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The Impact of Public Educational Investments and Education Spillovers on the Economic Growth of States: Are State Educational Investments Affecting Earnings and Employment?

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The Impact of Public Educational Investments and Educational Spillovers on the Economic Growth of States: Are State Educational Investments Affecting Earnings and Employment?

DISSERTATION

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the College of Business and Economics at the University of Kentucky

By
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Lexington, Kentucky 2017

ABSTRACT OF DISSERTATION

The Impact of Public Educational Investments and Educational Spillovers on the Economic Growth of States: Are State Educational Investments Affecting Earnings and Employment?

The first chapter provides an introduction to my investigation of the impact of state-level educational investments in public K-12 education on future labor markets, specifically earnings and employment. In Chapter 2, the current literature supporting this investigation is examined while I offer a hole in the literature that I intend to fill. Then, in Chapter 3 I present a two-period, balanced-budget theoretical model in which I relate educational investments, mobility, and future earnings. This theoretical model is then implemented in Chapter 4 using state-level data and again in Chapter 5 using individual-level data.

Chapter 4 examines the impact of state-level educational investments in public education on aggregate state labor markets, specifically earnings and employment. Using data on K-12 educational spending, 8th grade cognitive test scores, and educational demographics of a state's labor force, I observe the impact these state-level investments have on employment and earnings growth. Taking interstate migration into account, I separate the benefits from educational investment into benefits due to in-state investment and benefits due to out-of-state investment. By doing so I am able to identify whether or not educational investment spillovers exist between states. Results indicate that the earnings benefits associated with public K-12 educational spending spill over into other states, 8th grade NAEP test scores do not spill over into other states, and neither has a significant impact on other states' employment growth.

Chapter 5 examines the impact of educational investments in public education on earnings of individuals. I extend my analysis from Chapter 4 by employing micro-data (on individuals) from the American Community Survey (ACS) instead of using state-level data. Using micro-data allows me to more accurately measure the investments used in the education of an area and to incorporate where education was attained and where it was employed. Using individual-level data also allows me to narrow my focus to younger participants in the labor force, providing a stronger link between lagged educational spending and earnings. Results indicate that K-12 educational spending does spill over in the form of positive earnings benefits, which helps to support the results of Chapter 4.

KEYWORDS: educational spending; educational investment; educational finance; public finance; spillovers

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Date: July 31, 2017

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To my parents, Ralph and Sue, to whom I am grateful for their undivided love and support.

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Chapter 1 Introduction

Historically, K-12 educational spending was largely funded by local governments.[1] However, in the 1970's state government contributions for education started to meet and in some years even surpass contributions of local governments for educational spending. In fact, in 2014, state governments funded approximately 46% of total educational spending, while local governments funded approximately 45%.[2]

As seen in Figure 1.1, K-12 educational spending per pupil has substantially increased since 1990. Although spending has persistently increased, spending across states varies dramatically. In 2014, current educational spending per pupil in the U.S. averaged $11,009, but that average covered a wide variation across states, ranging from $6,500 in Utah to $20,610 in New York.[3] Figure 1.2 below illustrates the wide range of educational spending values per pupil in 2014 for all states.

Part of this variation in spending across states is obviously due to differences in costs of living as well as how state economies responded to the recession–many states are still spending less on education than before the recession.[4] The variation in educational spending across states can also be attributed to political differences.[5] At the same time, states also choose if and how they target funds to districts with low-income families who are less able to raise funds through property taxes compared to their wealthier counterparts. Naturally, these differences across states lead to questions of how returns to education vary across states. That states now have more control over educational funding and curricula offers motivation to examine

[1]Source: Federal Education Budget Project (2014).

[2]Source: U.S. Census Bureau, 2014 Annual Survey of School System Finances.

[3]Source: U.S. Census Bureau, 2014 Annual Survey of School System Finances.

[4]December 2015: Center on Budget and Policy Priorities: 25 states funding K-12 education at sub-2008 levels.

[5]Source: The Center on Budget and Policy Priorities.

Figure 1.1: Real Educational Spending

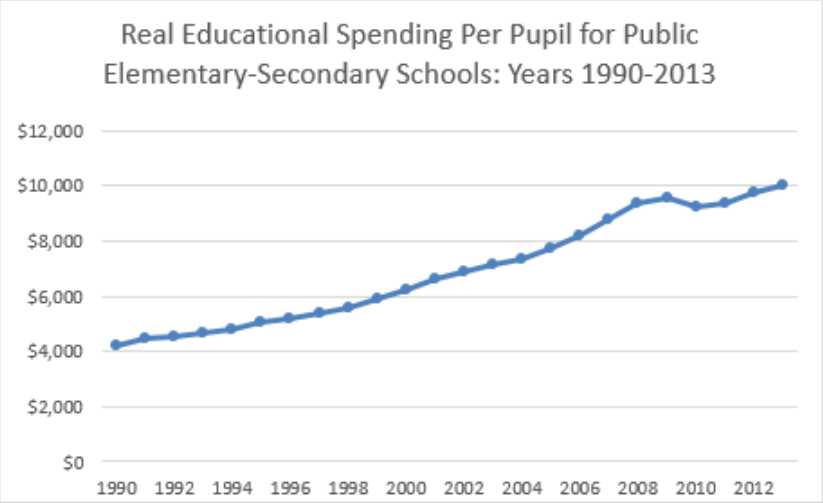
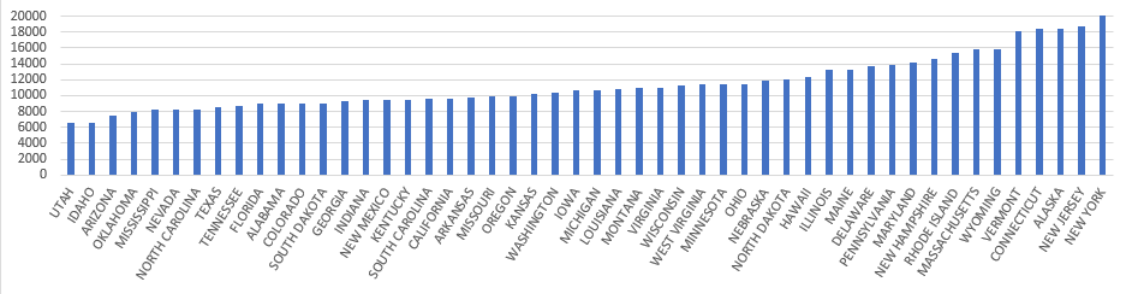


Figure 1.2: State Variation of 2014 Educational Spending



educational investments and their effects at the state level.

Educational funding and reform continue to be controversial. This being the case, determining the impact of educational spending spillovers as well as the potential benefits of educational spending, in terms of future earnings and employment growth, is an important task. Although the amount of government funds allocated to education does not necessarily measure the quality of that education or determine student

performance[6], knowing the relationship between funding and labor market outcomes could be useful when making future policy decisions.

A primary outcome of education for the individual receiving the education is their increased productivity. Figure 1.3 and Figure 1.4 below show employment rates and mean wages by educational attainment.[7]

In addition to the private returns an individual receives by having more education, individuals who are more educated benefit those around them. The individuals who receive education become skilled workers who tend to cause worker-to-worker spillovers that result in increases in other employees' productivity as well.[8] For example, Marshall (1890) and Lucas (1988) emphasize a model of human capital spillovers in which skilled workers generate positive externalities on others around them. These externalities occur because the workers learn from each other and the more skilled workers share their knowledge and skills; in this way, the interaction between individuals is the mechanism which causes the worker-to-worker spillover.

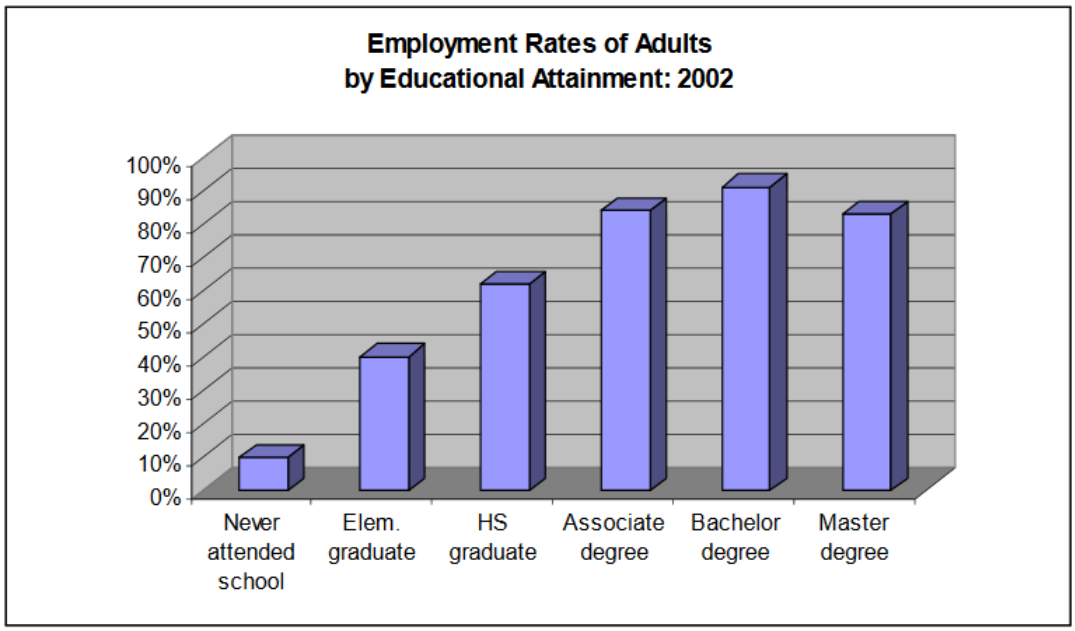
While education is provided and primarily funded at the state and local levels, extensive migration makes it likely that states that benefit from the education of their workforce are not the same as the states that fund this education. Better schools and better education not only lead to a more skilled labor force, but can also attract skilled laborers from other areas. Through labor migration, skills and knowledge acquired in one state cross state borders and are employed in another state. When this occurs, an educational investment spillover has taken place. The first state bears the cost of education, while the second state receives the future benefits, such as a more skilled labor force with increased tax revenues.

