Mila & McGuire, 1992; Baldwin et al. 2011) is that the authors did not examine if there was any relationship between the funding for higher education in one state and the economic performance across neighboring states. Deskins et al. (2010) address this limitation by including spatial elements into their methodology to examine if the spending on higher education in one state influences the economic performance in neighboring states. For example, Deskins et al. (2010) included variables in their model that accounted for the

average amount of funding provided to higher education in neighboring states to see if there was any relationship between that funding and a state's economic performance. Deskins et al. (2010) found there to be no relationship between neighboring state economic performance and higher education funding. Deskins et al. (2010) argued that the negative relationship between higher education funding and state economic performance may be due to the marginal benefits of positive economic performance being overshadowed by the taxes and costs used to finance higher education. Consistent with Vedder (2004), Deskins et al. (2010) also argue that the negative relationship between economic performance and higher education funding may also be due to the inefficient allocation of higher education funding to noninstructional resources, which may not lead to the enhanced human capital that is necessary to contribute to economic performance.

The examination of spatial correlation by Deskins et al. (2010) was an important contribution to the body of literature regarding the relationship between economic performance and higher education funding because it took into account the spillover effect of education. According to Garcia-Mila and McGuire (1992) people are mobile between states and "...the education provided by one state benefits other states..." (p.236). This benefit to other states is what is known as spillover effects, or the externalities of education such as economic growth that extend to society (McMahon, 2010). One limitation to note about the spatial aspect of this study, however, is that Deskins et al. (2010) did not seem to account for the endogeneity of appropriations for higher education. As indicated by Bielby et al. (2013) endogenous variables can produce biased estimates. Furthermore Deskins et al. (2010) did not seem to include any

exploratory spatial data analysis (ESDA). ESDA is the first step in spatial analysis because it is used to determine if any spatial correlation exists among the units of analysis (LeSage & Dominguez, 2012; Ye & Wu, 2011). ESDA is important because it justifies the use of any spatial elements in the regression model. In Deskins et al. (2010), if the results of ESDA indicate that no spatial correlation exist among the units of observation, then there would be no need to incorporate the average spending amount of neighboring states in the model. Another limitation of this study is that Deskins et al. (2010) did not include a conceptual framework for the study. Including a conceptual framework or theoretical model would have helped the reader understand what bodies of literature were used to frame the study. While the study by Deskins et al. (2010) was a great improvement over previous literature e.g. (Baldwin & Borelli 2008; Baldwin et al., 2011; Garcia-Mila & McGuire, 1992; Quan & Beck, 1987; Vedder, 2004) with respect to understanding the relationship between state economic performance and higher education funding the limitations described herein will need to be addressed in this study. For example, this line of research will utilize lagged values of the dependent and independent variables as instrumental variables to address the endogeneity of state appropriations for public higher education. Furthermore, this study will include exploratory spatial data analysis, which is used to justify whether or not any spatially weighted variables need to be included in the model.. This study will also include a conceptual framework which draws upon two distinct bodies of literature. This conceptual framework will help guide the study and provide a foundation for the variables to be utilized in the study.

Though they did not account for spillover effects across neighboring economies, Curs, Bhandari, and Steiger (2011) contributed to the body of literature regarding higher

education funding and state performance by taking into account the privatization of higher education. One limitation of Curs et al. (2011) is that the authors did not include a conceptual framework in their study. Not including a conceptual framework limits the readers' ability to understand the foundation of the study, especially with regard to variable selection and ultimately with regard to the relationship between the dependent and independent variables. Curs et al. (2011) found that the relationship between higher education appropriations and economic performance is positive in states with a larger proportion of public higher education institutions. For example, Curs et al. (2011) indicate that 40 states had a high ratio of public to private enrollment which was associated with a positive relationship between higher education funding and economic performance. Curs et al. (2011) posit that in these states, increased funding for higher education should result in economic growth. However, Curs et al. (2011) also found that this same relationship is negative in states with a larger proportion of private higher education institutions. Curs et al. (2011) utilized a panel data set which included 50 states and a time period from 1970 to 2005. While the authors included several variables to account for variations in state economic performance and higher education appropriations, the study is limited by the exclusion of a few key variables. For example, Curs et al. (2011) did not control for the labor force participation rate or the unemployment rate which are both key determinants of state economic performance (Miller & Russek, 1997). Another limitation is that Curs et al. (2011) did not include any direct measurement to account for private higher education. Instead, they made assumptions utilizing variations in student enrollment in public higher education. Because their research question focused on the role that private higher education played

with respect to higher education funding, Curs et al. (2011) should have included a direct measurement of the proportion of private higher education. For example, they could have utilized student enrollment in private higher education. Finally, Curs et. al. (2011) did not take into account any relationships across units of observation. Similar to Deskins et al. (2010) they did not conduct any exploratory spatial data analysis to examine whether or not the economic performance in one state is influenced by neighboring states' funding for higher education. One strength of the methodology is that Curs et al. (2011) utilized a dynamic fixed-effects regression model. Because higher education appropriations are endogenous, meaning the variable could be influenced by other unobserved factors within the state system, Curs et al. (2011) utilized a dynamic fixed-effects regression model. Doing so allowed Curs et al. (2011) to control for the endogenous nature of the higher education appropriations variable.

Though the aforementioned studies contributed to the body of knowledge regarding the relationship between state economic performance and higher education appropriations. These studies, though helpful, also had limitations. These limitations include the lack of controls for variable such as political influence and tax revenue that have influenced not only higher education funding but also state economic performance (Baldwin & Borelli, 2008; Baldwin, Borelli & New, 2011; Berry & Kaserman, 1993; Garcia-Mila & McGuire, 1992; Quan & Beck, 1987; Vedder, 2004). Furthermore, some studies were limited by the number of observations and the use of cross-sectional data (Baldwin & Borelli, 2008; Baldwin & Borelli, 2011; Quan & Beck, 1987, Vedder, 2004). Another limitation is that there were several studies that excluded the use of a conceptual framework (Berry & Kaserman, 1993; Curs et al., 2011; Deskins et. al., 2010; Vedder,

2004). One of the most significant limitations of prior research, however, is the lack of regard for spillover effects and spatial dimensions. Aside from Deskins et al. (2010), all of the aforementioned studies were limited by not examining the potential spillover effect of higher education funding onto neighboring state economies. Taking neighboring states into account in this new line of inquiry will address this limitation. As indicated earlier, there are spillover effects of education that extend beyond the locality of where one's education actually occurred (McMahon, 2010; Weisbrod, 1965). Because of these spillover effects, it is plausible that, either by migration or competition, well educated workers could have an influence on neighboring state economies (Case, Rosen, & Hines, 1993; Deskins et al., 2010). State level research that does not take neighboring states and spatial correlation into account has the potential to produce biased results (Case et al., 1993; Deskins et al., 2010). Therefore, this study will examine the spatial dimensions utilizing exploratory spatial data analysis. This study's focus on examining spatial dimensions within the relationship between state economic performance and higher education funding should be valuable. Hopefully this line of inquiry will add a deeper level of understanding that will help to inform higher education funding policy. The limitations described herein are addressed in this study through the use of control variables that have been shown throughout the literature to influence both economic performance and higher education appropriations. Furthermore, the use of a panel dataset, dynamic fixed effects panel model, and exploratory spatial data analysis will help to address the methodological shortcomings of previous research. Finally, the conceptual framework guided by the endogenous growth theory and principal agent theory will guide the selection of the variables.

## Conceptual Framework

As indicated in the previous section, several studies did not employ a conceptual framework in examining the relationship between state economic performance and higher education appropriations (Berry & Kaserman, 1993; Curs et al., 2011; Deskins et. al., 2010; Vedder, 2004). However, several scholars have utilized conceptual frameworks to guide their studies. For example, Garcia-Mila and McGuire (1992) and Quan and Beck (1987) both employed the production function which describes the relationship between labor, capital, and output with respect to manufacturing production (Douglas, 1976; Reed, 2009). Other authors utilized the human capital theory (Baldwin & Borelli, 2008; Baldwin, Borelli, & New, 2011) which describes how investing into people via education may influence future income (Becker, 1962; Romer, 1986). While appropriate for contextualizing the relationship between economic performance and higher education attainment, these frameworks do little to provide any context for the relationship between state governments and higher education institutions. This study will address the limitation of the previous conceptual frameworks by combining the endogenous growth theory with the principal agent theory. The next section will briefly describe these theories.

### *Endogenous Growth Theory*

Endogenous growth theory (EGT) has been used within economics as a way to guide studies that examine the relationship between knowledge accumulation and state, regional, and national economic performance. Utilizing the endogenous growth theory, Romer (1986) first introduced an economic model in which he argued that the accumulation of knowledge is the primary driver of long run economic performance. Consequently, this study incorporates the endogenous growth theory because it helps to

describe the relationship between knowledge acquisition and state economic performance.

The endogenous growth theory contains several constructs. One major construct of the theory is that the accumulation of knowledge facilitates human capital development. As individuals learn more and invest in attaining knowledge, their worth e.g. human capital leads to greater productivity and financial returns (Becker 1962; Martin & Sunley, 1998; Romer, 1986). EGT suggests that individuals with enhanced human capital are able to adapt to technology, be innovative, and contribute to the long run economic performance of the entities in which they work (Martin & Sunley; Romer, 1986). According to Martin and Sunley (1998) human capital development allows individuals to generate new ideas and add value to their organizations.

Another important construct of the endogenous growth theory is that it describes the spillover effect that comes with an investment in knowledge accumulation (Anderson & Karlsson, 2007; Martin & Sunley, 1998). For example, utilizing EGT, Romer (1986) suggested that as one entity (e.g. a technology firm) creates knowledge it is possible that this knowledge spills over to other entities by way of employee migration. In the context of this study, EGT supports the notion that as a state's citizens accumulate knowledge it is quite possible that they take this knowledge with them as they migrate to other states (Deskins et al., 2010).

Several scholars have turned to the endogenous growth theory to explain economic performance among cities, states, and regions (Anderson & Karlsson, 2007; Backman, 2014; Gottlieb & Fogharty, 2003; Mauro & Carmeci, 2003; Riddel & Schwer, 2003). A majority of these scholars examine the relationship between economic

performance and knowledge accumulation. However, none of these studies examined the context in which factors such as knowledge accumulation, innovation, and enhanced human capital are brought to bear through the mission of higher education. The study described herein will address this limitation by examining the relationship between higher education funding and state economic performance. The next section is used to briefly review the literature that has examined economic performance via the endogenous growth theory.

Riddel and Schwer (2003) examined the factors that impacted innovative capacity within the United States. Drawing upon the endogenous growth theory, the authors found that business R&D expenditures have a positive impact on innovation as measured by patent activity. However, university R&D expenditures did not have a statistically significant relationship with patent activity. Riddel and Schwer (2003) utilized panel data on all 50 states from 1989-1998 and a random-effects regression model. Consistent with the major concept of the endogenous growth theory, Riddel and Schwer (2003) found that the stock of knowledge is also positively related to innovative performance. More specifically, Riddel and Schwer (2003) measure stock of knowledge as the stock of patents, and found that a one percent increase in a state's stock of patents is related to a .15 percent increase in new patents. Riddel and Schwer (2003) found that a one percent increase in high tech workers e.g. IT, was related to a .43 percent increase in innovative capacity as measured by new patents issued by state. The relationship between stock of knowledge and economic activity is also indicated by the awarding of college degrees. More specifically, Riddel and Schwer (2003) found that a one percent increase in college degrees was associated with a .26 percent increase in innovative capacity.

Mauro and Carmeci (2003) drew upon the endogenous growth theory to examine the relationship between national unemployment rates and economic performance. Mauro and Carmeci (2003) examined whether unemployment had any effect on the relationship between human capital and economic performance. Though they did not indicate utilizing a fixed or random effects regression model the authors utilized panel data covering 30 years from 1960-1990 on 19 countries. Mauro and Carmeci found that national unemployment rates are negatively related to long run economic performance.

Gottlieb and Fogarty (2003) utilized EGT to examine the relationship between bachelor degree attainment and economic performance in metropolitan areas. Gottlieb and Fogarty (2003) argued that educated people engaging one another rather than working alone will create more economic value. Utilizing data from the U.S. Census Bureau, Gottlieb and Fogarty (2003) found that educational attainment is positively related to income and employment growth. More specifically, they found that a 1 percentage point increase in bachelor degree recipients was positively associated with a .04% change in income or employment growth.

Utilizing EGT, Anderson and Karlsson (2007) examined the relationship between knowledge accessibility and variations in economic performance across different regions. As indicated above, the spillover effect of knowledge accumulation is an important characteristic of EGT (Anderson & Karlsson, 2007; Martin & Sunley, 1998). Accordingly, Anderson and Karlsson (2007) argued that the knowledge accumulated in one community can spillover to other communities, however the accessibility to knowledge is not equal across all regions. To assess the relationship between knowledge accessibility and economic performance Anderson and Karlsson (2007) utilized ordinary

least squares (OLS) regression. Ordinary least squares regression is a technique used to identify a relationship between an outcome (dependent) variable and a set of explanatory (independent) variables (Dismuke & Lindrooth, 2006). Anderson and Karlsson (2007) utilized the number of hours that university and business employees spend on research and development (R&D) as a measurement of knowledge accessibility. Utilizing OLS regression, the authors found that knowledge accessibility was positively related to output per employee. Therefore, Anderson and Karlsson (2007) concluded that knowledge accessibility was positively related to economic performance. Consistent with the spillover effect of knowledge accumulation, the authors also found that the knowledge accumulation in one region was positively related to the economic performance in a neighboring region. In closing, Anderson and Karlsson (2007) posit that their study lends support to the notion that knowledge plays a role in economic performance, and spatial proximity to knowledge resources may also play a role in the growth of neighboring economies. The findings by Anderson and Karlsson (2007) provide further evidence that the spillover effects of knowledge accumulation truly exist. Because this is true, it gives further reason for the study described herein to examine the relationship between higher education funding and economic performance among neighboring states. As indicated by Romer (1986) the migration of employees between entities facilitates the spillover effect of knowledge accumulation, and according to Andersson and Karlsson (2007) this spillover effect is related to economic performance. Therefore, it is possible that the knowledge one accumulates in one state, courtesy of the state appropriations to higher education, migrates with them to a neighboring state. This migration thereby may have an influence on the economic performance of the state that the citizen has migrated to. This

gives more evidence that the relationship between state funding for higher education and state economic performance among neighboring states must be examined.

While the previous studies examined economic performance at a metropolitan, state, and regional level, Backman (2014) utilized EGT to examine the relationship between human capital and firm productivity at a firm and industry level. Given the multilevel data structure, Backman (2014) utilized a hierarchical linear regression model. The hierarchical linear model is one that facilitates the researcher's ability to not only examine relationships among the variables at one level but also to examine how one level influences the other (Bryk & Raudenbush, 1992). For example, in K-12 education, hierarchical linear modeling may be used to conduct research at a school level and school district level. In higher education, hierarchical linear modeling may be used to conduct research at an academic major level and institutional level. Backman (2014) measured human capital using proxies for education, experience, and cognitive skills. Backman (2014) measured education as the proportion of individuals who had at least three years of higher education coursework. Experience and skills were measured as an employee's average number of years since graduation, and the type of occupation the employee had respectively. Backman (2014) found that firm productivity is positively associated with human capital both at the firm level and the surrounding region level. More specifically, Backman (2014) indicated that productivity is positively influenced by having access to individuals with management and administration occupations.

While the aforementioned studies demonstrate how endogenous growth theory has been utilized as a way to estimate the relationship between knowledge accumulation, innovation, and increased human capital with economic performance, the theory has not

been utilized in the higher education literature. Furthermore, most of the aforementioned studies did not examine the relationship of economic performance across states. EGT is being used in this study because it introduces the theory into higher education research. Furthermore, this study builds upon previous literature by examining if the constructs of EGT hold when the relationship of economic performance and higher education funding is tested across multiple states.