[6]Hanushek (1981) suggests that there is no relationship between expenditures and student achievement.

[7]Both figures come from "Does higher education really lead to higher employability and wages in the RMI?" by Ben Graham and Charles Paul.

[8]Gruber (2004); Lucas (1988); Moretti (2004); Marshall (1890) all contribute to these findings.

Figure 1.3: Employment Rates by Educational Attainment

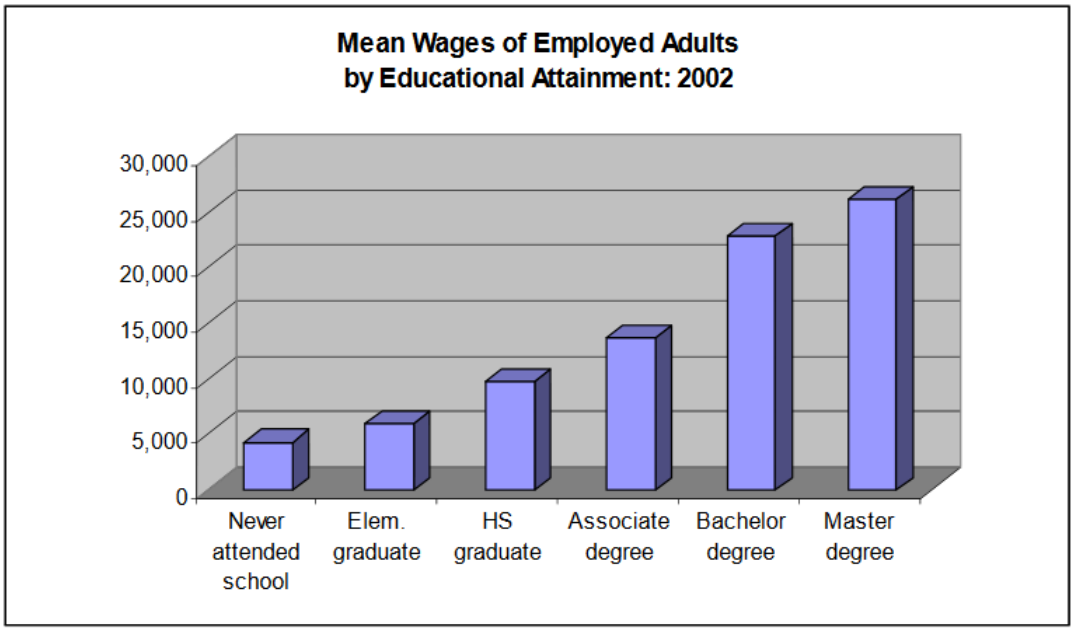


Educational investment also provides many non-monetary benefits to society. For example, Dee (2004), Glaeser and Saks (2006), and Milligan et al. (2004) find that increased education promotes civic activity and good governance. In addition, Deming (2011), Lochner (2011), and Lochner and Moretti (2004) show that increased education leads to lower crime rates. Futhermore, while Kenkel (1991), Lochner (2011), and Wheeler (2007) find that higher education can lead people to live in ways that contribute more to public health, Wolfe and Haveman (2002) identifies returns to education such as intrafamily productivity, marital choice efficiency, and health of children.

While there are numerous possible benefits associated with educational spending, in this investigation, I focus on the benefits to aggregate future earnings[9] and employment. More specifically, this dissertation evaluates the existence of educational

[9]Here, earnings refer to earnings per employed persons.

Figure 1.4: Mean Wages by Educational Attainment



investment spillovers on labor market outcomes across state borders. While there is an extensive literature examining the relationship between educational attainment for individuals and their labor market outcomes, there is much less evidence on how educational investment within a state affects future aggregate employment and earnings within that state, presumably a motivation for state-support of both K-12 and higher education. Examination at the aggregate state level allows for the inclusion of educational externalities affecting overall productivity (Moretti, 2004) and offers evidence about whether states appear to be providing education at levels consistent with maximizing future employment and earnings.

Past research including Berger and Fisher (2013), French and Fisher (2009), and Bauer et al. (2006) measure the private returns to education and have shown that higher educational attainment leads to higher median wages. By examining state-level data, Berger and Fisher (2013) report that by investing in education and therefore increasing the number of well-educated workers in a state, states can increase the

strength of their economies. French and Fisher (2009) also find that more educated individuals are more likely to participate and to succeed in the job market. Using state-level data for 1939-2004, Bauer et al. (2006) conclude that the main factors contributing to per capita income growth are a state's high school and college attainment rates as well as its stock of patents.

In addition, Moretti (2004) provides evidence to support the claim that more educated individuals increase the wages of less-educated individuals, proposing that educational externalities exist. Moretti concludes that a one percentage point increase in the supply of college graduates raises college graduates' wages by 0.4%, wages of high school graduates by 1.6%, and wages of high school drop-outs by 1.9%. It is important to investigate the returns to schooling at a broader, overall state level because returns to education extend passed just the individual returns; because there are external returns playing a part as well Moretti (2004).

In contrast to previous studies that use the level of educational attainment to measure the impacts of educational resources on individuals, I examine the impacts of both educational spending and educational achievement on state-level earnings and employment. In addition to examining the effects of different educational investments, I develop a simple theoretical model that allows me to estimate the relationship between state-level investments and future earnings. Determining the potential effect of educational investments on lifetime benefits can provide important policy implications as well as provide insights as to what factors impact future earnings and employment. For example, if educational funding is provided at an insufficient level, human capital is underinvested and as a result, economic growth and improvements in social welfare would be slower than they otherwise could be (McMahon, 1997).

The remainder of this dissertation is organized as follows. Chapter 2 provides a literature review and discusses the most relevant papers supporting my investigation, while Chapter 3 presents the model and its theoretical background. Then, in the

following two chapters, my theoretical analysis is extended into empirical estimations using aggregate, state-level data (Chapter 4) and individual-level, micro data (Chapter 5). Finally, Chapter 6 provides a conclusion for this dissertation. In Chapter 4, I use a variety of publicly available data sources to construct a 43-year panel from 1972-2014. This dataset includes variables such as income, expenditures, and K-12 education characteristics. My strategy involves disaggregating educational investments into four different measures weighted by migration, to more accurately measure the educational investments of each state. Doing this allows the benefits from educational investments to be identified as a result from one's own state investment or from another state's investment. Results of Chapter 4 suggest that educational investment spillovers do exist between states. In fact, at the mean, educational spending per pupil increases of $1,000 in one state imply a 0.12% increase in earnings growth in any other state. Overall, the results also indicate that the total lifetime net earnings associated with educational spending are less than the total cost.

In Chapter 5, I use data from the American Community Survey (ACS) from 2001-2014. This dataset includes similar K-12 education characteristics as well as individual's income, educational attainment, and other demographic characteristics. The main driving force behind the extension of Chapter 5 is that by using individual level data, I am able to narrow the focus of estimation on a younger generation of individuals to more strongly promote the connection between educational spending and future earnings. Again, integrating migration into estimation allows me to separate the effects of in-state educational investment and out-of-state educational investment. Results of this chapter support the results of Chapter 4 in that educational investment spillovers exist between states. At the mean, out-of-state educational spending per pupil increases of $1,000 imply a 0.20% increase in earnings within the state. Again, overall results show that the total lifetime net earnings from this educational spending are less than the total cost.

Through both of these detailed analyses, a more accurate estimation of the existence of educational investment spillovers across state borders is found. The findings of this dissertation suggest potential policy implications surrounding educational investment decisions as well as policies that could affect migration between states. From Chapter 4 and Chapter 5, results suggest that educational spending may be crowding out other potential investments that have a more prominent effect on future earnings. This suggests that society may benefit from a decrease in educational spending if this in turn increases other investments which largely and positively affect future earnings. In addition, as Chapter 5 further supports the results of Chapter 4, we see how large educational investment spillovers can be. The results of Chapter 5 also indicate that potential policies promoting entry into or exit out of the state could have major impacts on future earnings. Through both of these empirical estimations, when choosing an optimal level of educational spending, it is important to take into account the spillover effects of this spending due to labor migration as well as how this investment may be crowding out other private and public investments.

Chapter 2 Literature Review

While there exists a vast literature on the economics of education related to this study, I focus on three areas of particular relevance: the literatures on educational spillovers, returns to education, and efficiency and optimization in educational provision. By investing in individuals' education, as a society, we are not only promoting a better future for each individual, but also for society as a whole. Understanding these private returns as well as the public returns (or spillovers) to educational investments is an important first step to my investigation. Although investing in education is an essential task, it is also important to realize that it is harmful to largely over- or under-invest in education. Taking a look at the literature on the optimization of educational provision is the next step to my investigation. These three areas of literature are significant to my study not only because they provide background on the topic, but also because looking at them together reveals a hole in the literature that I intend to fill. This section helps to clarify my contribution to the literature.

2.1 Spillovers from Education

Because the literature focused on the evidence of spillovers from education is still young, there is a relatively small body of literature to examine. What is known, is the central idea that while many private returns from education exist, education also generates benefits beyond the individual. For example, Kenkel (1991), Lochner (2011), and Wheeler (2007) find that higher education can lead people to live in ways that contribute more to public health. In addition, increased education has been found to promote civic activity and good governance (Dee, 2004; Glaeser and Saks, 2006; Milligan et al., 2004), as well as lower crime rates (Deming, 2011; Lochner, 2011; Lochner and Moretti, 2004). Additional studies also indicate that increased education

can lead to higher productivity and wages for other workers (Moretti, 2004; Lucas, 1988).

At this point, a closer look at some of the studies that examine educational spillovers on wages across borders and across people is necessary. Case et al. (1993) expose channels in which educational expenditures can affect those across state borders using state-level data spanning 1970-1985. Although Case et al. mainly focus on expenditure reaction functions, the authors offer reasoning behind the existence of spillovers. Obviously those who receive education in one state and then move to another state to work, create one route for investments in education to cross state borders. In addition, well-educated workers in one state who received education there, increase competition with workers in other states through firm outputs.

Moretti (2004) investigates the social returns to higher education at the city level by comparing wages of similar individuals living in areas with different shares of college educated workers in the labor force. OLS estimates show a positive relationship between a city's share of college graduates and wages, but testing potential biases due to omitted variables is needed. Using data from the National Longitudinal Survey of Youths (NLSY) for 1979-1994 and the 1980, 1990 Census, Moretti shows that omitted individual and city-specific characteristics are not a major source of bias. Moretti concludes that as the supply of college graduates increases in a city, wages for high school dropouts, high school graduates, and college graduates increase. This finding indicates that there is a spillover of benefits occurring between more educated people and others around them. Moretti's work advances past research such as Lucas (1988) and Marshall (1890), that argue that positive externalities from education may be generated across workers through the sharing of knowledge and skills. In addition, Romer (1986, 1992) also acknowledge that externalities from education may exist when outputs from that education become public goods that spill over into the economy.

While many studies find that education externalities exist, Moretti (2004) notes that because the empirical literature is so young, there is little consensus on the size of the education externality. In addition, Lange and Topel (2006) review cross-country studies that use aggregate data and suggest that the evidence of educational externalities is inconclusive. The authors advise that empirical results do not always support the significance of productivity externalities from education. In fact, through their own spatial equilibrium model of local wage determination, they discuss a signaling model of education in which the spillover effect from education is actually negative. Through the investigations of this dissertation, I hope to fill the gaps within this literature and find more conclusive evidence about the existence and size of educational externalities.

2.2 Returns to Education

2.2.1 Monetary Returns - Earnings

There is an extensive literature that focuses on the returns to education at the individual level using micro-data. Card (1999) provides a summary of this literature on individual returns to education. Card shows that simple modeled papers such as Angrist and Krueger (1991) and Card (1995b) find 5% to 10% increases in yearly earnings for each additional year of schooling. Card (1999) also discusses the more intricate models in which the authors try to factor out characteristics that can be correlated with schooling; for example, ability. Such papers including Ashenfelter and Rouse (1998) and Arias and McMahon (2001) offer estimates for the educational returns to the individual using identical twins. Ashenfelter and Rouse (1998) use identical twins surveyed between 1991 and 1993 to measure the returns to schooling for the individual. They find that for the wage rates of twins, each additional year of schooling leads to an average return of 9% for genetically identical individuals. Using micro-data from 1967-1995, Arias and McMahon (2001) find slightly higher

average dynamic rates of return to total financial assets for college educated males and females of 11.7%.

2.2.2 Non-Monetary Returns

The returns to education literature also expands passed just the market returns to education. Although I do not measure any of these returns in this dissertation, it is very important to recognize that these benefits exist. For example, Wolfe and Haveman (2002) identify nonmarket returns to education such as intrafamily productivity, marital choice efficiency, and health of children. In addition, there are numerous publications that document that a child's level of education and cognitive ability is positively related to the education of the child's parents.[1] The education of adults in a neighborhood has also been shown to increase the likelihood of a child to graduate high school (Clark (1992), Duncan (1994), and Ginther et al. (2000)). Dye (1980), Hodgkinson and Weitzman (1988), and Freeman (1997) also show that increased schooling increases charitable giving of both time and money. Furthermore, Cutler and Lleras-Muney (2008) suggest that the relationship between increased education and higher life expectancy that they find, substantially raises the private returns to education.

2.2.3 State and Regional Returns

While there is an extensive literature examining the relationship between educational attainment for individuals and their private labor market outcomes, there is much less evidence on how educational spending within a state affects aggregate economic factors. After all, the estimates for private returns to education may in fact be underestimating the full returns to education if education exhibits characteristics

[1]There are too many papers offering this finding to list them all, but here are the most recent: Lam and Duryea (1999) and Duniform et al. (2001).

of a public good or generates positive externalities. For the investigation of Chapter 4, I focus on educational returns based on aggregate state measures.

Curs et al. (2011) investigates funding for higher education and how the level of privatization in this education system affects U.S. state economic growth. Using state-level data spanning from 1975-2005, the authors employ Arellano-Bond estimation techniques that offer empirical guidance. To account for the fact that education is an investment over many years, in their model, the authors use five year averages of past education expenditures to measure the effect of this spending on per-capita income growth. They find that states with large public shares of higher education experience a positive relationship between funding and per-capita income growth. In contrast, states with large shares of private higher education have a negative relationship between funding and economic growth. Although their work is mainly focused on higher education, the authors also find positive returns to K-12 education expenditures on per-capita income growth.

Important to my study is Hanushek et al. (2015). This paper examines how school quality is related to state income growth using newly-formed measures of human capital that focus on cognitive skills rather than years of schooling. Due to the high mobility of U.S. residents, migration rates are incorporated into their human capital measures that allow for a more accurate measure of the effects of educational achievement on incomes. By analyzing a range of feasible educational quality reforms, they discover significant state-level economic returns. Using various standard deviation increases in NAEP test scores of states, the authors find that these higher test scores of future workers in the state positively promote economic growth. In addition, because of the variation in test scores across states, states vary greatly in the benefits gained from the education quality reforms examined.

Futhermore, Hanushek et al. (2015) describes how policies of one state could have major implications for other states due to outmigration. If only one state chooses to

reform education, benefits to this state may be very low if the educated workers then move to another state and take their higher quality education with them. However, if all states reform in similar ways, then any educated worker who leaves the state in which they were educated, would potentially be replaced by another equally educated worker migrating from another state. The authors suggest that economic outcomes vary dramatically by state depending on that particular state's rate of outmigration. In essence, the states with high rates of outmigration would suffer the most and could subsequently lose the desire to invest more in education if they are not receiving much benefit. Because of this finding, it is much more beneficial for all states to reform education policies instead of just a few. Many states pushing for reform could motivate federal policy in the future.

While there is a vast literature examining the relationship between educational attainment for individuals and their labor market outcomes, there is much less evidence on how educational investments within a state affect future aggregate employment and earnings within that state as well as outside of that state, presumably due to the existence of educational investment spillovers. Through my work in Chapter 4 and Chapter 5, I am able to fill this gap within the literature by estimating the future benefits from educational investments through employment and earnings while accounting for migration.

As Hanushek et al. (2015) points out, much of the previous education literature does not provide a practical way of calculating the benefits from education and in fact can distort both calculations of cost and benefits. Following these authors' procedure, I implement a similar birthplace matrix to more accurately measure state education spending and student achievement. Through my investigation, I offer a more viable way to calculate these economic benefits by incorporating birthplace rates as well as present value discounting methods. By taking interstate migration into account, I separate and identify the educational investment benefits due to in-state investment

and benefits due to out-of-state investment.