Unfortunately EGT by itself does not accurately describe the role that state governments play with respect to facilitating the acquisition of knowledge and increased human capital among their citizenry. Although state governments have a vested interest in increased human capital, innovation, and knowledge accumulation, they are not able to complete these tasks on their own, therefore they turn to institutions of higher education. State governments provide funding to support higher education institutions in their role of educating the state's citizenry, research and development, and service. EGT does not capture this unique relationship between state governments and higher education institutions. Therefore, EGT is complimented by the Principal Agent Theory.

#### *Principal Agent Theory*

Principal agent theory (PAT) describes a unique relationship in which one party, the agent, acts on behalf of another, the principal, to carry out tasks that the principal is not able to carry out alone (Eisenhardt, 1989; Jensen & Meckling, 1976; Lane & Kivisto, 2008; Moe, 1984; Ross, 1973). While PAT is derived from economics and political science there are some differences with respect to the economic and political science perspectives on PAT. For example, the economic perspective views the relationship between the principal and agent as an explicit and formal contract, whereas political

science views the relationship in a more implicit, vague manner (Lane & Kivisto, 2008). From an economic perspective this means the contract between the principal and agent will focus on the specific tasks and compensation for the agent (Lane & Kivisto, 2008). However, the contract between the principal and agent, via the political science perspective, will typically focus on political relationships and power (Lane & Kivisto, 2008). Another difference between the economics and political science perspective is in the number of principals and agents. In economics, the principal agent relationship is viewed as one principal and one or more agents, whereas the political science perspective allows for multiple principals and multiple agents (Lane & Kivisto, 2008). The political science perspective also allows a collective of principals such as a higher education governing board, thereby making this perspective applicable to this study.

The underlying premise of this study is that state governments provide funding to the institutions to carry out the tasks of educating the state's citizenry, providing research, and service (Lane & Kivisto, 2008). PAT is being utilized in this study because it provides a framework for this relationship between state governments and higher education institutions and the main independent variable, higher education appropriations. Utilizing PAT, state governments are designated as the principal and higher education institutions are designated as the agents in this study.

While the various constructs of PAT are discussed in greater detail below, the constructs fall into two overarching categories, which are often described as the agency problem. These categories are goal conflict and information asymmetry. Goal conflict occurs when the goals and desires of the principal and agent are not in alignment (Eisenhardt, 1989). This misalignment motivates the agent to behave in ways that are

conducive to meeting their own goals but not the goals of the principal. For example, state governments may want to increase access to higher education, while institutions may be looking for ways to move up in *U.S. News and World Report Rankings*, which may require raising admissions criteria (Ehrenberg, 2003; Meredith, 2004). This may cause tension between state governments and institutions, as the institutions may seek out students who perform at a higher level on standardized tests often resulting in decreased student access (Atkinson & Geiser, 2012).

Information asymmetry is another major construct of PAT, and it may occur in different ways. One way is that agents have more information than the principal with respect to the practice they have been contracted to carry out (Waterman & Meier, 1998). For example, institutions of higher education may know more about what it takes to provide education to state citizens than the state governments themselves. This puts the institutions at an advantage to behave in ways that are self-serving, but not necessarily beneficial to the state governments. Shirking is another issue resulting from information asymmetry. Shirking occurs when the principal is not able to directly observe the work of the agent, and the agent is not putting forth the agreed upon effort (Eisenhardt, 1989). For example, shirking may exist if higher education institutions are not offering enough class sections for students to be able to complete their curriculum within four years. Another form of information asymmetry is adverse selection. The issue of adverse selection arises when an agent claims to have a certain skillset, however at the onset of the principal-agent relationship the principal has no way of validating the agent's claim (Eisenhardt, 1989). For example, higher education institutions may claim to have faculty

that specialize in specific areas of research at the time they have lobbied for funding from state governments.

To help mitigate the effects of issues such as goal conflict, shirking, and adverse selection, principals are often required to setup systems of accountability (Jensen & Meckling, 1976). For example, outcomes based contracts may be utilized to ensure the agent behaves in ways that benefit the principal. An example of this type of accountability would be state imposed performance based funding policies that tie the funding that institutions receive to their performance on goals and outcomes designated by the state governments (Liefner, 2003; Kivisto, 2008). State governments also use regulatory reporting such as annual reports to help monitor the behavior of institutions (Lane & Kivisto, 2008). Furthermore, monitoring systems are setup to secure information about the agent's actions. For example, some organizations utilize the board of directors to help gather information and monitor the behaviors of those in key positions of influence (Fama and Jensen, 1983). In higher education this type of monitoring may come in the form of state governance such as higher education commissions or state coordinated boards.

Several scholars have utilized the principal agent theory to explain the unique relationship between entities. PAT has been utilized both inside and outside of higher education. One way that the principal agent theory has been utilized was in an examination of the different ways state governments, as the principal, oversee the activities of higher education institutions as the agents (Lane, 2007). Lane (2007) utilized interviews and documents to develop case studies at Pennsylvania State University and the University of Illinois. The case studies were used to examine the

mechanisms that respective states used to monitor the actions of these institutions. Lane (2007) found that there are many mechanisms that states employ to oversee the actions of institutions. One method includes appropriations hearings in which campus presidents present their budget requests to state legislators and answer any concerns that legislators may have about the institution. Annual reports and governing boards are also mechanisms of oversight. For example, Pennsylvania State University receives approval from the state Board of Education before adding or removing an academic program (Lane, 2007). Centralized governing boards are often used to govern higher education at the state level (Nicholson-Crotty & Meier, 2003). According to Nicholson-Crotty and Meier (2003) governing boards are responsible for several functions with respect to planning, policy analysis, and policy resolution within higher education. Some of these functions may include academic program review and budget development (Nicholson-Crotty & Meier, 2003).

Another way scholars have turned to principal agent theory was in the examination of the effectiveness of state and local tax expenditure limits (TEs) on reducing state spending and revenues (Kousser, McCubbins, & Moule, 2008). Kousser et al. argued that voters or current legislators, as the principals, may enact TEs to constrain the actions of future legislators or lawmakers as the agents. Kousser et al.(2008) utilized a differences in differences approach, which compares the difference in outcomes both before and after a policy intervention, and ordinary least squares (OLS) regression to conduct their study. As indicated earlier, OLS regression is a basic statistical method that is used to identify a relationship between an outcome (dependent) variable and a set of explanatory (independent) variables (Dismuke & Lindrooth, 2006). Overall, the authors

found that, with the exception of Colorado, TELs had no impact on government spending or revenue. The findings indicate, that in this particular case, the voters or current legislators, as the principals, had no influence on the actions of the agents, which were the future legislators or lawmakers.

PAT has also been utilized as a framework for understanding data driven decision making within a school district (Wohlstetter, Datnow, & Park, 2008). Utilizing PAT, the authors identified the school districts as the principals and the school leaders (school principals) as the agents. Wohlstetter et al. utilized the case study methodology to gather the details of the data driven decision making process within four school districts. The authors studied two schools within each school district, creating a sample of eight schools in total for which they conducted the case study analysis. Overall, the authors conducted 70 interviews across the four district systems and the eight schools. Wohlstetter et al. (2008) found that districts and schools that embraced in data driven decision making worked to encourage more communication, specifically from the bottom up from school leaders (agents) to school districts leaders (principals) as a way to mitigate the effects of information asymmetry between the principals and agents. Finally, the authors found that districts provided more autonomy to schools and that schools and districts worked together to create better incentives such as compensation systems to help influence data driven decision making.

Titus (2009) utilized PAT as a framework for examining the relationship between the production of bachelor degrees and financial aspects of state higher education policy. Similar to this research, Titus noted that state governments and higher education institutions had an explicit contractual relationship in which state governments provide

funding for higher education institutions to carry out the educating of state citizens. Utilizing advanced econometric techniques, and state level panel data covering 49 states from 1992-2004, Titus found that bachelor degree production was positively associated with state appropriations to public higher education. As a result, Titus (2009) argued that states that increase funding for colleges and universities are likely to see increases in the number of bachelor degrees awarded per undergraduate student enrollment. Though Titus (2009) drew upon the principal agent theory, the author did not include any variables, such as whether or not a state had a centralized governing board, that would help to represent the principal agent relationship between state governments and the institutions. This limitation is addressed in the present study.

Despite its utility, PAT has not been combined with the endogenous growth theory in any known literature to examine any higher education research questions. This study will expand the body of literature that has drawn upon the principal agent theory, by combining it with the endogenous growth theory to examine the relationship of economic performance with higher education funding, with a specific focus on neighboring state economic performance. The next section will provide details on how these two theories are utilized in the present study.

#### *Endogenous Growth Theory and Principal Agent Theory within this study*

Conceptually, EGT helps to frame this research because it describes how knowledge accumulation, innovation, and the enhancement of human capital is related to economic performance (Becker 1962; Martin & Sunley, 1998; Romer, 1986). However, EGT does not accurately describe the role that state governments play with respect to facilitating the acquisition of knowledge and increased human capital among their

citizenry. State governments are not able to facilitate the acquisition of knowledge and enhance human capital on their own. Therefore, they entrust the responsibility of educating the state's citizens to institutions of higher education. Consequently, state governments provide funding to support higher education institutions. This unique, contractual relationship between state governments and higher education institutions is not captured by EGT, however the Principal Agent Theory helps to describe this relationship.

According to Principal agent theory (PAT) one party, the principal, seeks out another party, the agent, to carry out tasks that the principal cannot carry out on their own (Jensen & Meckling, 1976; Eisenhardt, 1989; Lane & Kivisto, 2008; Moe, 1984; Ross, 1973). PAT is being utilized to compliment EGT in this study because it describes the explicit relationship between state governments and higher education institutions.

Because the endogenous growth theory and the principal agent theory are used to develop the conceptual framework, the variables in this study are drawn based upon those theories. For example, variables such as personal, sales, and corporate tax revenue, state labor and unemployment rates, state educational attainment, and the agricultural and manufacturing industry output are utilized in the study as a part of the endogenous growth theory. In addition, there are several control variables that are included under the principal agent theory. These variables include centralized state governing boards, the governor's political party, and the legislative majority of the state.

There are several other control variables that are included given their influence on how much funding is allocated to higher education. These variables include the previous year's state appropriations to public higher education, state enrollment in public higher

education, net tuition revenue per full time equivalent, state expenditures on K-12 education, healthcare, welfare and public service, and corrections. Finally, state appropriations for public higher education across neighboring states are included as a spatially weighted variable.

### Conclusion

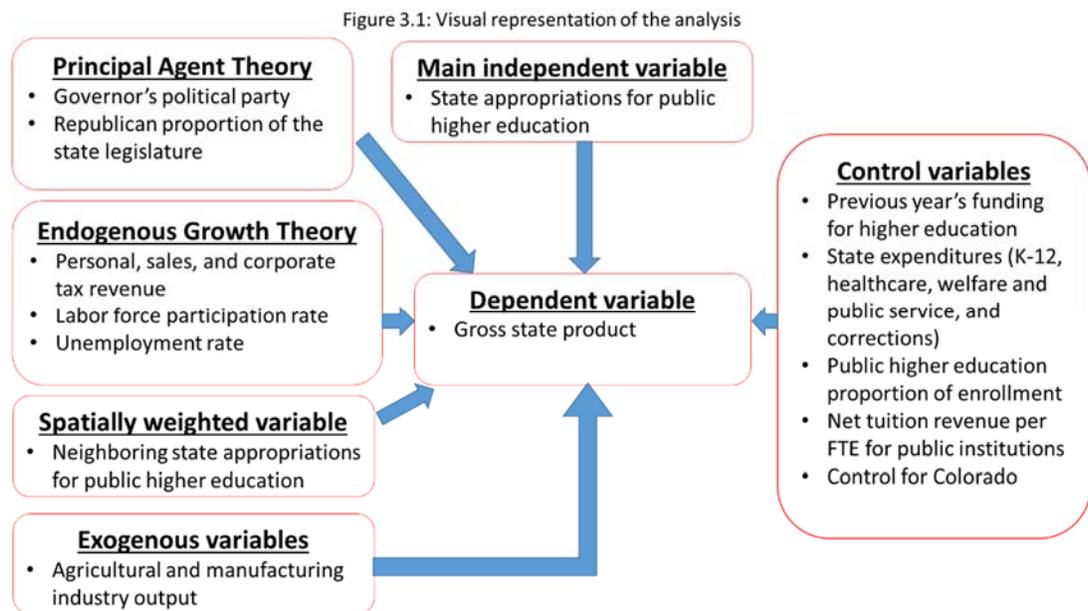
This chapter was used to review the literature surrounding state economic performance, state appropriations for public higher education, the relationship between state economic performance and state appropriations for higher education, and the conceptual framework that will guide this research. Utilizing EGT, this line of inquiry will control for variables that influence state economic performance. Utilizing the principal agent theory this study will also control for the political variables that influence the amount of funding state governments provide to higher education. Several other control variables are included in this study as they have been related to the amount of funding appropriated to higher education. Finally, a spatially weighted variable is included in this study to address the “spillover” effect between state funding for higher education and neighboring state economies. The next chapter will include a full discussion on this study’s research design and methodology.

## CHAPTER THREE METHODOLOGY

### Introduction

This chapter is used to re-state the research questions and discuss the research design including the variables, data sources, analytic framework, analytic model, and the limitations associated with this research.

Figure 3.1 provides a diagram of the conceptual framework and the variables included in the study.



### Research Questions

- 1) Is a state's economic performance related to that state's appropriations for public higher education?
- 2) Is the economic performance in neighboring states related to a state's appropriations for public higher education?

## Variables

### *Dependent variable*

For the purpose of this inquiry, state economic performance is the dependent variable. State economic performance is measured by gross state product per capita, which is the state level equivalent of gross domestic product. Gross domestic product represents the sum of what is spent on good and services by businesses, consumers, and the government. Gross state product represents the same economic activity, but on a state level (Bureau of Economic Analysis, 2014).

### *Main independent variable*

The main independent variable is state appropriations for public higher education per capita. As indicated in chapter one, public higher education appropriations were selected as opposed to total higher education appropriations, as the majority of state higher education appropriations are awarded to public institutions, and because of the principal agent relationship between state governments and public higher education institutions (Titus, 2009). Because there are several variables that influence the amount of state appropriations provided to public higher education, state appropriations for public higher education is considered an endogenous variable (Bielby, House, Flaster, & DesJardins, 2013). Consequently, the relationship between state appropriations for public higher education and gross state product per capita may be over or understated due to endogeneity (Bielby, et al., 2013). To mitigate any biases associated with this endogeneity, the analytic model utilized in this study will include instrumental variables. The use of an instrumental variable allows the researcher to minimize the risk of over or understating the relationship between the main independent variable and the dependent

variable (Bielby, et al., 2013). Lagged values of the dependent and main independent variables are used as the instrumental variables (Arellano & Bond, 1991; Arellano & Bover, 1995; Curs, 2011; Titus, 2009). The analytic model is discussed in greater detail in the analytic model section of this chapter.

As an aside, please note that in 2005 the state of Colorado instituted the College Opportunity Fund. Under this new policy Colorado provides the majority of their higher education funds directly to students as opposed to institutions of higher education (Colorado Succeeds, 2006). This change resulted in depressed amounts of appropriations to public higher education during the years of this study in Colorado. A dummy variable is created to control for this change in funding.

#### *Independent Variables related to the Endogenous Growth Theory*

The first set of independent variables were selected based upon the study's endogenous growth theory component of the conceptual framework. In addition to providing the context for how economic performance is related to knowledge accumulation, innovation, and the enhancement of human capital, the endogenous growth theory provides a context for the independent variables that influence state economic performance. For example, personal and sales tax revenue have been found to be negatively related, positively related, and unrelated to state economic performance (Berry & Kaserman, 1993; Miller & Russek, 1997; Ojede & Yamarik, 2012; Reed, 2009). Corporate tax revenue has been positively related to state economic performance (Miller & Russek, 1997; Reed, 2009). As such, personal, sales, and corporate tax revenue per capita are included as independent variables.

The state labor force participation rate and unemployment rate will also be included in the study. Growth in labor force participation has been shown to be positively related to state economic performance (Curs et al., 2011; Reed, 2009), and unemployment has been negatively related to economic performance (Miller & Russek, 1997).