2.3 Efficiency and Optimization in Educational Provision

The literature that examines the efficiency of public service provision offers baseline techniques that I adapt to form my educational spending models and interpretations. Examples of these studies include Brueckner (1979, 1982), Brueckner and Fansler (1983), and Barrow and Rouse (2004), which help to motivate my investigation of whether educational spending is set at a level which maximizes future earnings and employment. Brueckner (1979) develops a theoretical model and an estimating equation involving a government budget constraint that together allow for the inspection of whether a public good is provided efficiently. Brueckner uses property value determination along with a public good and property taxation of northeastern New Jersey communities for this study. Brueckner's theory supports the idea that efficient levels of public goods are those that maximize property values. Brueckner concludes that the communities in the study overprovide public goods and that a reduction in the provision of these public goods would lead to an increase in the communities' property values. Brueckner's approach rests upon the strong assumption that all of the communities were "identically efficient or inefficient in providing the public good". Brueckner argues that this assumption is justified by the fact that if communities were found to provide public goods inefficiently, all of the communities would be likely to provide the good inefficiently in the same direction, that is, either all communities would be overproviding the good or all communities underproviding the good, due to parallels in governmental structure and political processes.

Brueckner (1982) follows the same research agenda of examining the efficiency of public goods by using property value maximization for communities in Massachusetts. In this paper, aggregate property values in a community resemble an inverted U-shaped function of its public good output, which maximizes at the point in which

the output level reaches Pareto-efficiency. Because of the inverted U-shaped function and by applying the same assumption as in the 1979 paper that communities exhibit a common efficiency bias, Brueckner is again able to make efficiency interpretations simply based upon the sign of the coefficient associated with the public good. If the coefficient on the public good is positive, Brueckner interprets the public good as being underprovided, and if the coefficient is negative, then the public good is overprovided. Incorporating the same logic, if the aggregate property values in a community are unresponsive to marginal changes in the public goods provided, that is, if the coefficient is nearly zero, then this value indicates that the public good is being provided efficiently. When investigating the efficiency of community educational expenditures and non-education municipal expenditures in Massachusetts, Brueckner finds neither of the associated coefficients to be significantly different from zero. Under the assumption that a common efficiency bias exists, Brueckner suggests that these results indicate the communities are neither systematically over- nor underproviding the public goods.

In contrast to Brueckner (1979, 1982) and Brueckner and Fansler (1983), Barrow and Rouse (2004) examines school expenditure efficiency by investigating whether state aid for education maximizes property values. They find that school districts do not overspend on education and state funding is valued by residents. Like the previously discussed papers, if we assume that individuals choose where to live based on preferences for education (or other publicly provided goods), then property values should reflect the value of all benefits the individual associates with education investments. When publicly provided education investments increase and this provision of education is positively valued by residents, then the property values would increase, and vice versa. Allowing for mobility permits the property values to capture all of the perceived benefits from education. In this dissertation, I examine the relationship between education expenditures (a public good) and earnings. While I investigate the

potential of education investment to maximize future earnings (similar to maximizing property values), it is important to make the distinction that I am only looking to measure the earnings benefits from education rather than all benefits from education, as the previous authors have done.

2.4 Extensions to the Literature

This dissertation builds upon and adds many dimensions to the existing education literature. Combining the three areas of research discussed above reveals a hole in the literature that my dissertation can fill. For example, the current literature addressing spillovers from education is rather young and does not have strong, conclusive evidence about the existence or magnitude of educational investment spillovers. Through my empirical work of Chapter 4 and Chapter 5, I hope to provide a different perspective on the evidence for spillovers from education. In addition, much of the education literature focuses on individual-level returns. Chapter 4 of this dissertation, however, focuses on the aggregate state-level returns to educational investment. Furthermore, one of the largest contributions of my dissertation is the modeling and calculation of the impacts of educational investment. By integrating interstate migration into my estimation, I am able to separate the effects from in-state educational investments and from out-of-state educational investments, thereby identifying the spillovers from investments in education.

Chapter 3 A Model of Intertemporal Educational Spillovers

To study the implications of education, analyzing its effect on earnings and employment through a theoretical model is necessary. To determine the relationship between education and labor market outcomes, I follow Harden and Hoyt (2003) examination of how balanced-budget changes in the tax structure affect labor markets allowing for firm and labor mobility. In this model, integrating migration across state borders is a vital step as I estimate educational investment spillovers. For without introducing the concept of migration between states into this model, estimation of educational spillovers across borders would not be possible.

3.1 Maximizing Net Earnings

Here, I develop a theoretical model in which education investments are associated with future earnings and employment benefits. More specifically, this model establishes the relationship between education spending and earnings such that education is chosen to maximize future aggregate earnings net of educational expenditures (net earnings). As discussed in Chapter 2, there are numerous benefits associated with investments in education, both monetary and non-monetary. To keep my model simple, I do not account for every benefit from education. If I were to include all benefits, the goal of my model would be to choose the level of education investment that maximizes net benefits from education. In this sense, the net benefits from education would include all benefits and all costs associated with education. While this would provide a great perspective on the cost and benefits of education, many of these aspects do not hold a numerical value. Because of this, including all of the benefits from education in my model would be very difficult. Therefore, it is important to keep in mind that I am only focusing on earnings and employment benefits in this dissertation, so my

results are in terms of net earnings (NE), rather than net benefits (NB). As you will see in the model below, I only include earnings benefits (in the form of wages) as a future benefit from education investment.

I model the government's problem of maximizing future social welfare (net earnings), of its constituents by choosing current education and taxes. Consider a simple two-period model in a balanced-budget framework. First, the level of education in a state is chosen to maximize the net income of the current generation (t=0) and the discounted income of their children, $-E_0^A$. This term represents the loss in wages due to taxes because of the balanced-budget framework ($E_0^A = T_0^A$). No wages are shown for time t=0 as these wages are already determined and have no effect on this model.

Then, let there be two states, A and B. State A is only concerned about the wages of those working in state A: (w^A). Because of migration, however, the wages in state A not only depend on those educated in state A, but also on those educated in state B and the mix of workers from both states. In equation form: $w^A = \frac{L_1^{BA}}{L_1^{AA}} w^{AA} + \frac{L_1^{AA}}{L_1^{AA}} w^{BA}$ where w^{AA} is the wage of workers in state A educated in state A, w^{BA} is the wage of workers in state A educated in state B, and the fractions containing L act as weights for migration. Taking one step further, w^{AA} is a function of the education of state A and of state B as: $w_1^{AA}(E_0^A, E_0^B \times \frac{L_1^{BA}}{L_1^{AA}})$ where $\frac{L_1^{BA}}{L_1^{AA}}$ weights E_0^B for migration of those from state B to state A. Given this, the second term of the w^{AA} function accounts for spillovers between states.

Then, putting these concepts together, the problem in state A at time 0 is:

$$\max_{E_0^A} NE^A = -E_0^A N^A + \beta \left[L_1^{AA} w_1^{AA} \left(E_0^A, E_0^B \times \frac{L_1^{BA}}{L_1^{AA}} \right) + L_1^{BA} w_1^{BA} \left(E_0^B, E_0^A \times \frac{L_1^{AA}}{L_1^{BA}} \right) \right] \tag{3.1}$$

where E_t^i is the level of educational expenditures per pupil in state i in year t, N^A is the number of students receiving education in state A, β is the discount rate, L_t^{ij} is the number of workers educated in state i working in state j at time t, w_1^{AA} is the

wage of workers educated in state A working in state A at time 1, and w_1^{BA} is the wage of workers educated in state B working in state A at time 1.[1]

The first order condition with respect to E_0^A is then:

$$-1 + \beta \left(\frac{L_1^{AA}}{N_A} \frac{\partial w_1^{AA}}{\partial E_0^A} + \frac{L_1^{BA}}{N_A} \frac{\partial w_1^{BA}}{\partial E_0^A} \times \frac{L_1^{AA}}{L_1^{BA}} \right) = 0 \tag{3.2}$$

Upon expanding the above equations to include those who were educated in state B, we have a social net earnings (SNE) function which includes education expenditures and earnings benefits for both states:

$$\begin{aligned} \max_{E_0^A} SNE = & \left[-E_0^A N^A + \beta \left[L_1^{AA} w_1^{AA} \left(E_0^A, E_0^B \times \frac{L_1^{BA}}{L_1^{AA}} \right) + L_1^{BA} w_1^{BA} \left(E_0^B, E_0^A \times \frac{L_1^{AA}}{L_1^{BA}} \right) \right] \right] \\ & + \left[-E_0^B N^B + \beta \left[L_1^{BB} w_1^{BB} \left(E_0^B, E_0^A \times \frac{L_1^{AB}}{L_1^{BB}} \right) + L_1^{AB} w_1^{AB} \left(E_0^A, E_0^B \times \frac{L_1^{BB}}{L_1^{AB}} \right) \right] \right] \end{aligned} \tag{3.3}$$

Then, the socially optimal investment in education satisfies the condition:

$$-1 + \beta \left(\underbrace{\frac{L_1^{AA}}{N_A} \frac{\partial w_1^{AA}}{\partial E_0^A}}_{(a)} + \underbrace{\frac{L_1^{BA}}{N_A} \frac{\partial w_1^{BA}}{\partial E_0^A} \times \frac{L_1^{AA}}{L_1^{BA}}}_{(b)} + \underbrace{\frac{L_1^{BB}}{N_B} \frac{\partial w_1^{BB}}{\partial E_0^B}}_{(c)} + \underbrace{\frac{L_1^{AB}}{N_B} \frac{\partial w_1^{AB}}{\partial E_0^B} \times \frac{L_1^{BB}}{L_1^{AB}}}_{(d)} \right) = 0 \tag{3.4}$$

where the residents in state A ignore any impact that education of their children have on the wages earned by those working in either state A or B who, as children, received their education in state B. This relationship can be seen through the fact that terms (a) and (b) of the above equation are independent of terms (c) and (d). Examining Equations (3.2) and (3.4), we see that state A is only concerned about state A's net earnings and not the social net earnings. Also, the expenditures and number of students of state B do not have an affect on state A's net earnings. Terms (a) and

[1] Additional information of the model setup can be found in Appendix A.