Collectively, state personal, sales, and corporate tax revenue along with the state labor force participation rate and unemployment rate are included in the model as they are related to the endogenous growth theory aspect of the conceptual framework.

The next set of independent variables were selected based upon the study's principal agent theory aspect of the conceptual framework.

#### *Independent Variables related to the Principal Agent Theory*

In this study state governments are the principal and higher education institutions are the agents. This principal agent relationship, along with several other variables within the state, have an influence on the amount of funding that state governments provide to public higher education. For example, the political party of the governor and legislative majority may influence appropriations for higher education. Prior research has shown that Republican governorship has been positively associated with funding (Weerts & Ronca, 2012). However, Republican governorship and legislative majority has also been negatively associated with funding for higher education (McClendon et. al, 2009). Consequently, a dummy variable is included that indicates whether or not the state governor is a Republican, and another dummy variable is included that indicates whether or not Republicans represent the majority of the state legislature.

Aside from these aforementioned variables, there are several other variables within the state that need to be included based upon their influence on the main independent variable. These variables are incorporated into the model as control variables.

#### *Control variables*

As indicated above, state appropriations for public higher education is considered an endogenous variable in this study because it is influenced by other variables within the state system. This section will describe these variables as the control variables for this study.

Prior research has found that state governments fund higher education based upon the previous year's funding and may make changes according to the economic condition of the state (Delaney & Doyle, 2007; Delaney & Doyle, 2011; Hossler et al., 1997; Shelley & Wright, 2009). As such, the previous year's state appropriations for public higher education is included in the model as a control variable. State expenditures on K-12 education, healthcare, welfare and public service, and corrections will also be included as these variables have been found to influence state appropriations for public higher education (Delaney & Doyle, 2007; Delaney & Doyle, 2011; Okunade, 2004; Tandberg, 2010; Weets & Ronca, 2006).

The proportion of undergraduate enrollment in the public sector of higher education is included in the study as enrollment may influence the extent to which state governments financially support higher education (McClendon, 2009b; Tandberg, 2010). Net tuition revenue per full time equivalent at public higher education institutions will

also be included. Tuition has been found to be negatively related to state appropriations for higher education (Strathman, 1994).

Collectively, previous year's state appropriations for public higher education, state expenditures on K-12 education, healthcare, welfare and public service, corrections, the proportion of undergraduate enrollment in public higher education, and net tuition revenue per FTE equivalent are included in this study as control variables.

#### *Exogenous Variables*

Because they have been found to have a direct positive influence with respect to gross state product (Bureau of Economic Analysis, 2014; Curs, 2011; Garcia-Mila & McGuire, 1992; Heckelman, 2013; Miller & Russek, 1997; Reed, 2009), the manufacturing and agricultural industry output as a percentage of gross state product per capita are included individually in this study as exogenous variables.

#### *Spatially weighted variable*

The focus of this study is to examine the relationship between state economic performance and higher education funding, with a specific focus on the relationship between state economic performance and neighboring state appropriations for public higher education. Consequently, state appropriations for public higher education of neighboring states is included in this study as a spatially weighted variable. The spatially weighed appropriations for public higher education is derived by taking the average of the state appropriations across the neighboring states. More details regarding this process are discussed in the analytic model section.

Table 3.1: Variables included in the study

Name of variable	Description of variable	Source of variable
<b>Dependent</b>		
Gross state product per capita	Sum of what is spent on final goods and services by consumers, businesses, and the government	Bureau of Economic Analysis
<b>Independent Variables</b>		
<u>Main independent variable</u>		
State appropriations for public higher education per capita	Amount of state funding provided to public higher education	Digest of Education Statistics
<u>Independent Variables: Endogenous Growth Theory</u>		
Personal income tax per capita	Income tax revenue per population	U.S. Census Bureau
Sales tax per capita	Sales tax revenue per population	U.S. Census Bureau
Corporate tax per capita	Corporate tax revenue per population	U.S. Census Bureau
Labor force participation rate	Total number of people in the state labor force age 16 and over as a percentage of the state population	Bureau of Labor Statistics
Unemployment rate	Number of unemployed people divided by the total labor	Bureau of Labor Statistics
<u>Independent variables: Principal Agent Theory</u>		
Governor's political party	A dummy variable that indicates the governor's political party	Klarner Politics Governors Dataset; Encyclopedia Britannica; National Governors
Republican majority in the state legislature	A dummy variable that indicates whether or not Republicans represent the majority of the state legislature	Klarner Politics Governors Dataset; National Conference of State Legislatures
<u>Other control variables</u>		
Previous year's funding for higher education	Amount of state funding provided to public higher education	Digest of Education Statistics
Other state expenditures	Amount of state funding allocated to K-12 education, healthcare, welfare and public service, and corrections	National Association of State Budget Officers
Public higher education enrollment as a proportion of total enrollment	Proportion of the undergraduates enrolled in public higher education	Digest of Education Statistics
Net tuition revenue per FTE (full time equivalent)	Tuition and fee revenue divided by the total public FTE enrollment	Digest of Education Statistics
Colorado	A dummy variable to control for the change in Colorado's state funding for higher education	Colorado Succeeds
<u>Exogenous variables</u>		
Agricultural GSP per capita	Percentage of gross state product accounted for by the agricultural industry per population	Bureau of Economic Analysis
Manufacturing GSP per capita	Percentage of gross state product accounted for by the manufacturing industry per population	Bureau of Economic Analysis
<u>Spatially weighted variable</u>		
Neighbors' state appropriations for public higher education	Average amount of state appropriations allocated to public higher education across neighboring states	Digest of Education Statistics

## Data Sources

Because of the focus on the relationship between state appropriations for public higher education and neighboring states, the study described herein is limited to the 48 contiguous states. Alaska, Hawaii, and all United States territories (e.g. Puerto Rico and Guam), will not be included. Given the availability of more recent data, the data for the study will cover between 2004-2013, thereby resulting in a 10 year range and 480 case observations. The data for this line of inquiry are amassed utilizing various sources which are shown in Table 3.1 and described below. Though some of the data will come directly from the United States Census Bureau, other sources such as the Bureau of

Economic Analysis and the Bureau of Labor Statistics either utilize census data or use the same concepts and definitions as the census bureau for their data; thereby increasing the consistency and integrity in the data. All fiscal year data e.g. state appropriations for public higher education per capita is aligned with calendar year data e.g. labor force participation rate. Economic variables such as state appropriations for public higher education per capita and gross state product per capita are adjusted for inflation, and all continuous variables are log transformed for consistency and ease of interpretation.

The data source for the dependent variable, gross state product per capita is the Bureau of Economic Analysis (BEA). Data on the gross state product by state can be found on the Bureau of Economic Analysis website for the years 1997-2013. The BEA estimates the gross state product for each state utilizing several sources of data, most of which comes from the economic census that is conducted every five years by the Census Bureau. The BEA's estimate of gross state product is derived as the sum of the gross state product from all industries within a state. This represents the gross output of each industry less the inputs which are goods and services purchased from other industries.

The Bureau of Economic Analysis (BEA) will also be used to gather data on the agricultural and manufacturing industries. Similar to the gross state product data, the BEA uses estimates to provide data on these industries. For agriculture, the gross state product estimate is based on the difference between farm receipts and expenditures from the United States Department of Agriculture. Manufacturing estimates are based on the value added of the industry after removing the cost of production.

Data for appropriations for public higher education are drawn from the National Center for Education Statistics (NCES). The data is accessed via the Digest of Education

Statistics which is available on the NCES website. Specifically, the data for state appropriations, neighboring state appropriations, as well as prior year appropriations, will come from an annually produced table entitled: Appropriations from state and local governments for public degree-granting institutions, by state or jurisdiction. Enrollment will also be drawn from the Digest of Education Statistics. Enrollment data will come from a table entitled: Full-time equivalent fall enrollment in degree-granting postsecondary institutions, by control of institution and state or jurisdiction.

Finally, the Digest of Education Statistics is used to amass the data on net tuition revenue per full time equivalent enrollment. Net tuition revenue per full time equivalent (FTE) enrollment at public institutions is derived by dividing the tuition and fee revenue per state at public institutions by the total public FTE enrollment per state per year.

Tuition and fee revenue per state at public institutions will come from a table within the Digest of Education Statistics entitled: Revenues of public degree-granting postsecondary institutions, by source of revenue and state or jurisdiction.

Data on state expenditures such as K-12 education, healthcare (Medicaid), welfare and public service (public assistance), and corrections are gathered from the National Association of State Budget Officers' State Expenditure Report. The state expenditure report began in 1987 as a baseline for the analysis of state spending (NASBO, 2014).

State tax revenue data are drawn from the United States Census Bureau. Tax information will come from the Census, Annual Survey of State Government Tax Collections. This annual survey is used to provide a summary of taxes in the areas of property taxes, sales and gross receipts, licenses, income, and other. The data in the survey is gathered via a request to state government offices that are involved with state-

administered taxes. All 50 states are involved in this annual survey of state government tax collections.

The labor force participation and unemployment rates data will come from the Bureau of Labor Statistics, Local Area Unemployment Statistics (LAUS) program. The program is a collaborative effort between state employment agencies and the Bureau of Labor Statistics to produce monthly estimates of employment data. The LAUS program provides annual average unemployment rate data by state on their website. The concepts and definitions underlying the LAUS data are the same as those used by the United States Census Bureau for the Current Population Survey (CPS) (Bureau of Labor Statistics, 2014).

Data on governor party affiliation and legislative control are drawn from the Klarner Politics Governor Dataset, Klarner Politics State Legislative Election Returns Dataset (Klarner, 2013) as well as the National Governors Association (National Governors' Association, 2015), Encyclopedia Britannica (Encyclopedia Britannica, 2016), and the National Conference of State Legislatures (National Conference of State Legislatures, 2012; 2013). These datasets contain data dating back several decades on several variables including a governor's party affiliation, and state legislative election results.

### Analytic Framework

The first step in analyzing the relationship between state economic performance and state appropriations to public higher education is to provide descriptive statistics on all of the variables included in the study. Beyond providing the summary statistics such as mean, median, mode, etc. descriptive statistics will also include an examination of

serial correlation and a test to examine if time itself is a significant factor. These tests will help the researcher better understand the behavior of the data in preparation for the regression analysis.

After performing the descriptive statistics, the next step is to perform the regression analysis to further examine the relationship between state economic performance and state appropriations to public higher education.

The regression analyses utilized in this study will incorporate the use of panel data. Panel data analysis has been identified as an effective method for examining policy studies for statistical power and conceptual reasons (Volkwein & Tandberg, 2008; Zhang, 2010). Panel data analysis allows the researcher to observe multiple units of observation over multiple points in time, thereby creating a larger sample size and increased predictive power (Tandberg, 2010; Zhang, 2010). As indicated in chapter one, panel data models are deemed more informative and contain less multicollinearity than cross-sectional methods (Baltagi, 1995; Elhorst, 2009; Zhang, 2010). More specifically, fixed or random effects panel data analysis allows the researcher to control for unobserved differences, also referred to as heterogeneity, between units of observation (Tandberg, 2010; Zhang, 2010). Fixed effects and random effects models differ in that in a random effects model there is an assumption that the independent variables are not correlated with the group error (e.g. state culture) (Titus, 2009; Zhang, 2010). Panel data analysis will first be used to examine the relationship between a state's gross state product per capita and that state's appropriations for public higher education.

In examining the relationship between a state's gross state product per capita and that state's appropriations to public higher education there are two issues that have

implications for the methodology. The first issue is that independent variables may be correlated with the group error, otherwise referred to as the unobserved heterogeneity among the units of observation. For example, the amount of state appropriations provided to public higher education may be correlated with state culture or politicians' attitudes towards higher education. This correlation would suggest the use of a fixed effects model, as fixed effects models do not require the independent variables and the group error to be uncorrelated (Arellano & Bover, 1995; Titus, 2009; Zhang, 2010). The second issue is that the main independent variable, state appropriations for public higher education is endogenous, meaning that it may be influenced by other observable and unobservable variables within the state system. These variables create a potential for endogeneity bias in examining the relationship between state economic performance and higher education funding (Bielby et al., 2013; Curs et. al, 2011). To properly address the aforementioned possible correlation between the independent variables and the group error term and the endogeneity of higher education appropriations, a dynamic fixed-effects model is used.

#### *Dynamic Fixed-Effects Panel Model*

The dynamic fixed-effects panel (DFEP) model has several aspects that allow it to be the most appropriate method for addressing the issues of correlation and endogeneity. One such aspect is that the model allows for correlation between the independent variables and the error term (Arellano & Bover, 1995; Titus, 2009; Zhang, 2010). Therefore, the method facilitates the researcher's ability to more accurately examine the relationship between the key variables of interest and the dependent variable, while

controlling for unobserved factors that may influence the relationship but be of less interest (Titus, 2009).

In addition, the dynamic fixed effects panel model uses first differences to address endogeneity (Arellano & Bond, 1991; Arellano & Bover, 1995; Curs, 2011; Titus, 2009). First differences is the difference that one gets when subtracting the value of a variable in one year from the value of the same variable from another year. For example, first differences of state appropriations for public higher education would be derived from subtracting the state appropriations for public higher education in 2004 from the state appropriations for public higher education in 2005. The dynamic fixed effects panel model also uses lagged values to address endogeneity (Arellano & Bond, 1991; Arellano & Bover, 1995; Curs, 2011; Titus, 2009). For example, gross state product per capita in 2005 is regressed on state appropriations for public higher education in 2004. In this case, state appropriations for public higher education has been lagged one year. Because, prior research has shown that a state's economic performance (Delaney & Doyle, 2007; Delaney & Doyle, 2011; Shelley & Wright, 2009) and prior year's appropriation levels (Hossler et al., 1997) influence the extent to which state governments provide funding for higher education, this study will incorporate the use of lagged values of gross state product per capita and state appropriations for public higher education and first differences as instrumental variables. For example, gross state product per capita in the year 2005 will not only be regressed on the lagged values of gross state product per capita and state appropriations for public higher education in 2004, but also is regressed on the difference one would get when subtracting gross state product per capita in 2004 from gross state product per capita in 2005 and the difference between state appropriations for

public higher education in 2004 and state appropriations for public higher education in 2005.

The dynamic fixed-effects panel model is expected to facilitate the ability to determine how previous levels of funding and past economic performance influence current economic performance (Titus, 2009), thus making it an appropriate method for this study. The dynamic fixed effects panel model is not without its limitations, however. This method may produce biased and inefficient estimates when used with higher order lags of the dependent variable and small samples (Arellano 1989). Because the model in this study will incorporate lags of the dependent variable (gross state product per capita) and the main independent variable (state appropriations for public higher education), and use a relatively small sample (10 years), the limitations described by Arellano (1989) may be applicable in this study. To mitigate these limitations and produce more accurate estimates, the dynamic fixed-effects panel model is used in conjunction with a system of equations, referred to as the system Generalized Method of Moments (GMM) technique (Titus, 2009).

The system GMM technique allows the researcher to utilize lags of the differenced values of the endogenous variables along with exogenous variables as instruments for the endogenous variables (Titus, 2009). The use of such instruments, especially for studies examining a short time period, allows for more robust parameter estimates (Arellano & Bover, 1995; Blundell & Bond, 1998).

Overall, the potential correlation between the independent variables and the group error term, in addition to the endogeneity of the main independent variable, state appropriations for public higher education, make the dynamic fixed effects panel model

the most appropriate tool for this study. Because this study spans a short period of time, and will require the use of instrumented variables the dynamic fixed-effects panel model is combined with a system GMM technique. The dynamic fixed-effects panel model, via a system GMM technique, is used to address research question one which examines whether there is a relationship between gross state product per capita and state appropriations for public higher education, controlling for other variables.

Researchers have concluded that standard methods of evaluation (e.g. ordinary least squares and fixed effects models) of first-differenced models may contain biases of the coefficients (Nickell, 1981; Blundell & Bond, 1998; Kiviet, 1995). To mitigate these biases other researchers recommend the system GMM technique (Arellano & Bover, 1995; Blundell & Bond, 1998). Scholars have concluded that system GMM includes an instrument matrix, uses lagged differences and levels of the dependent and independent variables, and is more efficient than the standard first differenced GMM model (Arellano & Bover, 1995; Blundell & Bond, 1998). However, system GMM often results in a downward bias of the standard errors when used with small samples. To mitigate this limitation system GMM is estimated with a small sample finite sample correction procedure that will yield robust standard errors (Windmeijer, 2004).

There are two major assumptions with the dynamic fixed effects model that is used in this study. The assumptions are that there is no second order serial correlation in the error terms, and that the instruments are not correlated with the residual error, the latter assumption is otherwise referred to as the overidentifying restriction. The Arellano-Bond test for autocorrelation is used to test for serial correlation in the error term when utilizing lagged values of variables as instruments (Arellano & Bond, 1991;

Hillman, 2012). A statistically significant test statistic ( $p < .05$ ) would indicate that there was serial correlation in the errors and that the instruments used in the model are not valid. The Hansen-J test is used in this model to check whether or not the instruments are correlated with the residual error and that the over-identifying restrictions have been violated (Hillman, 2012). A statistically significant test statistic ( $p < .05$ ), would indicate that the instruments are not valid.

*Analytic Model for Research Question One: Is a state's economic performance influenced by that state's appropriations for public higher education?*

As noted above, dynamic fixed-effects panel models, via a GMM technique, involves the use of a series of equations. The first equation (1), indicates that gross state product per capita ( $GSP_{it}$ ) is a function ( $f$ ) of prior year gross state product per capita ( $GSP_{it-1}$ ), current appropriations to public higher education ( $Appr_{it}$ ), prior year state appropriations to public higher education ( $Appr_{it-1}$ ), governor's political party ( $GovP_{it}$ ), percentage of Republicans in the state legislature ( $Rep_{it}$ ) competing state expenditures ( $Comp_{it}$ ), public institution enrollment ( $Enroll_{it}$ ), net tuition revenue per FTE ( $Tuit_{it}$ ), agricultural and manufacturing industry output ( $Output_{it}$ ), personal, sales and corporate tax revenue ( $Tax_{it}$ ), labor force participation rate ( $Labor_{it}$ ), and unemployment rate ( $Uemp_{it}$ ).

$GSP_{it} = f(GSP_{it-1}, Appr_{it}, Appr_{it-1}, GovP_{it}, Rep_{it}, Comp_{it}, Enroll_{it}, Tuit_{it}, Output_{it}, Tax_{it}, Labor_{it}, Uemp_{it})$

(1)

In equation (1)  $i$  represents the unit of analysis which are the states and  $t$  represents time. After combining the independent, control, and exogenous variables (governor's political party, percentage of Republicans in the state legislature, competing state expenditures, enrollment, net tuition revenue per FTE, agricultural and manufacturing industry output, personal, sales and corporate tax revenue, labor force participation rate, and unemployment rate) equation (2) is produced as follows:

$$y_{it} = \alpha y_{it-1} + \gamma_1 W_{it} + \gamma_2 X_{it} + \eta_i + \lambda_t + \varepsilon_{it}$$

(2)

where  $y_{it}$  is gross state product per capita,  $\alpha$  represents the coefficient for gross state product lagged one year,  $\gamma$  is the coefficient,  $W_{it}$  is the vector of endogenous variables i.e. state appropriations to public higher education and prior year state appropriations to public higher education,  $X_{it}$  is the vector of independent, control, and exogenous variables,  $\eta_i$  is the state specific (group) error term, otherwise referred to as the unobserved heterogeneity between the units of analysis (states),  $\lambda_t$  is the time specific error term, and  $\varepsilon_{it}$  is the residual error for the overall model which represents the difference between the predicted and actual observations.

The next equation (3) shows a first differences model in which each variable is being subtracted from the previous time period

$$y_{it} = \alpha(y_{it-1} - y_{it-2}) + \gamma_1(W_{it} - W_{it-n}) + \gamma_2(X_{it} - X_{it-1}) + \lambda_t + (\varepsilon_{it} - \varepsilon_{it-1})$$

(3)

The state specific error term ( $\eta_i$ ) is excluded from equation (3) because it is invariant across time periods.

Equation (3) is rewritten below as Equation (4) to include system GMM. This model is used to address the first research question: Is a state's economic performance influenced by that state's appropriations for public higher education?

$$y_{it} = \alpha + \beta y_{it-1} + \gamma_1(W_{it} - W_{it-n}) + \gamma_2(X_{it} - X_{it-1}) + \lambda_t + (\varepsilon_{it} - \varepsilon_{it-1})$$

(4)

Equation (4) indicates a dynamic fixed effects regression model where  $\beta$  is the coefficient of the lagged dependent variable;  $y_{it}$  is gross state product per capita;  $\gamma$  is the coefficient;  $W_{it}$  represents the endogenous variable state appropriations for public higher education;  $X_{it}$  is the vector of independent, control, and exogenous variables including governor's political party, percentage of Republicans in the state legislature, competing state expenditures, enrollment, net tuition revenue per FTE, agricultural and manufacturing industry output, personal, sales, and corporate tax revenue, labor force participation rate, and unemployment rate,  $\lambda_t$  is the time specific error term;  $\varepsilon_{it}$  represents the overall residual error.

*Analytic Model for Research Question Two: Is the economic performance in neighboring states influenced by a state's appropriations for public higher education?*

Research question two examines whether there is a relationship between neighboring state appropriations for public higher education and state economic

performance. Consequently, research question two will require spatial analysis. Spatial analysis allows the researcher to determine if there is a relationship across units of observation (LeSage & Dominguez, 2012; Ye & Wu, 2011). Moreover, spatial analysis has gained importance over time with respect to understanding spillover effects (Baller, Anselin, Messner, Deane, & Hawkins, 2001). To address research question two, the analytic model discussed in the previous section is adjusted to account for spatial data analysis. In this study, there are several steps in performing spatial data analysis which includes creating a spatial weight matrix, exploratory spatial data analysis, and executing a spatial regression.

#### *Spatial Weight Matrix*

The first step in performing spatial analysis in this examination is developing a spatial weight matrix (Anselin, 1995; Mitchell, 2013). There are several different types of spatial weight matrices. For example, a rook contiguity matrix would indicate which states share a border, while queen contiguity and nearest neighbor would indicate neighbors as those states that either share a common vertex or common border and those states that are within a certain distance from one another respectively (Anselin, 1988; Mitchell, 2013).

This study will incorporate the use of the nearest neighbor spatial weight matrix. The neighbors that each state has is determined utilizing distance and the Moran's Index (I) statistic. More specifically, the Moran's I will determine neighbors utilizing latitude and longitude and will give significant values for neighbors.

The spatial weight matrix is developed utilizing binary coding and an element  $W$  which indicates whether or not states are neighbors (Anselin, 1995; Anselin, 1996)

For example, consider “states” A,B,C and D below. The main diagonal represents the states relationship to itself, therefore it receives a 0. States that are neighbors receive a 1 and those are not receive a 0 (Anselin, 1995). For example  $W(A,B)= 1$  because states A and B are neighbors. In the sample weighting matrix below, the states that have been identified as neighbors are:

- State A and B
- State A and C
- State B and C
- State C and D

W=

	A	B	C	D
A	0	1	1	0
B	1	0	1	0
C	1	1	0	1
D	0	0	1	0

Once the spatial weight matrix has been developed, the exploratory spatial data analysis becomes the next step in the spatial analysis process.

### Exploratory Spatial Data Analysis (ESDA)

There are three global measures of spatial association which examine if there is overall similarity with respect to gross state product per capita among the entire dataset. Those measures are Moran’s I, Global G, and Geary’s C (Canche, 2014; Cliff & Ord, 1973; Getis & Ord, 1992; Mitchell, 2013). Local indicators of spatial association, also referred to as hotspots and coldspots, will also be used to examine similarity of gross

state product among neighboring, or local units (Anselin, 1995; Anselin, 1996; Michell, 2013; Ye & Wu, 2011). In this research a hotspot would indicate a region of states that have a high level of similarity with respect to gross state product per capita.

Moran I's is one measure to test for spatial autocorrelation within the entire dataset. A significant test statistic of the Moran I's indicates that spatial autocorrelation exists among the units of observation (Mitchell, 2013). Values in the coefficient for Moran's I range from -1 to 1, with positive values indicating a positive relationship among neighboring units of observation (Mitchell, 2013). The Moran's I also indicates a linear relationship between the observed values in the dependent variable and a weighted average of neighboring values of the same variable (Anselin, 1996). This linear relationship is formally represented by the Moran's I when the weighted average of the neighboring values in the dependent variable are regressed on the dependent variable in one unit of observation. In other words, the Moran's I represents the linear relationship between the weighted average of gross state product per capita across neighboring states with any one particular state.

$$I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2} \quad (5)$$

In equation (5), there is an  $n$ -by-1 vector  $x = [x_1 \dots x_n]$  which contains measurements of a variable in  $n$  units of analysis and a  $n$ -by- $n$  symmetric spatial weighting matrix  $W$ , where  $X$  is the variable of interest and the values of  $w_{ij}$  are weights from the matrix  $W$ . A weighted average of all values  $x$  is created by row-standardizing (each row total equals 1) the weight matrix  $W$  (Anselin, 1995).

The Moran I statistic can be interpreted visually utilizing the Moran scatterplot (Anselin, 1996), where the slope of the regression line through the plot represents the Moran I statistic. The four quadrants in the Moran scatterplot represent the different associations between a given value of the dependent variable and the weighted average of the dependent variable across neighbors. The northeast and southwest quadrants represent positive spatial associations where a particular location i.e. state is surrounded by similar locations i.e. neighboring states. The northeast associations are considered high-high, while the southwest are considered low-low (Anselin, 1996). In this study, a high-high association would indicate that if one state's gross state product per capita is higher than average, the same would be expected of its neighboring states. Conversely, a low-low association would indicate that a state with a below average gross state product per capita would be expected to be surrounded by other states that have below average gross state product per capita. The northwest and southeast quadrants represent negative spatial associations where are particular location such as a state is surrounded by dissimilar neighbors. The northwest associations are considered low-high, while the southeast are considered high-low. In this research, a low-high association would indicate states with below average gross state product per capita are expected to be surrounded by neighbors with above average gross state product per capita, while a high-low association would indicate states with an above average gross state product per capita would be surrounded by states with below average gross state product per capita. In this study, the Moran's I of local and global spatial autocorrelation are shown for key variables including gross state product per capita and state appropriations for public higher education. In addition to the Moran scatter plot just described, spatial maps will

also be shown to help illustrate any spatial relationships in the data. Spatial maps will visually show hot spots across the 48 contiguous states. Different shades of color on the spatial map will indicate the high-high, low-low, low-high, and high-low associations previously mentioned.

If ESDA has indicated that global and local spatial autocorrelation exists within the data, then research question two regarding the relationship between neighboring state appropriations for public higher education and state economic performance will be examined utilizing a spatial instrumental variable (IV) fixed effects regression. After spatially weighted values of state appropriations per public higher education are added to the model, a Moran's I test will be utilized to determine if spatial correlation still exists among the error terms (Mitchell, 2013).

#### Spatial Instrumental Variable (IV) Fixed Effects Regression Model

Equation (6) represents the spatial instrumental variable (IV) fixed effects regression that is used to answer research question two.

$$y_{it} = \alpha + \beta y_{it-1} + \gamma_1(Z_{it} - Z_{it-1}) + \rho\gamma_2(W_{it} - W_{it-n}) + \gamma_3(X_{it} - X_{it-1}) + \lambda_t + (\epsilon_{it} - \epsilon_{it-1})$$

(6)

Where  $\beta$  is the coefficient of the lagged dependent variable;  $y_{it}$  is gross state product per capita;  $\gamma$  is the coefficient;  $Z_{it}$  represents the endogenous variable state appropriations for public higher education;  $W_{it}$  represents the spatially lagged average state appropriations for public higher education in neighboring states;  $\rho$  is the spatial multiplier that measures the spillover effect of neighboring state appropriations;  $X_{it}$  is the

vector of independent, control, and exogenous variables including the controlling party of the state legislature, governor's political party, percentage of Republicans in the state legislature, competing state expenditures, enrollment, net tuition revenue per FTE, agricultural and manufacturing industry output, personal, sales and corporate tax revenue, labor force participation rate, and unemployment rate.  $\lambda_t$  is the time specific error term;  $\varepsilon_{it}$  represents the overall residual error.

The global spatial multiplier ( $1/(1-\rho)$ ) (Anselin, 2003) represents the direct and indirect (spillover) effects of the influence of neighboring state appropriations on a state's economic performance. If  $\rho$  (*rho*) is positive (negative) the spillover effect is positive (negative). In this study, the global spatial multiplier should be considered as the average extent to which the direct effect of state appropriations for public higher education on gross state product per capita is affected by the spillovers across the 48 contiguous United States. Therefore, the estimated beta coefficients in a spatial regression model could be interpreted as estimates of the marginal effect of a change in state appropriations for public higher education on gross state product per capita, while the full or total effect is a multiple of the marginal effect. For example, if *rho* is equal to .20, the global spatial multiplier would equal 1.25. This would indicate that a quarter of the impact of state appropriations for public higher education on gross state product per capita within a state is reflected by its neighbors' appropriations to public higher education.

### Limitations

The primary concern with this research is its reliance on secondary data. According to Wells, Lynch, and Seifert (2011), secondary data analysis is inherently risky because the researcher has no control over how the data was collected and reported.

For example, the institutional data in IPEDS or the Digest of Education Statistics were first collected by the campuses then reported to the Department of Education.

Subsequently the U.S. Department of Education had to aggregate and report the data for public consumption. The exchange of information and calculations alone carry risk that cannot be avoided in this study.

Along with misreported data, missing data is also a limitation. The benefit of panel data analysis is the power associated with the increased number of cases and observations. Any missing data from institutions, or the state or national government will diminish the power associated with conducting the panel data analysis. According to Chen and DesJardins (2008) the limitation of missing data is commonly found in secondary data analysis. Because spatial data analysis will require the use of a strongly balanced dataset which includes the same number of observations for each of the variables and units of observations, variables with missing data will not be included in the analysis.

Another limitation of this study is that there are other variables that could potentially influence the relationship between state appropriations and state economic performance that are not able to be captured in this research. For example, the mobility of talented individuals or the diffusion of ideas cannot be captured empirically in the model, however these variables could potentially influence the relationship in question.

## CHAPTER FOUR RESULTS

### Introduction

This chapter contains a review of the research questions and the results of the study including the descriptive statistics of the variables used in the analysis, the results of several regression models including the dynamic fixed effects panel (DFEP) model estimated via Generalized Method of Moments (GMM), the results of the exploratory data analysis, and the results of the spatial dynamic fixed effects panel model estimated via GMM.

### Research Questions

- 1.) Is a state's economic performance related to that state's appropriations for public higher education?
- 2.) Is the economic performance in neighboring states related to a state's appropriations for public higher education?

### Descriptive Statistics

Table 4.1, shown below, contains descriptive information on the analytic sample. The sample for this study includes the 48 contiguous United States across the 10-year period, 2004-2013.

#### *Gross State Product*

As shown in table 4.1 below, the dependent variable, gross state product per capita ranges from \$27,335.78 to \$69,260.80, with a median value of \$44,281 in 2009 dollars. This amount indicates that there is some disparity in the economic performance across the sample.

### *Main Independent Variable*

In 2009 dollars, state appropriations for public higher education ranges from \$3.05 per capita to \$654.11 per capita. Similar to the economic performance across the sample these values indicate a disparity in the amount of funding that states allocated to higher education across the analytic sample. For example, the average amount of state appropriations per capita is \$207.17. However, there are some states such as North Dakota and North Carolina that had an average state appropriations amount of \$356.02 and \$329.25 respectively, which is well above the average. On the other hand, some states such as New Hampshire and Pennsylvania had an average of \$83.76 and \$103.32 respectively, which is well below the average.