(b) of Equation (3.4) zero out given the relationship of Equation (3.2). This leaves only terms (c) and (d) of the social net earnings function and these terms are what I consider the externality (or marginal external benefit) occurring from educational investment:

$$MEB = \left(\frac{L_1^{BB}}{N_B} \frac{\partial w_1^{BB}}{\partial E_0^B} + \frac{L_1^{AB}}{N_B} \frac{\partial w_1^{AB}}{\partial E_0^B} \times \frac{L_1^{BB}}{L_1^{AB}} \right) \tag{3.5}$$

Finally, the impact of education in one state on labor earnings is estimated by:

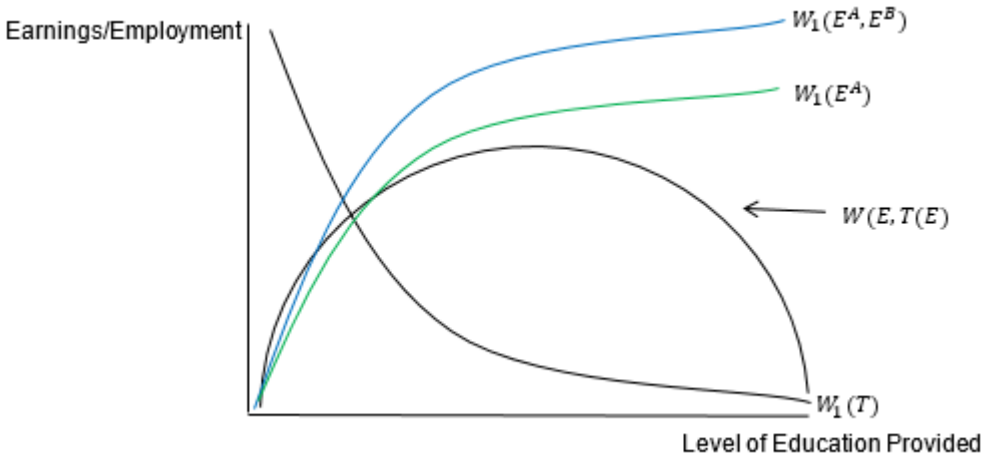
$$\frac{L_1^{AA}}{N^A} \frac{\partial w_1^{AA}}{\partial E_0^A} + \frac{L_1^{BA}}{N^A} \frac{\partial w_1^{BA}}{\partial E_0^A} \times \frac{L_1^{AA}}{L_1^{BA}} \tag{3.6}$$

where only earnings of those working in the state matter. Now, the equation for the relationship between wages, birthplace, and education has been derived. From this equation, I can separate the benefits due to in-state investment as well as out-of-state investment and identify the spillover from educational investments. Below, I illustrate this theoretical model and explain how I will use this model in conjunction with my empirical model to estimate the returns to education in a state.

Using this framework, I estimate the lifetime earnings returns of these educational investments. Using Brueckner (1982) as a guide, if the effect from education on earnings and employment is positive, the government could be underproviding education in respect to future earnings and employment. In Figure 3.1 below, I illustrate the relationship between educational spending and earnings, assuming diminishing returns to education. Also illustrated, when a positive coefficient is estimated, we think of the level of education provided by the government as being in the positively sloped area of the quadratic function. Adapting the work of Brueckner, being in this area would indicate that the level of education is below the maximizing level of education because this coefficient represents the partial derivative, or slope, of this relationship. Using the same logic, if the effect is a negative value, the government could be overproviding

education in respect to future earnings and employment. Last, if the coefficient is approximately zero, the government may be choosing a level of education in which earnings benefits are equal to the cost. In the figure below, the downward sloping wage function, $W_1(T)$, represents how wages decrease to offset an increase in taxes or how employment would decrease with an increase in taxes, as education is held constant. The two wage functions which are upward sloping show how education has diminishing marginal returns. The lower upward sloping curve, $W_1(E^A)$, represents how the wages or employment of state A respond to the education provided by state A. The other upward sloping curve, $W_1(E^A, E^B)$, illustrates state A's earnings or employment levels of the current labor force who were educated in state A or educated in state B. Then, at the point where the quadratic function is maximized, the slopes of the two wage functions are opposite in sign, but equal in magnitude, as shown by Figure 3.1 below. The summation of these two slopes equal zero, as formulated by the theoretical modeling of Equation (3.2).

Figure 3.1: Educational Returns



My predictions of this model are that the sign associated with educational spending is positive, indicating that there is an underprovision of educational investment in

terms of maximizing future earnings and employment. In addition, I predict that the future lifetime earnings returns to these educational investments will outweigh the total costs of education. After all, we invest in education in order to promote future success and if this success is less than the cost of investing, why would we invest in the first place.

Chapter 4 Educational Investment On Earnings and Employment: State-level Analysis

In this chapter, the impacts on labor market outcomes associated with state-level educational investments are examined through aggregate future earnings[1] and employment. This chapter, specifically, evaluates the existence of educational investment spillovers on labor market outcomes across state borders. While education is provided and primarily funded at the state and local levels, extensive migration makes it likely that states that benefit from the education of their workforce are not the same as the states that fund this education. Examination at the aggregate state level allows for the inclusion of educational externalities affecting overall productivity (Moretti, 2004) and offers evidence about whether states appear to be providing education at levels consistent with maximizing future employment and earnings. My strategy involves disaggregating educational investments into four different measures weighted by migration, to more accurately measure the educational investments of each state. Doing this allows the benefits from educational investments to be identified as a result from one's own state investment or from another state's investment.

My results suggest that educational investment spillovers do exist between states. In fact, results show that at the mean, educational spending per pupil increases of \$1,000 in one state imply a 0.12% increase in earnings growth in any other state. Overall, the results also indicate that the total lifetime benefits associated with educational spending are less than the total cost. One major takeaway from this chapter is that it is easy to see that educational investments of one state do impact future labor market outcomes of other states.

[1]In this paper, earnings refer to earnings per employed persons.

The theoretical model presented in Chapter 3 is estimated here by using a 43-year panel from 1972-2014 of state-level data including measures of education achievement (lagged 8th grade NAEP math test scores) and (lagged) educational spending to investigate the impact of education on the growth of earnings and employment in states. My empirical approach follows a first differenced dynamic panel data model and the results of this estimation provide a clearer view of the impact of education provided within a state on that state's economic performance as well as the economic performance across state borders. The high degree of interstate mobility of U.S. residents necessitates a measure to account for those in the state workforce who did not receive their education there. Using state of birth as a proxy for where K-12 education was received, I implement a birthplace-weighted matrix that allows educational investments to be more accurately measured.

My research differs from previous studies in various ways. The main focus of this chapter is to identify educational investment spillovers on labor market outcomes across state borders. To do this, I use public K-12 educational spending and 8th grade NAEP test scores as my educational investment measures and earnings growth and employment growth as my labor market outcomes. My data spans from 1972 to 2014, which is a longer and more recent timeframe for state-level data compared to other studies. Spillovers from investments in education are shown to exist and by using state-level data, I am able to account for school district spillovers as a whole. I am also able to capture and quantify the effect of spillovers across state lines. My research continues to differ from past studies in that not only am I examining the impact of educational investment on earnings and employment growth, but I am also using a balanced-budget framework which allows me to compare the total cost of education to the investments devoted to education and the resulting future lifetime earnings benefits.

The remainder of this chapter is organized as follows. Section 4.1 includes a

description of the state-level data and Section 4.2 explains my empirical methodology, while Section 4.3 discusses my results. Finally, Section 4.4 addresses caveats, discusses contributions, offers extensions for future work, and concludes.