### *Independent Variables*

The variables related to the endogenous growth theory and the principal agent theory are also included in table 4.1. These variables include personal income tax, sales tax, and corporate tax revenue per capita, the labor force participation rate, the unemployment rate, the governor's political party, and a dummy variable that indicates whether or not Republicans were a majority of the state legislature. The data in table 4.1 indicates that the largest tax revenue that states across the sample received came from sales tax, with a maximum of \$2,605.80 per capita. The average labor force participation rate and unemployment rates were 65.96% and 6.41% respectively. The governor's political party and Republican majority dummy variables indicate that across the sample that on average 51% of the Governors have been Republicans and that on average Republicans represented the majority in the state legislature 49% of the time.

### *Exogenous Variables*

As the descriptive data in table 4.1 indicates, the manufacturing industry, with an average of \$5,744.56 per capita, represents a larger share of the economic performance across the sample compared to the agricultural industry which had an average of \$803.01 per capita.

#### *Control Variables*

The control variables for this study include state funding for K12 education, Medicaid, public assistance, and corrections. Control variables also included the proportion of students enrolled in public higher education, net tuition revenue per full time equivalent, and a dummy variable which accounts for the shift in funding in the state of Colorado, which in 2005 elected to provide funding directly to students as opposed to institutions of higher education. The descriptive statistics indicate that funding for K12 education per capita and Medicaid per capita represent the largest proportions of state appropriations. Furthermore, the majority of students enrolled in higher education are enrolled at public institutions. Finally, across the 10-year period the median tuition revenue per full time equivalent was \$5,421.09.

#### *Spatially weighted variable*

This variable represents a weighted average of the funding that neighboring states allocate to public higher education. As indicated by the values in table 4.1, the median amount of funding provided to public higher education across neighboring states was \$203.01 per capita.

Overall, the variables are normally distributed with the exception of enrollment in public higher education, expenditures on public assistance, and agricultural gross state product per capita. On average only about 43% of students enroll in public higher

education in Arizona, 39% in Massachusetts, and 44% in Rhode Island, compared to the average of 73% across the entire sample, thereby contributing to the negative skew.

Public assistance expenditures are positively skewed due to states like California, Massachusetts, and New York who had an average of expenditures on public assistance of \$256.28, \$196.67, and \$185.21 respectively, which is well above the sample average of \$63.91. The agricultural industry values were also positively skewed due to states like Nebraska, North Dakota, and South Dakota who had average agricultural gross state product of \$3465.23, \$4450.03, and \$4186.22 respectively compared to the sample average of \$803.01.

Table 4.1 Descriptive Statistics							
Variable Name	Mean	SD	Minimum	Maximum	25th Percentile	Median	75th Percentile
<b>Dependent variable</b>							
Gross State Product Per Capita (2009 dollars)	45567.36	8529.98	27335.78	69260.81	39488.24	44281.82	50640.31
<b>Main independent variable</b>							
State appropriations for public higher education per capita (2009 dollars)	207.17	84.64	3.05	654.51	156.68	197.46	242.56
<b>Independent variables (EGT)</b>							
Personal income tax per capita (2009	772.63	472.30	0.00	2322.17	546.61	777.12	1036.23
Sales tax per capita (2009 dollars)	1117.51	363.04	176.68	2605.80	894.32	1099.10	1323.78
Corporate tax per capita (2009 dollars)	130.31	85.35	0.00	461.59	79.53	120.84	163.93
Labor force participation rate	65.96%	4.10%	53.80%	74.80%	63.20%	66.00%	68.80%
Unemployment rate	6.41%	2.24%	2.60%	14.40%	4.60%	5.95%	8.00%
<b>Independent variables (PAT)</b>							
Governor's political party	0.51	0.50	0.00	1.00	0.00	1.00	1.00
Republican party majority in the state legisla	0.49	0.50	0.00	1.00	0.00	0.00	1.00
<b>Exogenous Variables</b>							
Agricultural GSP per capita (2009 dollars)	803.01	1090.79	70.79	7891.07	224.90	464.29	846.38
Manufacturing GSP per capita (2009 dollars)	5744.56	2455.64	1653.35	16090.41	4028.30	5338.41	6958.67
<b>Control Variables</b>							
K12 education per capita (2009 dollars)	1039.14	353.80	372.92	2709.33	803.49	995.44	1175.14
Medicaid per capita (2009 dollars)	1098.50	352.85	254.28	2393.90	840.45	1047.33	1311.25
Public assistance per capita (2009 dollars)	63.91	65.59	0.00	392.22	20.97	41.11	78.33
Corrections per capita (2009 dollars)	149.72	54.04	1.86	510.50	114.56	139.45	172.85
Public enrollment	73%	14%	34%	95%	65%	77%	83%
Net tuition revenue per FTE (2009 dollars)	5832.66	2481.40	1792.47	18894.55	4116.95	5421.09	6905.32
Colorado	0.02	0.14	0.00	1.00	0.00	0.00	0.00
<b>Spatially weighted variable</b>							
Spatial lag, state appropriations for public higher education	216.43	98.37	3.37	654.51	162.44	203.01	250.37

In addition to the descriptive statistics several tests were performed to understand what accommodations needed to be made in the regression model. The Woolridge test for autocorrelation ( $p < .05$ ) indicated that serial correlation existed in the error terms. Furthermore a Wald test for time fixed effects ( $p < .05$ ) indicated that time was a significant factor and that time effects would need to be controlled for in the regression model. In addition to the Wald test for time, a Wald test for heteroscedasticity was performed to examine whether or not heteroscedasticity existed among the error terms.

The results ( $p < .05$ ) indicated that there was non-constant variance among the error terms which needed to be accounted for in the regression model.

#### Results: Research Question One

Research question one examines the relationship between state economic performance and that state's appropriations for public higher education. The dynamic fixed effects panel (DFEP) data model was used to address this question. The DFEP model was used because it allows the researcher to account for issues of correlation and endogeneity (Arellano & Bond, 1991; Arellano & Bover, 1995; Curs, 2011; Titus, 2009). In addition to the serial correlation, the small time period, large number of observations, and heteroscedasticity among the error terms, indicates a need to estimate the DFEP model with a two-step system Generalized Methods of Moments and robust standard errors (Roodman, 2009; Windmeijer, 2004). This system GMM technique allows the researcher to use lags of the dependent and endogenous variables as instruments for the endogenous variables and facilitate for more robust parameter estimates (Arellano & Bover, 1995; Blundell & Bond, 1998; Titus, 2009).

Prior to reviewing the results of the DFEP model, it is instructive to review the results of several other models that were conducted to better understand the relationship between gross state product and higher education appropriations per capita. To estimate the overall effectiveness of the models, a cutoff value of  $p < .05$  was utilized in this study. The first model is the pooled OLS regression model. The results of this model are shown in table 4.2 below. The major difference between model one and model two, is that model two incorporates a spatially weighted variable for state appropriations for public higher education. As indicated in table 4.2 not only are state appropriations for public higher

education statistically significantly related to gross state product, but also personal income tax, sales tax, corporate tax, the labor force participation rate, the unemployment rate, the agricultural industry, the manufacturing industry, Medicaid, state funded public assistance and corrections, the proportion of students enrolled in public higher education, net tuition revenue, and the shift in funding in Colorado are all statistically significantly related to gross state product.

Table 4.2 An analysis of the relationship between gross state product per capita and state appropriations for public higher education among the 48 contiguous United States, results of the Pooled Ordinary Least Squares (OLS) model (2004-2013): all continuous variables are natural log transformed. Financial variables were transformed into 2009 dollars.

Variable Name	Model 1	Model 2
Constant	3.341 (0.564)	3.321 (0.565)
State appropriations for public higher education per capita	0.076* (0.033)	0.074* (0.033)
Personal income tax per capita	0.044*** (0.008)	0.044*** (0.008)
Sales tax per capita	-0.087*** (0.016)	-0.087*** (0.016)
Corporate tax per capita	0.104*** (0.010)	0.104*** (0.010)
Labor force participation rate	1.354*** (0.115)	1.364*** (0.115)
Unemployment rate	-0.146*** (0.030)	-0.148*** (0.030)
Governor's political party	-0.002 (0.010)	-0.004 (0.010)
Republican majority in the state legislature	0.007 (0.012)	0.008 (0.012)
Agricultural GSP per capita	-0.082*** (0.007)	-0.083*** (0.007)
Manufacturing GSP per capita	0.115*** (0.013)	0.116*** (0.013)
Previous year state appropriations for public higher education per capita	0.014 (0.027)	0.017 (0.027)
Spatial lag, state appropriations for public higher education	n/a n/a	-0.007 (0.007)
K12 education per capita	-0.037 (0.024)	-0.037 (0.024)
Medicaid per capita	0.121*** (0.029)	0.123*** (0.030)
Public assistance per capita	-0.141* (0.006)	-0.015* (0.006)
Corrections per capita	0.154*** (0.020)	0.152*** (0.020)
Public enrollment	-0.091** (0.030)	-0.088** (0.031)
Net tuition revenue per FTE	-0.069** (0.021)	-0.067** (0.021)
Colorado	0.536*** (0.104)	0.529*** (0.104)
Observations	414	414
Time fixed effects	Yes	Yes
F-Statistic	48.15***	46.47***
R Square	0.77	0.77

Note: \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ ; standard errors in parenthesis

Table 4.3 shows the results of a random effects model using robust standard errors. Models three and four only differ by the inclusion of the spatially weighted variable for state appropriations. There are several notable results in this table. As the table indicates, state appropriations for public higher education are no longer statistically significant, however previous year state appropriations for public higher education are statistically significant, controlling for all of the other variables in the model. In the random effects model personal income tax and sales tax are statistically significant, while corporate tax revenue was no longer statistically significant. The labor force participation rate, and unemployment rate were both statistically significant. The agricultural industry was no longer statistically significant, however the manufacturing industry was still statistically significant. Contrary to the results of the pooled OLS model, state expenditures for Medicaid, public assistance, and corrections as well as the proportion of students enrolled in public higher education and tuition were no longer statistically significant. These findings would indicate that some of the statistical significance in the pooled OLS model was accounted for in the random effects model by controlling for unobserved heterogeneity.

Another notable finding from the random effects model is the correlation between the predictor variables and state specific characteristics. In a random effects model there is an assumption that the predictor variables are not related to any unobservable group specific characteristics such as state culture or attitudes towards higher education. However as indicated by the Theta statistic in models three and four the predictor variables are related to the group specific error. Since it is highly correlated with the other predictor variables, this correlation is most likely due to the endogeneity of state

appropriations for public higher education. This provides further evidence that the use of the dynamic fixed effects panel model is warranted because it will address the issue of endogeneity.

Table 4.3 An analysis of the relationship between gross state product per capita and state appropriations for public higher education among the 48 contiguous United States, results of the Random-Effects model (2004-2013): all continuous variables are natural log transformed. Financial variables were transformed into 2009 dollars.

Variable Name	Model 3	Model 4
Constant	5.965 (0.863)	5.942 (0.869)
State appropriations for public higher education per capita	0.002 (0.018)	0.002 (0.018)
Personal income tax per capita	0.058* (0.025)	0.057* (0.025)
Sales tax per capita	0.163** (0.059)	0.163** (0.059)
Corporate tax per capita	0.013 (0.007)	0.012 (0.007)
Labor force participation rate	0.364** (0.109)	0.372** (0.109)
Unemployment rate	-0.088*** (0.016)	-0.089*** (0.017)
Governor's political party	0.002 (0.004)	0.002 (0.004)
Republican majority in the state legislature	0.005 (0.005)	0.005 (0.005)
Agricultural GSP per capita	0.007 (0.011)	0.007 (0.011)
Manufacturing GSP per capita	0.117*** (0.021)	0.117*** (0.021)
Previous year state appropriations for public higher education per capita	0.012** (0.004)	0.012** (0.004)
Spatial lag, state appropriations for public higher education	n/a n/a	-0.002 (0.002)
K12 education per capita	0.050 (0.031)	0.049 (0.032)
Medicaid per capita	-0.005 (0.022)	-0.006 (0.022)
Public assistance per capita	-0.002 (0.005)	-0.002 (0.005)
Corrections per capita	0.051 (0.028)	0.052 (0.028)
Public enrollment	0.019 (0.042)	0.017 (0.043)
Net tuition revenue per FTE	0.010 (0.038)	0.012 (0.038)
Colorado	0.029 (0.064)	0.024 (0.064)
Observations	414	414
Number of states	42	42
Time fixed effects	Yes	Yes
Chi-Square	30010.23***	29680.26***
Theta	0.89	0.89
R Square	0.26	0.26

Note: \*p<0.05; \*\*p<0.01; \*\*\*p<0.001; standard errors in parenthesis

As indicated in chapter three, the endogeneity of state appropriations for public higher education calls for the use of the dynamic fixed effects panel model, via GMM techniques. To properly assign instrumental variables in the DFEP model, a two stage least squares regression model was executed to test the hypothesized relationship between state appropriations for higher education and the variables said to influence this variable, a full discussion of such variables is available in chapter two. The results of the first stage of the least squares model, shown in table 4.4, indicates which variables are significant predictors of state appropriations of public higher education. As the model indicates, personal income tax, Governor's political party, previous year state appropriations, state expenditures for K-12 and public assistance, and net tuition revenue are all statistically significant predictors of state appropriations for public higher education, controlling for all of the other variables. Therefore, these six variables are used as the standard instrumental variables in the DFEP model.

Table 4.4 An analysis of the relationship between gross state product per capita and state appropriations for public higher education among the 48 contiguous United States, first stage results of the Instrumental Variable Random-Effects model (2004-2013): all continuous variables are natural log transformed. Financial variables were transformed into 2009 dollars.

Instrumental Variable Name	Model 5
Constant	2.369 (1.468)
Personal income tax per capita	0.176*** (0.044)
Unemployment rate	-0.058 (0.041)
Governor's political party	-0.025* (0.010)
Republican majority in the state legislature	0.008 (0.014)
Previous year state appropriations for public higher education per capita	0.073** (0.024)
K12 education per capita	0.156** (0.053)
Medicaid per capita	0.070 (0.059)
Public assistance per capita	-0.020* (0.010)
Corrections per capita	0.043 (0.045)
Public enrollment	0.156 (0.097)
Net tuition revenue per FTE	-0.351*** (0.077)
Observations	414
Time fixed effects	Yes
Chi-Square Statistic	2013***

Note: \*p<0.05; \*\*p<0.01; \*\*\*p<0.001; standard errors in parenthesis

Table 4.5 contains the results of the DFEP model. Model six and model seven differ in that in addition to the unemployment rate (beta = -0.212, p<.05), state expenditures for public assistance (beta=.040, p<.05) has a statistically significant relationship with gross state product per capita. These findings indicate that for every

one percentage point increase in unemployment that there would be a .2% decrease in gross state product per capita and that a 10% increase in state funded public assistance would be associated with a .4% increase in gross state product per capita. The results of model seven also indicate that the following variables have no statistically significant relationship with gross state product per capita, when controlling for all of the other variables in the model: state appropriations for public higher education per capita (beta=-.054, p=.732), personal income tax per capita (beta=-.095, p=.177), sales tax per capita (beta= -.075, p=.429), corporate tax per capita (beta = .010, p=.868), and the labor force participation rate (beta = .055, p=.917). Furthermore, the Governor's political party (beta = -.018, p=.368), having a Republican majority in the state legislature (beta= .038, p=.426), the agricultural industry gross state product per capita (beta = .023, p=.717), and the manufacturing industry gross state product per capita (beta= .122, p=.546), were all insignificant. Other insignificant variables include previous year state appropriations for public higher education per capita (beta= .011, p=.873), spatially weighted state appropriations for public higher education ( beta= .000, p= .970), state expenditures on K-12 education (beta = .013, p= .863), Medicaid (beta = .086, p = .615), and corrections (beta = -.015, p= .872). Finally, the proportion of students enrolled in public higher education ( beta = .011, p= .962), net tuition revenue ( beta = .026, p=.823), and the shift in Colorado funding policies ( beta = - .007, p= .989) were all insignificant. Model eight differs from models six and seven in that all of the independent variables were lagged five years, however there were no statistically significant relationships between any of the independent variables and gross state product per capita.

The lack of statistically significant relationships in the DFEP model can be attributed to the model's use of instrumental variables and GMM techniques. As indicated in chapter three, these techniques control for the endogeneity of state funding for higher education, and serial correlation in the residual error terms. In the same manner that statistically significant relationships that existed in the pooled OLS model became insignificant when the random effects model was used, there were statistically significant relationships in the random effects model that became insignificant when the dynamic fixed effects model was used. In sum, by controlling for unobserved heterogeneity, endogeneity, serial correlation, the small time period, large number of observations, and heteroscedasticity among the error terms the significance of predictor variables diminished.

The Hansen J and the Arellano-Bond post estimation tests were employed to test the overidentifying assumptions and validate the instruments used in the DFEP model. More specifically, the Hansen J test statistic examines whether or not the instruments used in the model are correlated with the error term, and the Arellano-Bond examines whether or not there is serial correlation in the error terms when utilizing lagged values of variables as instruments (Arellano & Bond, 1991). The null hypothesis in the Hansen J test is that the instruments utilized in the model are not correlated with the error term, therefore a statistically significant test statistic would indicate that the instruments are correlated with the error term, thereby rendering them invalid. The null hypothesis in the Arellano-Bond test is that there is no serial correlation in the error term when utilizing lagged variables as instruments. As shown in table 4.5 the test statistics indicated by the Hansen J across models six, seven, and eight ( $X^2 = 1.61, p = .899$ ) ( $X^2 = 4.29, p = .993$ ) (

$X^2 = 4.74$ ,  $p = .449$ ) confirms that the instruments utilized in this study were valid and uncorrelated with the error. Furthermore, the Arellano-Bond test statistic (AR2) indicates that there is no serial correlation among the residual errors across all three models ( $z = -.55$ ;  $p = .581$ ) ( $z = .04$ ,  $p = .965$ ) ( $z = -.27$ ,  $p = .790$ )

Table 4.5 An analysis of the relationship between gross state product per capita and state appropriations for public higher education among the 48 contiguous United States, utilizing a Dynamic Fixed Effects Panel model (2004-2013): all continuous variables are natural log transformed. Financial variables were transformed into 2009 dollars.

Variable Name	Model 6	Model 7	Model 8
Constant	Omitted	8.805 (2.826)	6.288 (5.330)
State appropriations for public higher education per capita	-0.054 (0.124)	-0.054 (0.157)	0.067 (0.065)
Personal income tax per capita	0.081 (0.074)	0.095 (0.069)	0.049 (0.064)
Sales tax per capita	-0.023 (0.219)	-0.075 (0.094)	-0.215 (0.132)
Corporate tax per capita	-0.013 (0.079)	0.010 (0.058)	0.080 (0.054)
Labor force participation rate	0.391 (0.946)	0.055 (0.521)	0.989 (1.313)
Unemployment rate	-0.274* (0.132)	-0.212* (0.102)	-0.012 (0.108)
Governor's political party	-0.020 (0.016)	-0.018 (0.020)	0.033 (0.058)
Republican majority in the state legislature	0.040 (0.052)	0.038 (0.047)	-0.090 (0.102)
Agricultural GSP per capita	-0.029 (0.111)	0.023 (0.063)	0.066 (0.083)
Manufacturing GSP per capita	-0.006 (0.348)	0.122 (0.200)	0.004 (0.127)
Previous year state appropriations for public higher education per capita	0.009 (0.057)	0.011 (0.068)	0.005 (0.155)
Spatial lag, state appropriations for public higher education	n/a	(0.000)	n/a
	n/a	0.0127131	n/a
K12 education per capita	0.027 (0.073)	0.013 (0.077)	-0.022 (0.156)
Medicaid per capita	-0.040 (0.317)	0.086 (0.169)	-0.129 (0.150)
Public assistance per capita	0.039 (0.019)	0.040* (0.018)	0.039 (0.055)
Corrections per capita	0.030 (0.310)	(0.015) (0.096)	0.024 (0.217)
Public enrollment	0.068 (0.316)	0.011 (0.223)	-0.275 (0.344)
Net tuition revenue per FTE	0.010 (0.156)	0.026 (0.115)	0.112 (0.115)
Colorado	-0.124 (0.405)	-0.007 (0.535)	0.000 Omitted
Observations	414	414	205
Number of states	42	42	41
Number of instruments	36	46	36
Time fixed effects	Yes	Yes	Yes
F-Statistic	43919.57***	109.92***	6.50***
Hansen J Statistic	1.61	4.29	4.74
Arellano-Bond (AR2) statistic	-0.55	0.04	-0.27

Note: \*p<0.05; \*\*p<0.01; \*\*\*p<0.001; standard errors in parenthesis

## Results: Research Question Two

Research question two examines the relationship between state economic performance and neighboring state appropriations for public higher education. As indicated in chapter three the first step in examining research question two is to conduct exploratory spatial data analysis (ESDA). The first step in ESDA is creating a spatial weight matrix that will determine which states are neighbors and which are not. This study incorporated the use of a nearest neighbor weights matrix which defined states within a certain distance as neighbors. After creating the spatial weight matrix, ESDA involves investigating global and local measures of spatial correlation among states with respect to the gross state product. A global Moran's I was used to measure spatial correlation across all of the states. A statistically significant global Moran's I statistic would indicate that spatial correlation would exist across the states in the entire sample.

Table 4.6 shows the results of the ESDA, which indicates that gross state product per capita was globally spatially autocorrelated, but only to the first neighbor in both 2004 and 2013. This indicates that the null hypothesis that gross state product was not correlated across units of observation (States) was rejected at one nearest neighbor. Based on the nearest neighbor  $k=1$  for 2004 ( $I= 0.180, p<.01$ ) and 2013 ( $I= 0.180, p<.01$ ) spatial weight matrices the Moran I was statistically significant and remained consistent from 2004 to 2013. However, the Moran's I statistics for  $k=2$  ( $I = .059, p=.076$ ) was not statistically significant for 2004 and 2013.

Similarly based on nearest neighbor  $k=1$  for 2004 ( $I=.111, p < .05$ ) and 2013 ( $I=.111, p<.05$ ) the Moran's I for state appropriations for public higher education was statistically significant indicating spatial autocorrelation. However, the Moran's I

statistic for  $k=2$  ( $I= .032$ ,  $p=.203$ ) was not statistically significant for 2004 and 2013 for state appropriations for public higher education.

The Moran's I ranges from negative one (perfect dispersion) to a positive one (perfect correlation), with a zero value indicating no spatial autocorrelation (Mitchell, 2013). Therefore, the Moran's I statistics of .180 for gross state product per capita and .111 for state appropriations for public higher education per capita indicate a weak but positive global spatial autocorrelation at the one nearest neighbor level.

Table 4.6 Moran Index (I) of global spatial autocorrelation of gross state product per capita, 2004 & 2013		
	2004	2013
One nearest neighbor (k=1)	.180**	.180**

\*  $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$

Table 4.7 Moran Index (I) of global spatial autocorrelation of state appropriations for public higher education per capita, 2004 & 2013		
	2004	2013
One nearest neighbor (k=1)	.111*	.111*

\*  $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$

The Moran I scatterplot also helps to visually depict the spatial relationships that exist across the sample. The northeast quadrant of the plot represents spatial associations where states are surrounded by similar neighbors with above average values. The

southwest quadrant indicates spatial associations where states are among neighbors with below average values. The northwest quadrant represents spatial associations where states are dissimilar among neighboring states, meaning they have values that are typically below average but are among states with above average values. Finally, the southeast quadrant represents spatial associations where states typically have above average values but are among states with below average values.

As Figure 4.1 indicates, in 2004 Rhode Island, Connecticut, and Delaware were all in the northeast quadrant indicating they were associated with similar states, and they stood out as having higher values for gross state product per capita. This is also depicted graphically in figure 4.2 as these states are all yellow indicating a “high-high” association with other states. Figure 4.1 also indicates that in 2004 Mississippi was in the southwest quadrant indicating it was associated with similar states that had lower values of gross state product and that Mississippi stood out among those states. This can also be seen in figure 4.2 as Mississippi is blue indicating a “low-low” association.

Figure 4.1 Moran I Scatter Plot, Gross State Product Per Capita 2004

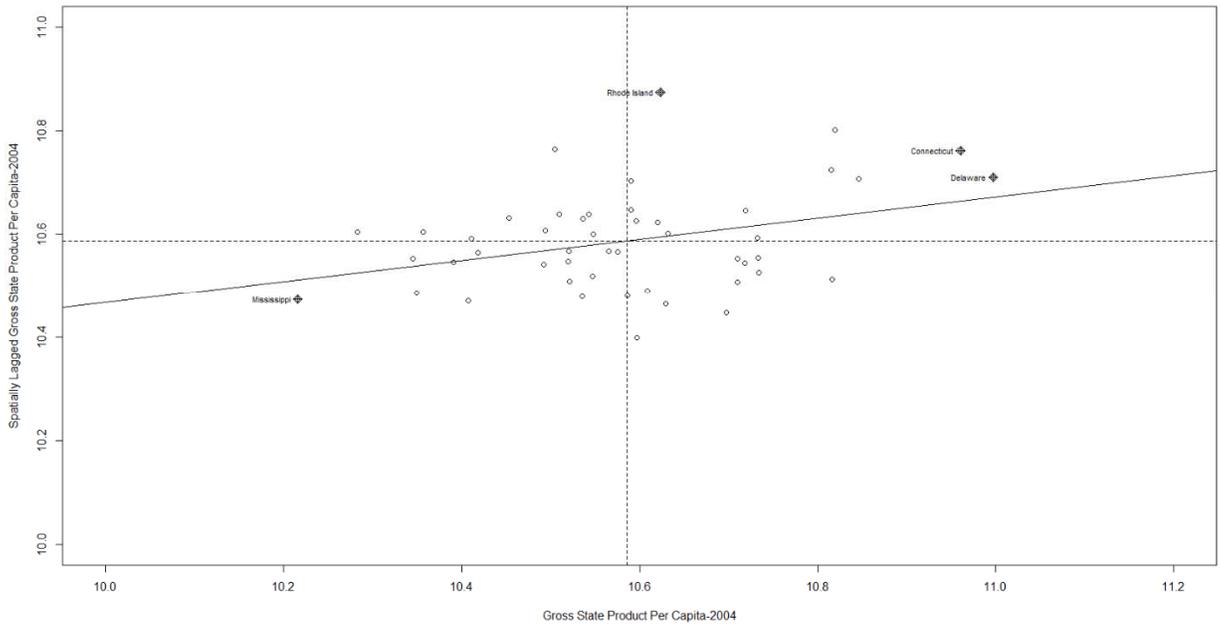


Figure 4.2 Local spatial autocorrelation, Gross State Product Per Capita 2004



Figure 4.3 differs from figure 4.1 in that Rhode Island now stands out in the northeast quadrant among those states that are similar and have “high-high” associations. Furthermore, Vermont also stands out in figure 4.3 in the northwest quadrant as having a low value among high neighbors. Mississippi’s relationship stayed the same among its neighbors in both 2004 and 2013. These relationships are all indicated in figure 4.4.

Figure 4.3 Moran I Scatter Plot, Gross State Product Per Capita 2013

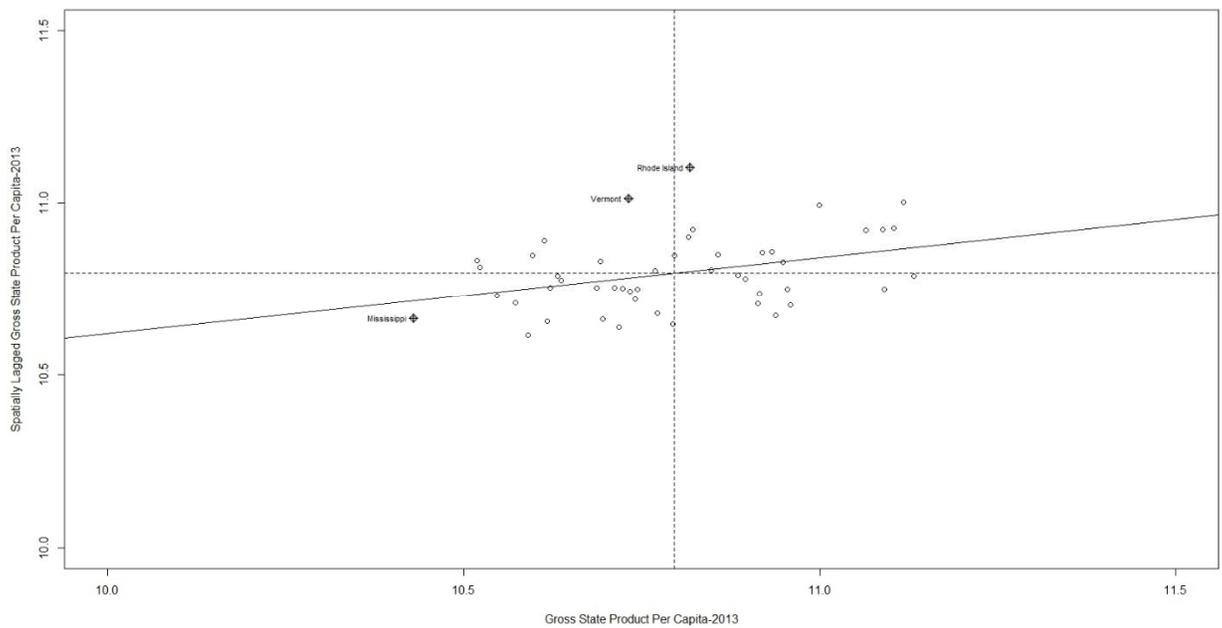
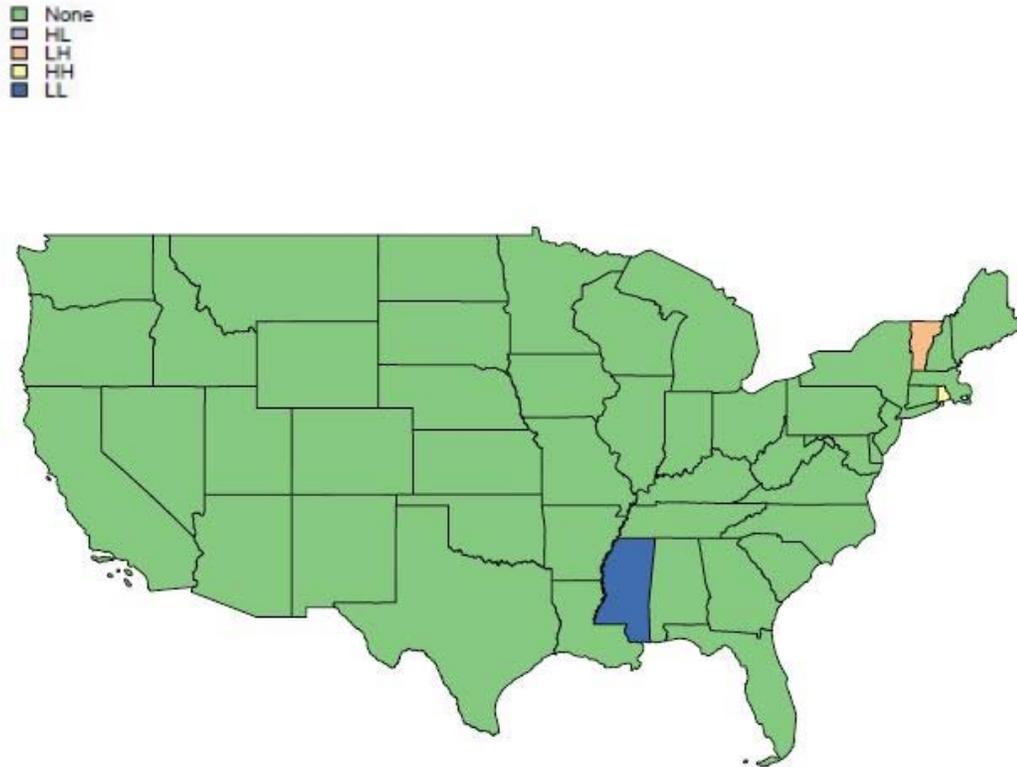


Figure 4.4 Local spatial autocorrelation, Gross State Product Per Capita 2013



As Figure 4.5 indicates, in 2004 Wyoming stands out in the northeast quadrant indicating that it stood out among states that had higher values of state appropriations for public higher education. This is also depicted graphically in figure 4.6 as Wyoming is yellow indicating a “high-high” association with other states. Figure 4.5 also indicates that in 2004 Pennsylvania, New Hampshire, Vermont, and Maine stood out in the southwest quadrant among neighbors that had lower values of state appropriations for public higher education. This can also be seen in figure 4.6 as these states were all blue indicating a “low-low” association. Both Colorado and New Mexico stood out as being dissimilar from their neighbors. Colorado stood out among states that had low values of

state appropriations for public higher education that were surrounded by states that had high values of state appropriations for public higher education. This is indicated in figure 4.6 by the orange “low-high” association. New Mexico was the opposite, it stood out among states that had high values of state appropriations for public higher education that were surrounded by states that had low values of state appropriations for public higher education. This is indicated in 4.6 by the purple “high-low” association.