4.1 Data

To examine the effects of education on employment and earnings, I employ a 43-year panel from 1972-2014 of state-level data for the 50 U.S. states.[2] This panel includes publicly available data from various sources measuring incomes, expenditures, and K-12 education characteristics. From the U.S. Bureau of Economic Analysis (BEA), I obtain my two primary variables of interest, annual earnings by place of work[3] and the annual employment level, as well as total annual state population.[4] Following Curs et al. (2011), I also collect other types of state and local government expenditures and industry shares of annual state GDP from the BEA. From the U.S. Census Bureau, I collect labor force demographics (gender, race, educational attainment). Public K-12 education data are obtained from the National Center for Education Statistics (NCES) and the Annual Digest of Education Statistics and include state and local current expenditures per pupil and total enrollment levels recorded at an annual frequency under the spring of the academic year.[5] Total current expenditures per pupil collected at the state level include all funds originating from the federal, state, and local governments. To accurately capture state-to-state spillovers in this analysis, I use only the state and local expenditures per student.[6] I

[2]The District of Columbia is omitted due to missing data. For all states, "neighbors" are not defined by state borders, but by migration of the population between states.

[3]Earnings are the sum of wages and salaries, supplements to wages and salaries, and proprietors' income.

[4]I then calculate growth rates for earnings and employment using: $(Y_t - Y_{t-1}/Y_{t-1})$

[5]For example, academic year 1980-1981 is recorded under the year 1981.

[6]Federal revenues are subtracted from the total current expenditures per pupil, so expenditures per pupil are only from state and local sources. Federal revenues are also collected from the NCES and Annual Digest of Education Statistics.

collect total higher educational funding and enrollment levels for public institutions from the Annual Digest of Education Statistics and use this total to calculate higher public education spending per student.[7] I also calculate the college enrollment rate by dividing the enrollment level by the state population. All data are adjusted for inflation and expressed in 2015 dollars. Summary statistics of data values are shown in Table A.1 in the Appendix.

Because of the high degree of mobility of U.S residents among states, migration rates must be accounted for when measuring educational investments. For example, the workforce in the state of Kentucky is not only made up of individuals educated there, but also those educated in any other state who then migrated to Kentucky. For this reason, I use place of birth as a proxy to measure where a state resident received their elementary and secondary education.[8] Following the Hanushek et al. (2015) weighted average migration matrix, I use a weighted average birthplace matrix to measure the appropriate amount of education invested in each state's current workforce. Using 1970 Census IPUMS, this state-by-state migration matrix contains birthplace totals for 1% of the 1970 population for each state.[9] Doing this for the entire U.S. allows me to more accurately weight the educational investment and educational achievement of each state. Figure 4.1 below depicts the percentage of the 1970 population who were born in their current state of residence. A full list of state percentages in 1970 as well as in 2010 can be found in Table A.2 in the Appendix. Table 4.1 below illustrates what part of the migration matrix that I incorporate looks like. For this table, I have chosen only the state of Kentucky and its bordering states. In this table, the rows show the state in which the 1970 population lived and the

[7]Total higher education funding includes funding from Federal, State, and Local governments.

[8]This follows Card and Krueger (1992). In the United States, 86% of children aged 0-14 live in their state of birth.

[9]Then for each state, I calculate the percentage born in each of the fifty states, DC, and foreign-born.

columns show the state in which the population was born. For example, at the intersection of the column labeled Kentucky and row labeled Illinois, we see a value of 0.92. This value indicates that 0.92% of the 1970 Illinois population was born in Kentucky.

Figure 4.1: 1970 Population Born in Current State of Residence

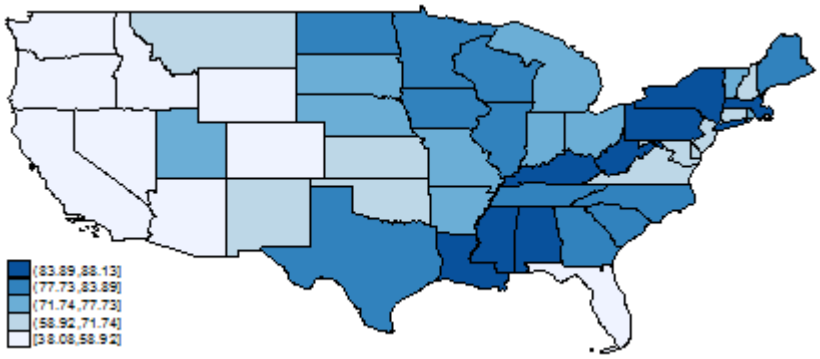


Table 4.1: Migration Matrix for Kentucky and Bordering States

	Kentucky	Illinois	Indiana	Missouri	Ohio	Tennessee	Virginia	West Virginia
Kentucky	84.57	1.12	1.64	0.45	2.50	2.03	0.58	0.80
Illinois	0.92	77.85	1.60	1.83	0.88	1.05	0.25	0.26
Indiana	5.33	4.02	75.04	0.67	2.35	1.67	0.42	0.46
Missouri	0.54	3.46	0.64	76.07	0.58	0.92	0.18	0.16
Ohio	3.84	0.88	1.26	0.31	76.03	1.07	0.73	3.35
Tennessee	1.80	0.87	0.49	0.55	0.61	79.17	1.59	0.29
Virginia	0.78	0.83	0.43	0.41	1.10	0.95	68.84	2.59
West Virginia	1.48	0.30	0.24	0.05	2.91	0.27	2.54	85.05

Using this birthplace rate matrix in different weighting calculations gives me four different measures of educational investment to be used in estimation. These different measurements are weighted for interstate migration in the following ways: unweighted for migration (known as own investment from this point forward), weighted-average based on migration, in-state weighted by only those who were educated and now work in the same state, and out-of-state weighted by migration of those who were educated

in a state other than where they now work. Shown below are the calculations for the educational investment measures weighted by migration where f_{ji} is the percent of the population who were born in state j and now live and work in state i and E_j is the educational investment of state j.

Own Education (OE): Own Education measures educational investment that is unweighted for migration. That is, this variable includes the data straight from the publicly available data source.

$$OE_i = E_i \tag{4.1}$$

Weighted Average Education (AE): Weighted Average Education measures the standard calculation for weighted-averages applied to educational investment and weighting by migration.

$$AE_i = \Sigma_{j=1}^{50} f_{ji} E_j \tag{4.2}$$

In-State Education (IE): In-State Education measures only those educational investments that occur within the state that future labor markets outcomes are being estimated.

$$IE_i = f_{ji} E_j, i = j \tag{4.3}$$

Out-of-State Education (TE): Out-of-State Education measures only those educational investments that occur outside of the state that future labor market outcomes are being estimated.

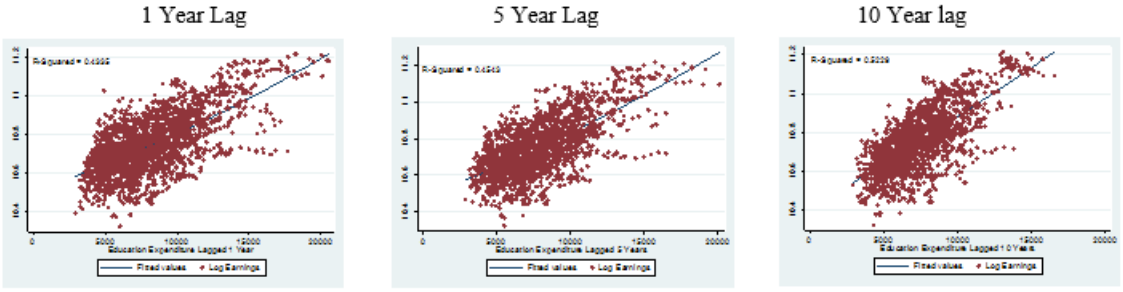
$$TE_i = \Sigma_{j=1}^{49} f_{ji} E_j, i \neq j \tag{4.4}$$

By applying the four different variations of educational investments in estimation, I am able to identify the separate labor market benefits due to in-state educational investment and out-of-state investments.

4.1.1 Trends in Data

To evaluate the impacts of educational investment on future earnings, it is important to note the trends in educational spending as well as earnings. Figure 4.2 below illustrates the relationship between the log of earnings and different lags of educational spending for years of data. Across all lag options the relationship between earnings and education expenditures appears to be positive.

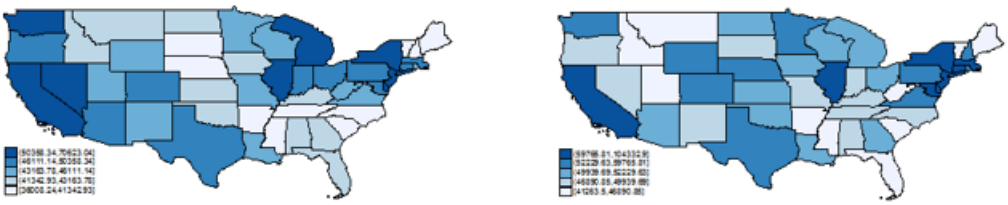
Figure 4.2: Earnings and Lagged Education Expenditures



To give some perspective of the differences in K-12 educational spending and earnings across states, Figure 4.3 and Figure 4.4 below map earnings and spending patterns across states. All values are shown in 2015 dollars. Earnings for years 1976 and 2011 are shown below in Figure 4.3. Although many states' earnings level change, some states are consistently at the higher end of the earnings spectrum, such as California and New York, while other states are consistently at the lower end, such as Mississippi and Alabama.