Figure 4.5. Moran Scatter Plot, State Appropriations for Public Higher Education Per Capita, 2004

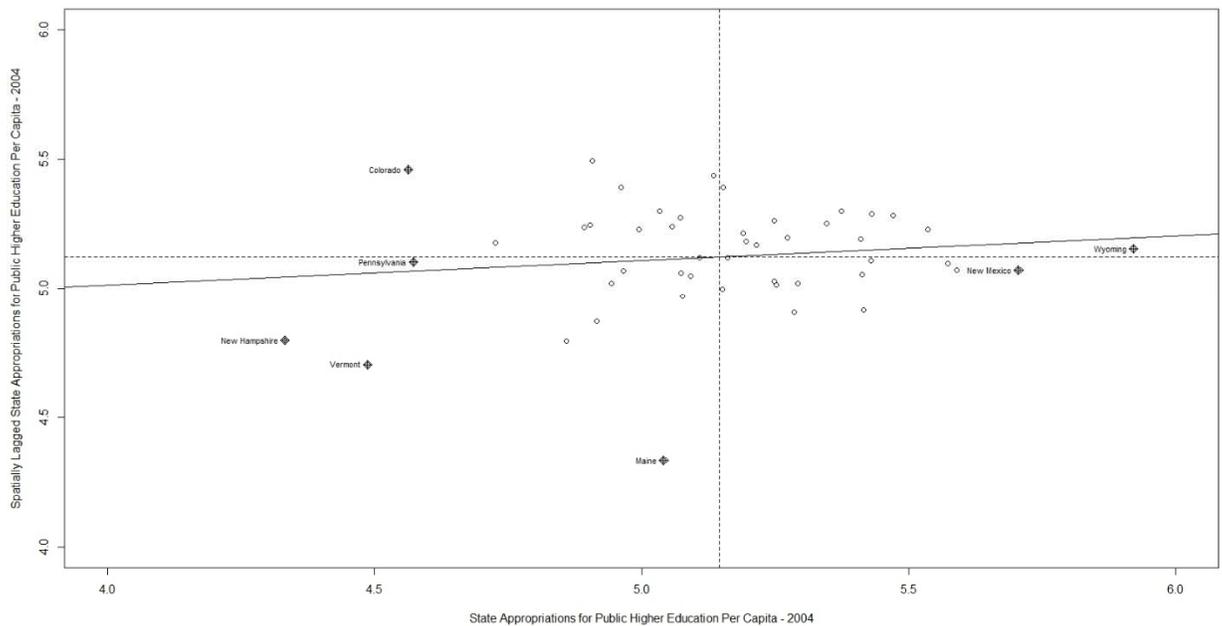


Figure 4.6. Local spatial autocorrelation, State Appropriations for Public Higher Education Per Capita, 2004

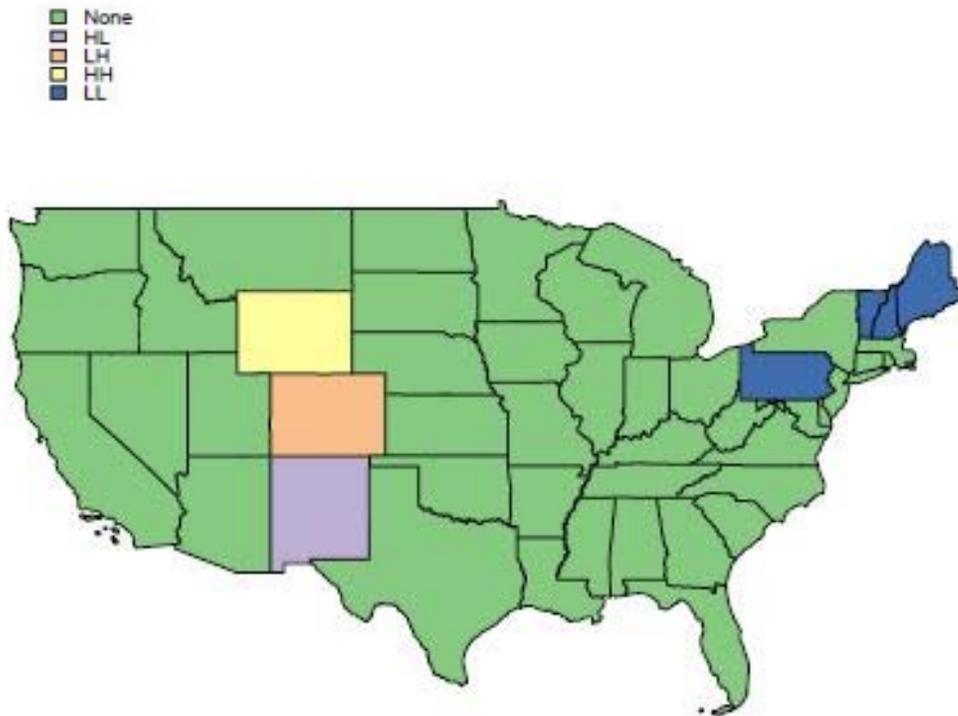


Figure 4.7 differs from figure 4.5 in that in 2013 there are no states that stand out among the states that have lower values of state appropriations for public higher education. However, Montana replaced Wyoming as standing out among those states that are similar and had higher values of state appropriations for public higher education. Kansas and Maine, replaced New Mexico as standing out among states that had high values of state appropriations for public higher education that were surrounded by states that had low values of state appropriations for public higher education. Finally, to a greater extent than what was evident in the 2004 graphs, Colorado stood out among states that had low values of state appropriations for public higher education that were surrounded by states that had high values of state appropriations for public higher

education. This shift for Colorado was most likely due to its change in higher education funding practices in 2005. These relationships are all indicated in figure 4.8.

Figure 4.7. Moran Scatterplot, State Appropriations for Public Higher Education Per Capita, 2013

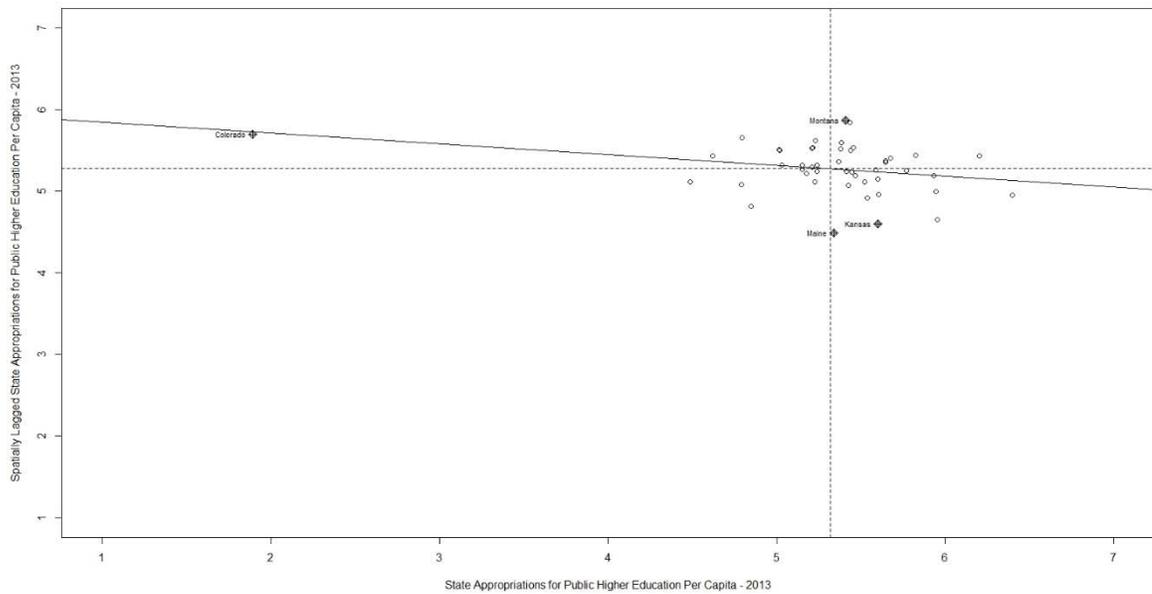
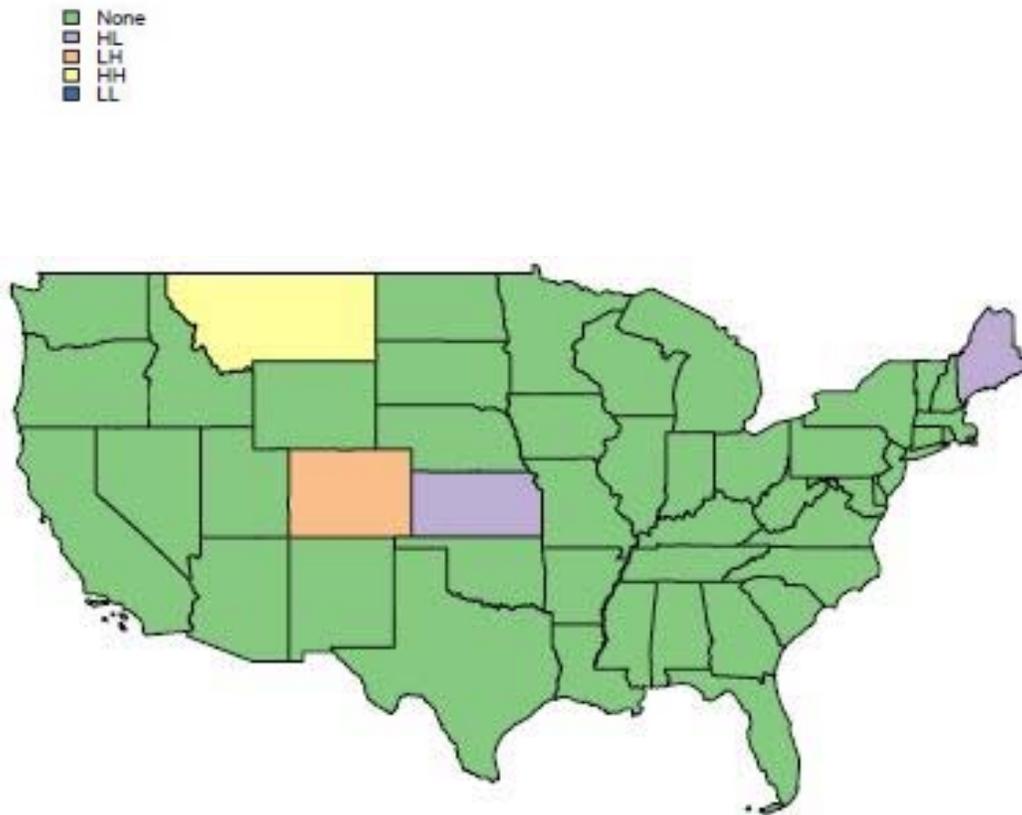


Figure 4.8 Local spatial autocorrelation, State Appropriations for Public Higher Education Per Capita, 2013



The results of the exploratory spatial data analysis (ESDA) show that there is spatial autocorrelation present in the data. Though very little, it would still warrant the investigation of whether or not spatially weighted state appropriations for public higher education was related to gross state product.

As indicated in tables 4.2, 4.3, and 4.6 above, spatially weighted state appropriations for public higher education had no statistically significant relationship with gross state product. This non-significant relationship was true across the pooled OLS, random effects, and dynamic fixed effects panel (DFEP) models.

### Limitations

As was discussed in chapter three, the validity of the DFEP model is reliant upon utilizing a balanced dataset and missing data could inhibit the analysis. Therefore educational attainment, and whether or not a state had a centralized governing board, were omitted due to missing data.

## CHAPTER FIVE

### DISCUSSION

#### Introduction

Utilizing a conceptual framework that combined the principal agent theory and endogenous growth theory, this study examined the relationship between state appropriations for public higher education and state economic performance. This concluding chapter is used to discuss the results and conclusions of this examination, especially with respect to the previous literature surrounding this topic, as well as contributions to the literature, implications for theory, research and policy, and recommendations for future research. The research questions for this study were as follows:

- 1.) Is a state's economic performance related to that state's appropriations for public higher education?
- 2.) Is the economic performance in neighboring states related to a state's appropriations for public higher education?

#### Discussion of results

The results of this study were shown in chapter four for three overarching models, a pooled OLS regression model, a random effects panel data model, and the dynamic fixed effects panel (DFEP) data model. The results of each of these models were displayed both without the spatially weighted variable for state appropriations for public higher education, and with the spatially weighted variable for state appropriations for public higher education.

The results of both pooled OLS models indicate that state appropriations for public higher education had a positive, statistically significant relationship with gross state product. However, the pooled OLS model that included the spatially weighted state appropriations variable, indicated that there was no statistically significant relationship between spatially weighted state appropriations for public higher education and gross state product.

The results of both random effects models indicate that there was no statistically significant relationship between state appropriations for public higher education and gross state product. However, the random effects model did indicate that there was a positive statistically significant relationship between previous year state appropriations for public higher education and gross state product. The random effects model also indicated that there was no statistically significant relationship between spatially weighted state appropriations for public higher education and gross state product.

Finally, the DFEP model indicated that there was no statistically significant relationship between state appropriations for public higher education, previous year state appropriations for public higher education, or spatially weighted state appropriations for public higher education with gross state product, controlling for all other variables in the model. As indicated in chapter three, the DFEP model addresses methodological issues of correlation and endogeneity in ways that the pooled OLS and random effects panel model do not (Arellano & Bond, 1991; Arellano & Bover, 1995; Curs, 2011; Titus, 2009).

Therefore, the following discussion will focus on the results of the DFEP model.

*State appropriations for public higher education*

The results of the DFEP model indicate that the relationship between state appropriations for public higher education and economic performance was insignificant. This finding is inconsistent with other literature (Baldwin & Borelli, 2008; Baldwin, Borelli, & New, 2011; Berry & Kaserman, 1993; Deskins, Hill, & Ulrich, 2010; Garcia-Mila, McGuire, 1992; Quan & Beck, 1987; Vedder, 2004), potentially due to differences in conceptual frameworks and methodology.

Overall, previous literature utilized economic theories only or no conceptual framework. In many ways previous literature (Curs et al. 2011, and Baldwin & Borelli, 2008; Baldwin, Borelli, & New, 2011; Berry & Kaserman, 1993; Curs et al., 2011; Deskins et al. 2010; Quan & Beck, 1987; Vedder, 2004) did not account for the control variables utilized in this study, possibly due to the limitations of their conceptual framework. Also previous literature e.g. (Vedder, 2004) utilized smaller sample sizes.

#### *Spatially weighted state appropriations for public higher education*

Spatially weighted state appropriations for public higher education were not statistically significantly related to gross state product. This finding is consistent with other literature that has examined this relationship (Deskins, Hill, & Ulrich, 2010).

#### *Governor's political party and Republican proportion of the state legislature*

As the results in chapter four indicate, the Governor's political party and the Republican proportion of the state legislature had no statistically significant relationship with gross state product. Unfortunately previous literature, such as those cited herein, that have explored this topic did not control for these variables. Future studies on this topic, should however, consider these variables as they have been found to be influencers in the

funding that is provided to public higher education (McClendon et al., 2009; Okunade, 2004; Tandberg, 2010; Weerts & Ronca, 2012).

*Personal, sales, and corporate tax revenue, labor force participation rate, and unemployment rate*

Tax revenue was not included in several of the previous examinations of this topic (Baldwin, Borelli, & New, 2011; Curs et al., 2011; Deskins et al., 2010) However, Berry and Kaserman (1993) and Baldwin and Borelli (2008) did include tax revenue. Berry and Kaserman (1993) found there to be a negative relationship between tax revenue and economic performance, and consistent with this study, Baldwin and Borelli (2008) found the relationship between tax revenue and economic performance to be insignificant.

This study found the relationship between labor force participation rate and gross state product to be insignificant. Other studies (Baldwin and Borelli, 2008; Baldwin, Borelli, & New, 2011; Curs et al., 2011; Deskins et al., 2010; Quan & Beck, 1987) did not control for the labor force participation rate, therefore there is no other study of this relationship to compare these findings with. Future studies should consider controlling for the labor rate.

The DFEP model presented in this study indicated a negative statistically significant relationship between the unemployment rate and gross state product. These findings, however, are inconsistent with Deskins et al. (2010) who found there to be no statistically significant relationship between the unemployment rate and gross state product. It is likely that differences in the methodology may explain this inconsistency. While both studies analyzed ten years of data, Deskins et al. (2010) did not utilize the

DFEP model, which accounts for the previously discussed endogeneity of state appropriations for public higher education.

*State funding for K-12, Medicaid, welfare and public service, corrections, public higher education enrollment, net tuition revenue*

The results presented in chapter four indicate that state appropriations for K-12 education and other state expenditures including Medicaid, public service and welfare, and corrections have no statistically significant relationship with gross state product. These results contradict previous studies (Baldwin, Borelli, & New, 2011; Curs, 2011) who found that state expenditures e.g. K-12 education had a positive statistically significant relationship with economic performance. These differences may be due to the methodological differences with respect to the averaged values of state expenditures and independent variables utilized by Curs et al. (2011) and Baldwin et al. (2011).

Prior research (Curs et al. 2011) found that the percentage of students enrolled in public higher education was statistically significantly related to economic performance. However, there were differences in methodology between this study and Curs et al. (2011). As previously stated, Curs et al. (2011) utilized different values for independent variables that may have resulted in the different findings.

*Agricultural and manufacturing industry output*

Contrary to previous literature (Berry and Kaserman, 1993; Curs, et. al., 2011; Deskins et al., 2010), the results of this study indicate no statistically significant relationship between the agricultural and manufacturing industries with gross state product. Berry and Kaserman (1993) and Curs et al., (2011) found the relationship to be positive while Deskins et al. (2010) indicate this relationship to be negative. Though

Deskins et al. (2010) utilized a panel data model, they did not account for endogeneity and serial correlation. Curs et al. (2011) found the agricultural and manufacturing industries to have a positive significant relationship with economic performance. This study contradicts those of Curs et al. (2011) because there was no statistically significant relationship between these industries and gross state product. One of the main differences is the timespan of the studies. For example, Curs et al. (2011) conducted a panel data analysis that covered between 1975 and 2005, while this study examined the time period between 2004 and 2013. The growth in these industries were different over the two different time periods. For example, the agricultural industry grew on average 4.3% during the period in the Curs (2011) study, while between 2004 and 2013 the agricultural industry grew 7.6%. The manufacturing industry grew 5.4% during the period in Curs (2011), while it only grew 2.9% during the time period covered in this study. (BEA, 2016)

#### Conclusions and contributions to the literature

The first major conclusion one can draw from this study is that the findings with respect to state appropriations for public higher education contradicts some of the previous literature. The results of this examination found the relationship between state appropriations for public higher education, previous year state appropriations for public higher education, and economic performance to be insignificant. Furthermore, there was no statistically significant relationship between spatially weighted state appropriations for higher education and state economic performance. This finding was consistent with Deskins et al. (2010) who also incorporated the use of a spatially weighted variable to examine any potential spillover effects of state appropriations for public higher

education. This study differs from Deskins et al. (2010), however, by including the results of exploratory spatial data analysis. As the results in chapter four indicate, spatial correlation exists with respect to gross state product and state appropriations for public higher education. Despite the results of the regression analysis, the exploratory spatial data analysis indicates that some level of spatial correlation does exist. These findings are critical as they not only provide explicit answers to the research questions, but more importantly have significant implications for future research and policy. These implications are discussed in greater detail in the sections that follow.

Another key conclusion from this study is that the conceptual framework in this study drew upon two disparate theories. This framework not only explained economic performance, but also the unique relationship by which state governments contract with institutions of higher education to provide education for the state's citizenry. The previous studies cited herein (Baldwin et al., 2011; Curs, et al., 2011; Deskins et al, 2010; Vedder, 2004; Quan & Beck, 1987) either did not indicate conceptual frameworks or primarily utilized economic theory e.g. the production function to provide a basis for their study. Therefore, several key variables were excluded. Studies that examine the relationship between state provided higher education funding and state economic performance must consider not only economic growth but also the principal-agent relationship. Utilizing both the endogenous growth theory and the principal agent theory facilitated an ability to incorporate key variables that would not only help to explain state economic performance but also the amount of funding that states provide to higher education.

In addition to broadening the conceptual frameworks utilized to examine the relationship between higher education funding and economic performance, the results of this study indicate that advanced statistical techniques need to be utilized to not overestimate this relationship. As indicated in the models presented in chapter four, not properly accounting for the endogenous nature of state appropriations and serial correlation could have deleterious effects on properly understanding this relationship. Furthermore, the DFEP model utilized in this study not only accounted for endogeneity and serial correlation but also for the small time period and heteroscedasticity via the use of GMM style instruments (Titus, 2009, Windmeijer, 2004). Though the DFEP model estimated via GMM techniques utilized in this study resulted in an insignificant relationship between state funding for higher education and economic performance it adds to the body of literature surrounding this topic by introducing a more advanced technique not previously utilized in the literature.

#### Implications for theory, research and policy

The results discussed in this chapter provide key implications for theory, research, and policy which are discussed in the sections that follow.

##### *Implications for theory*

As indicated in the conclusions, this study was guided using two disparate theories. Both theories were instrumental in guiding the selection of key variables that not only explained economic performance, but also the variables that influence the amount of funding that states provide to higher education. Because these two theories were instrumental in guiding the selection of the variables utilized to examine this relationship, they may also be helpful in examining other relationships between state funding and

economic performance. Researchers that seek to examine the relationship between state funding for K-12 education, Medicaid, police and corrections, etc. and state economic performance might also seek to employ these theories as a foundation for their examination. Furthermore, any other studies that include a principal agent relationship between two entities such as a state government and state organization and economic growth might find these theories helpful. Overall, the conceptual framework in this study provides an example of how theories from different disciplines can be used in a complimentary fashion to support the analysis of a relationship between two variables.

#### *Implications for research*

There are several implications for research that are evident as a result of this study. One implication, is that scholars must continuously consider the limitations in their research. Prior research on this topic was limited in that the methods utilized in previous studies did not control for several of the previously described factors e.g. endogeneity. However, as indicated in this examination, once these limitations were accounted for several key, significant relationships were no longer statistically significant. This finding in and of itself warrants further examination on this topic. It is unclear from the results in this study whether previous research which did not account for factors such as endogeneity and serial correlation were accurate and state appropriations are significantly related to gross state product, or if the DFEP model “wiped away” the significance in this relationship, thereby revealing a possible limitation of this study. Further examination of this topic might employ other latent variable models e.g. structural equation modeling that help to account for the unobserved heterogeneity in the units of observation (Byrne, 2006).

Another key implication for research is how the relationship between state funding for higher education and economic performance is defined. Though this study found the relationship between state appropriations for public higher education and gross state product to be insignificant there may be other ways of defining this relationship that is not captured in this study or in the previous literature. For example, the relationship could be defined in terms of the relationship between the state funding provided to those institutions with a Research I Carnegie classification and the development of new patents within a state. The relationship might also be defined as the relationship between the state funding provided to institutions of higher education and the number of jobs that are created at these institutions. Furthermore, the relationship could be defined as examining the relationships between state funding for higher education at community colleges and the state or local unemployment rate. Overall, it is important to note that there are multiple ways of examining this relationship and this study is inherently limited to examining just one way in which the relationship between state funding for higher education and economic performance is defined.

Given the findings of an insignificant relationship between state funding for public higher education and economic performance in this study, one might consider building upon this study to also include private investment. Over time there has been an increase in private investment in higher education (Hahn, 2007); as such, a limitation of this study is not considering the role that public investment may play in the relationship between state funding for higher education and state economic performance.

This examination also revealed an implication for research with respect to data. Two variables were excluded from this study due to the lack of data. These variables

include the state educational attainment rate and whether or not a state has a centralized governing board. Unfortunately, there was not enough data from year to year for each state to include these variables, therefore limiting the study. In addition, there is no known state level variable that captures the mobility of college educated employees. Having such data would provide another variable to gauge the “spillover effect” of educating the state citizenry. For better research in this area it would be beneficial for the Department of Labor, Census Bureau, or other establishment to begin capturing this information. One way to do so might be to build upon what the National Student Clearinghouse already does to track college students.

Another implication for research is for scholars to consider the spatial dimensions of their topic. One of the compelling implications in this study is that exploratory spatial data analysis revealed that spatial correlation exists with respect to economic performance and state appropriations for public higher education. If researchers posit that a spillover effect exist for one of their variables, this study provides an example of how such a hypothesis can be explored. By utilizing exploratory spatial data analysis one can examine the extent to which serial correlation exist not only across the entire analytic sample but also across neighbors in a more local sense. Once spatial correlation has been determined, a spatially weighted variable in a regression analysis will help determine if there is a statistically significant relationship and if a spillover effect does in fact exist.

Overall, more research is needed to truly ascertain the relationship between state appropriations for public higher education and state economic performance. Such research may be conducted utilizing different methods and analytic models but should be sure to account for the limitations of previous research. In addition, scholars should think

beyond the narrow relationship defined in this study and perhaps examine the relationship between funding for higher education and state economic performance in different ways, utilizing different variables. Furthermore, better data is needed to capture the mobility of labor, knowledge, and ideas. As higher education markets continue to be competitive, better metrics will be desired to understand the mobility of college educated employees and the knowledge and ideas that they carry with them. Finally, spatial relationships should be given more consideration in higher education research. As higher education continues to broaden its reach via satellite campuses and online learning there should be an increased understanding of how the research, instruction, and service of higher education institutions reach beyond their home state and region.

#### *Implications for policy*

Building upon the implications for theory and research there are also several implications for policy that should be considered. For example, the insignificant relationship between state funding for public higher education and state economic performance found in this study should serve as a catalyst for policymakers to support more research on this topic and not make policy decisions based on this study alone. Other research, such as the examples given in the previous section, could help broaden the understanding of the relationship between funding provided to higher education and economic performance. Such research could help provide more information that in conjunction with the study discussed herein, could provide a more comprehensive analysis that can be used to inform policymaking.

Additionally, the spatial correlation in state economic performance that was identified in this study is worth consideration. The implications of such spatial

correlation indicates that states legislatures may need to pay particular attention to the economic conditions of neighboring states and how such conditions may affect them. Consider for illustration, a state that aggressively targets unemployment by creating opportunities. Doing so may lure talent from other states. As such if employees from one state are migrating to a neighboring state for employment they are then helping to improve the economic condition of the receiving state rather than their home state (Martin & Sunley, 1998; Ehrenberg, 2004) Legislatures would do well to pay attention to what is happening in neighboring states particularly with respect to labor and unemployment and state policies that could have negative consequences on their own economy.

Another implication for policy is that of policy diffusion. The exploratory spatial data analysis discussed in chapter four indicates that state appropriations were spatially correlated with other states. Therefore, one can conclude that the funding that states provide for higher education may be influenced by or related to the amount of state appropriations for public higher education in neighboring states. For example, the state of New York recently announced that they are considering free tuition for students at public two and four-year institutions, dependent upon family income (McKinley, 2017; Zamudio-Suarez, 2017) The “spillover effect” of such a policy could ripple throughout neighboring states who may feel the pressure from their own constituency to offer a similar program.

Implications for institutional policy should also be considered as a result of this study. While this study focused on state funding, there are institutional policies such as admissions and selectivity that may have “spillover effects”. Though conducted on

Chinese institutions, a study by Gu (2012) indicates that admissions competitiveness can be correlated across neighboring institutions. As such, it would wise for institutional leaders to think strategically about the practices that are happening at neighboring institutions that could have an influence on their institution.

Overall, the spatial correlation found in state appropriations for public higher education and state economic performance supports the notion that "...near things are more related than distant things." (Tobler, 1970, p. 236). Because of this, legislatures and other leaders that create policies on a state and institutional level must be aware that there will always be a potential for the spillover effect of such policies onto neighboring entities. Furthermore, policies that are enacted by neighboring entities could potentially be related to the business of one's own state or institution so leaders must be vigilant.

#### Recommendations for future research

As indicated in the implications for theory and research this study added to the body of literature in several key ways. One of which was the use of a conceptual framework that was based upon two different theories. In the future, scholars may utilize a similar approach to understand other relationships. For example future studies could examine the relationship between state-funded corrections and safety programs and crime rates, or federally funded loan programs and college completion.

Future research might also be done on the topic explored throughout this study. As indicated previously, prior literature and this examination arrived at different conclusions with respect to the relationship between state higher education funding and state economic performance. Though this study accounted for several limitations of previous research it might be improved or redesigned in several ways. One of which

might be to examine the relationship over a longer period of time, thereby increasing the statistical power. Second, different variables might be used to capture the relationship between state funding for higher education and state economic performance. For example, one might consider using the unemployment rate as a measure of economic activity. Because unemployment rates are expected to be lower for those with higher levels of education (Ma, Pender, & Welch, 2016; Strauss, 2011) one might examine the relationship between state appropriations for public higher education and the state unemployment rate. Other dependent variables may include the development of patents, the number of jobs that are created at higher education institutions, degree completion at the two-year college level, the number of students who enroll in public higher education, or in overall state college enrollment. Furthermore, funding for public higher education might be defined as the funding provided to certain types of institutions e.g. community colleges, or Research I institutions.

The aspect of spatial dimensions examined in this study provides an argument that spatial effects need to be considered in higher education research. In many ways institutional, state, regional, and national policies may influence the direction of higher education. For example, institutional policies regarding selectivity in admissions could have an influence on other “neighboring” institutions; as the selectivity of one state institution increases, the more other institutions may see an increase in enrollment. State policies regarding financial aid could also have an influence on how neighboring states not only recruit but also support their students. For example, consider the effect of state aid policies such as the aforementioned policy regarding free tuition in the state of New York. Such a policy might have an influence on neighboring state enrollment, as

institutions in other states may depend on receiving students from the state of New York. Admissions and selectivity provides an area ripe for spatial considerations as admissions is driven by competition across institutions, states, regions, and for nationally competitive institutions, across the country.

Beyond state aid policies and admissions competitiveness higher education scholars should consider the inextricable link between research and development and knowledge creation and how these university outcomes are related to state economic performance. Colleges and universities are engines of knowledge creation (Hanushek, 2016) and as previously described in this study, states depend on these institutions for educating the citizenry, R&D, and service. Because the exploratory spatial data analysis in this study indicated that spatial correlation for state economic performance is present, future research might explore the relationship that institutional R&D might have with state economic performance and if a “spillover effect” exists. Future research must consider that knowledge flows beyond municipalities, and the resources in one area can have a positive effect on the growth of another area, provided these areas are within the same region (Andersson & Karlsson, 2007).

Overall this study provides a foundation for future research that should not only utilize advanced methods to address the limitations of previous research but also consider defining the relationship between state funding for higher education and economic performance in different ways. Moreover, the spatial considerations should become more prevalent in higher education research. As scholars, particularly in higher education, we must seriously consider the fact that the research and development, teaching, and service

occurring at our institutions is not contained to one particular state or region, and that these efforts can have a benefit beyond what we might imagine.

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