Educational spending per pupil in years 1976, 1996, 2006, and 2011 are shown in Figure 4.4 below. The maps show areas with consistently high educational spending in states such as Wyoming and multiple Northeastern states. The maps also show areas of consistently low educational spending in states such as Utah, Arkansas, Mississippi, and Tennessee. It is important to notice that just because a state has lower

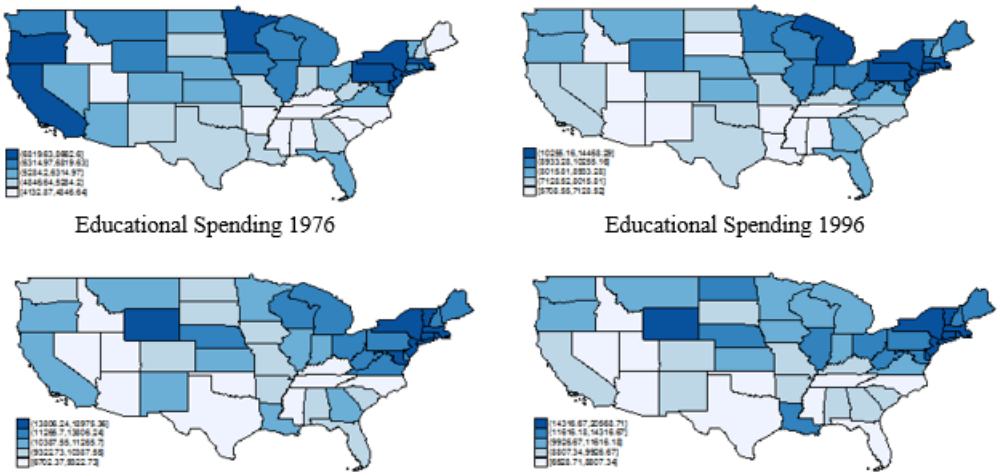
Figure 4.3: Earnings (of labor force)



Earnings Per Capita 1976 Earnings Per Capita 2011

earnings than another state, does not mean that the state spends less on educational expenditures, and vice versa.

Figure 4.4: Educational Spending Per Pupil



Educational Spending 1976 Educational Spending 1996

Educational Spending 2006 Educational Spending 2011

4.2 Empirical Methodology

Rather than simply focus on quantifying the impact of education on earnings, I also determine if, in fact, the level of educational investment chosen in a state is set so that the future lifetime earnings of these investments are greater than the cost. By integrating migration data for each state's population, I also evaluate whether

these educational investments extend passed state borders and influence the future earnings of the people there. The relationship between earnings and employment and educational investments is estimated by a dynamic panel data model:

$$Y_{it} = \theta Y_{it-1} + \alpha_1 E_{it-10} + \alpha_2 E_{it-10}^2 + \eta_1 E_{it-10} \times HS_{it-10} + \eta_2 E_{it-10} \times SC_{it-10} + \eta_3 E_{it-10} \times C_{it-10} + \beta X_{it} + \gamma_i + \mu_t + \upsilon_{it} \tag{4.5}$$

where Y_{it} is earnings growth, Y_{it-1} is earnings growth lagged one year, E_{it-10} is educational investment lagged ten years, E_{it-10}^2 is the square of educational investment lagged ten years, $E_{it-10} \times HS_{it-10}$ is an interaction term for educational spending and the percent of the population with a high school diploma lagged ten years, $E_{it-10} \times SC_{it-10}$ is an interaction term for educational spending and the percent of the population with some college (1-3 years) lagged ten years, $E_{it-10} \times C_{it-10}$ is an interaction term for educational spending and the percent of the population with a college degree (4+ years) lagged ten years, X_{it} is a vector containing other state-level variables and controls such as other types of government expenditures and industry shares of annual state GDP, γ_i are state fixed effects, and μ_t are year fixed effects.[10] The educational investments used in the model above include cognitive measures of student achievement through 8th grade NAEP math test scores and the level of educational spending per pupil. The educational attainment variables used here act as a proxy for parent's educational background. Using these attainment values interacted with spending allows me to observe the effect of education spending on earnings while holding parents' education constant. The different migration weights for educational investment, own, average-weighted, in-state, and out-of-state, are incorporated across

[10]The covariates were chosen because they are potential factors that affect the productivity of labor in addition to the level of education. Variables focusing on the determination of education spending were left out.

different specifications and substituted in for all $E's$ in the above equation.

When estimating this baseline model, I instrument using Arellano Bond techniques as done by Curs et al. (2011):

$$\begin{aligned}\Delta Y_{it} = \theta \Delta Y_{it-1} + \alpha_1 \Delta E_{it-10} + \alpha_2 \Delta E^2_{it-10} + \eta_1 \Delta E_{it-10} \times HS_{it-10} \\ + \eta_2 \Delta E_{it-10} \times SC_{it-10} + \eta_3 \Delta E_{it-10} \times C_{it-10} + \beta \Delta X_{it} + \Delta \mu_t + \Delta \upsilon_{it}\end{aligned} \tag{4.6}$$

I estimate this model with two-step system GMM. and by following this procedure, I obtain efficient estimates (Arellano and Bond, 1991; Arellano and Bover, 1995). By implementing a dynamic panel data model in first differences, I mitigate issues of unobserved heterogeneity and autocorrelation while avoiding inconsistent estimates due to estimating a model with both a lagged dependent variable and fixed effects (Baum, 2006). The use of the ten-year lag on educational investment was selected based on both theory and through inspection of the Bayesian information criterion (BIC) for multiple lag options. Theory suggests that because investments, such as those in education, can take many years to impact economic factors and because current educational investments might only affect those who are currently in school, values of educational investment should be lagged a significant number of years in this model.[11] When examining multiple year lag options, the ten-year lag on educational investment minimized the value of the BIC compared to other lags between one year and fifteen years.[12] For this earnings regression, the difference in values of the BIC with the ten-year lag versus other year lags shows some evidence to use the ten-year lag for educational investment. However, theory and data concerns mostly drive the use of a ten-year lag for this investigation.

The baseline empirical model, (4.5), is modified to capture the educational invest-

[11] In the Curs et al. (2011) income growth regression, the average of the previous five years of higher education expenditures is used to account for this investment over many years.

[12] Schwarz et al. (1978) introduced the BIC to be used with descriptive models in comparison to the Akaike information criterion (AIC) which is used for predictive models.

ment effects on state employment as:

$$M_{it} = \theta M_{it-1} + \alpha_1 E_{it-10} + \alpha_2 E_{it-10}^2 + \eta_1 E_{it-10} \times HS_{it-10} + \eta_2 E_{it-10} \times SC_{it-10} + \eta_3 E_{it-10} \times C_{it-10} + \beta X_{it} + \gamma_i + \mu_t + \upsilon_{it} \tag{4.7}$$

where M_{it} is total employment growth, M_{it-1} is total employment growth lagged one year, and all other variables are defined as above in Equation (4.5). When empirically solving this model, I use the same procedure as above in Equations (4.5) and (4.6).

4.3 Results

Results from my preferred specifications for estimating the impact of educational spending on earnings growth are reported in Table A.4 in the Appendix. The four different weighted measures of educational spending are included in this table. Across specifications, the variables own spending, average-weighted spending and in-state-weighted spending all enter the regression linearly, squared, and interacted with the percent of the population with varying educational achievements. Table 4.2 below illustrates the coefficient results for my variables of interest. In this table, six different specifications are shown depending on what migration-weighted educational spending is used for estimation and whether that educational spending is interacted with educational attainment. As seen in Table 4.2, interactions with college (4+ years) are negative across all specifications and statistically significant at the 5% and 10% level, while the interactions with high school and some college (1-3 years) are positive across all specifications and statistically significant at the 5% and 10% level, depending on the specification.

The negative coefficient on all of the interaction terms between educational spending and college may seem unexpected, however, I offer one possible explanation for this finding. Remember, this interaction shows how the relationship between educa-

tional spending and future earnings varies based on the highest level of educational attainment achieved by each state's population. The variable *college* measures the percentage of a state's population that has completed 4 or more years of college. Being that this interaction term is negative could indicate that as more of the state's population completes college, past K-12 educational spending has a smaller effect on future earnings. This could be the case because if more of the state's population is educated well beyond high school, the effect on future earnings from K-12 education is probably much smaller than other factors such as college education and worker-to-worker spillovers. This explanation also aligns with the fact that the interaction terms on high school diploma and some college are positive. When the percentage of the population with these lower educational achievement levels is higher, education from K-12 is much more important and probably plays a more significant role on the future earnings of these individuals.

Table 4.2 also provides results for a more straightforward regression with no interaction terms. One change to notice is that my variables of interest have all dropped in significance and magnitude. The linear and squared terms of all educational spending measures are now statistically insignificant and nearly zero. Taking out the interaction terms between educational spending and educational attainment clearly affects this part of the model. Interpretation of the effects of educational attainment on earnings growth involves examination of the marginal effects of each variable because the percent of the population with a high school diploma, some college, and college degree appear multiple times in the regressions. It is important to note that the marginal effects of all educational attainment variables are relatively the same, although slightly smaller, compared to my preferred specification. From both of these models, the marginal effects of a high school diploma and some college are negative, while the marginal effect of college is positive. These marginal effects are what we would expect to see in that the marginal effects become larger in magnitude and more

positive with an increase in the level of education achieved. For example, the marginal effect of college for average-weighted educational spending has a value of 0.148 (from specification (2)) and 0.088 (from specification (5)), indicating that as the percentage of the population with at least 4 years of college increases, future earnings increase as well. To be more specific, as the percentage of the population with a college degree increase by 1 percentage point, future earnings increase by .15% and .09%.

Table 4.2: Educational Spending on Earnings Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Own Educational Spending$_{t-10}$ (OE)						
OE$_{t-10}$	−0.007			0.001		
OE$^2_{t-10}$				−0.000		
OE$_{t-10}$ × HS	0.009					
OE$_{t-10}$ × Some College	0.023**					
OE$_{t-10}$ × College	−0.037**					
Average-weighted Educational Spending$_{t-10}$ (AE)						
AE$_{t-10}$		−0.008*			0.001	
AE$^2_{t-10}$					−0.000	
AE$_{t-10}$ × HS		0.013*				
AE$_{t-10}$ × Some College		0.020*				
AE$_{t-10}$ × College		−0.031*				
In-state-weighted Educational Spending$_{t-10}$(IE)						
IE$_{t-10}$			−0.005			−0.000
IE$^2_{t-10}$						−0.000
IE$_{t-10}$ × HS			0.009			
IE$_{t-10}$ × Some College			0.020*			
IE$_{t-10}$ × College			−0.032**			
Out-of-state-weighted Educational Spending$_{t-10}$(TE)						
TE$_{t-10}$			0.004			0.004
TE$^2_{t-10}$			−0.002			−0.002
High School Diploma$_{t-10}$	−0.062**	−0.073***	−0.063**	−0.038**	−0.036*	−0.039**
Some College (1-3 years)$_{t-10}$	−0.160***	−0.147**	−0.131**	−0.049**	−0.055**	−0.056**
College (4+ years)$_{t-10}$	0.280***	0.259***	0.187***	0.081**	0.088***	0.071**

Note: Full regression results are shown in the Appendix, Table 7 and Table 8. The squares of Own Education Spending, Average-weighted Education Spending, and In-state weighted Education Spending for specifications (1)-(3) are not shown here because coefficients are zero. *** p<0.01, ** p<0.05, * p<0.1.

4.3.1 Calculation of Lifetime Benefits vs. Cost

Because educational spending appears multiple times in my preferred specification, to correctly evaluate the impact of educational spending on earnings growth I first calculate the total differential at the mean:

$$\frac{dY}{dE_i} = \alpha_1 + (2\alpha_2 * \overline{E}_{t-10}) + \eta_1 \overline{HS}_{t-10} + \eta_2 \overline{SC}_{t-10} + \eta_3 \overline{C}_{t-10} \tag{4.8}$$

I then calculate the earnings benefits for each specification and state by multiplying the total differential by the mean of earnings of each state:

$$B = \frac{dY}{dE_i} \times \overline{Y_i} \tag{4.9}$$

At the mean, educational spending per pupil increases of $1,000 in one state imply a 0.12% increase in earnings growth in any other state. In terms of earnings, this cost of $1,000 of one state implies a future earnings benefit of $58 in another state. Examining the values of in-state benefits and out-of-state benefits for each state shows an interesting pattern. For all states, the in-state education spending impact on earnings is negative, while for most states, the out-of-state impact on earnings is positive. In addition, for a number of states, these values are similar in magnitude, but opposite in sign. However, testing the significance of the differentials used to calculate the impact on earnings, indicates that they are not statistically different from zero.

To determine the benefits of this educational spending in terms of future lifetime earnings, this value is then discounted for 40 years. Proper discounting is done using

a 3% discount rate, as is standard.[13]

$$1 + \left(\frac{1}{1+.03}\right) + \left(\frac{1}{1+.03}\right)^2 + ... + \left(\frac{1}{1+.03}\right)^{40} = 24.11477 \tag{4.10}$$

$$\text{Present Value of Benefits} = B \times 24.11477$$

This final value gives the appropriately discounted present value of the earnings benefits from educational spending. Overall, the discounted future earnings benefits of the in-state-weighted educational spending per additional $1,000 is -$3,024, while the future earnings benefits associated with out-of-state-weighted educational spending per additional $1,000 is $1,383.

Next, I determine if educational spending is set so that the future lifetime earnings benefits are greater than the cost. Applying a $1,000 increase per pupil per year for grades K-12 assumes that the total amount spent on education is $13,000 per pupil. Then, due to using a ten-year lag on the education variables, this $13,000 needs to be properly discounted for those 10 years. Again using a 3% discount rate, this $13,000 becomes $17,470 as the total education cost. Finally, to calculate the net earnings benefit of education, this cost value is subtracted from the benefits previously found:

$$\text{Present Value of Total Cost} = 13,000 \times (1.03)^{10} = 17,470$$

$$\text{Net Earnings} = \text{Earnings Benefit - Total Cost}$$

Overall, the results indicate that the total lifetime earnings benefits associated with educational spending are less than the total cost for every state. Figure 4.5 and Figure 4.6 below show these results broken down by state. Figure 4.5 illustrates the net earnings for in-state-weighted educational spending evaluated at the mean. Although the net earnings values vary, all states have a negative net earnings. These

[13] In their paper, Hanushek et al. (2015) use a 3% discount.

negative net earnings indicate that the earnings benefits from educational spending are smaller than the cost and that educational spending may be set at a level that is too high.

Figure 4.5: In-State Educational Spending Net Earnings

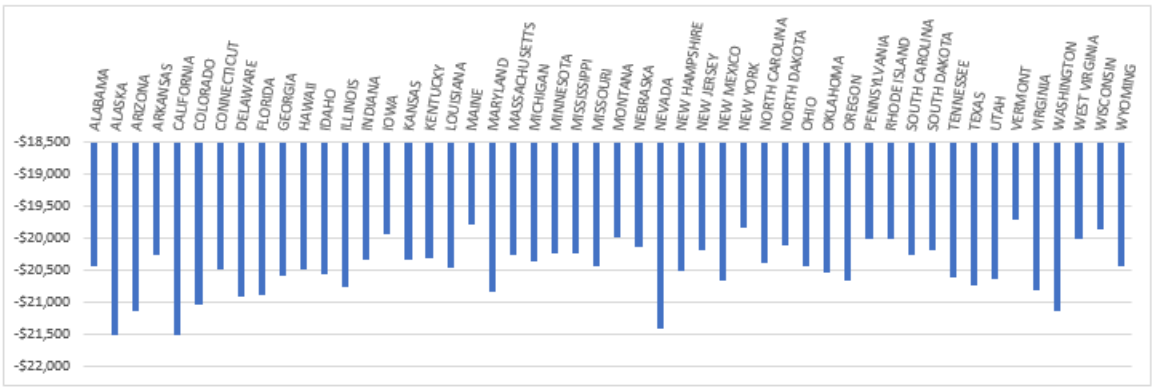
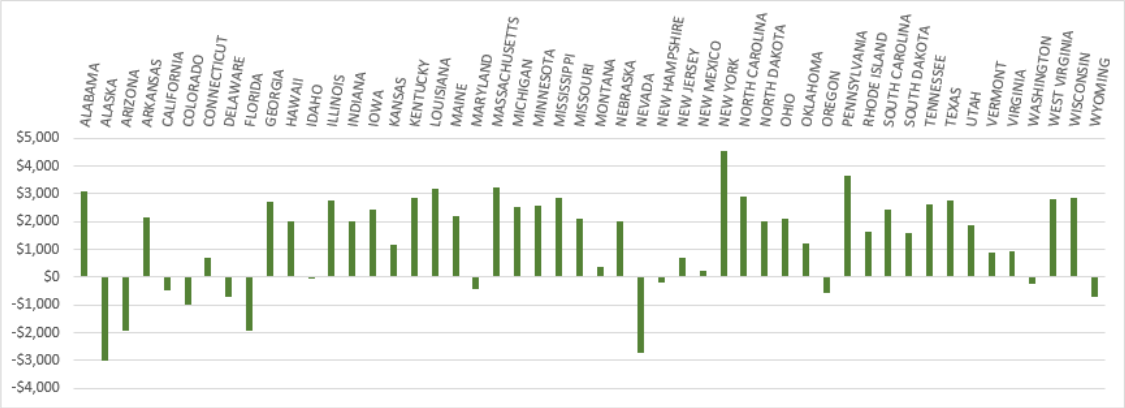


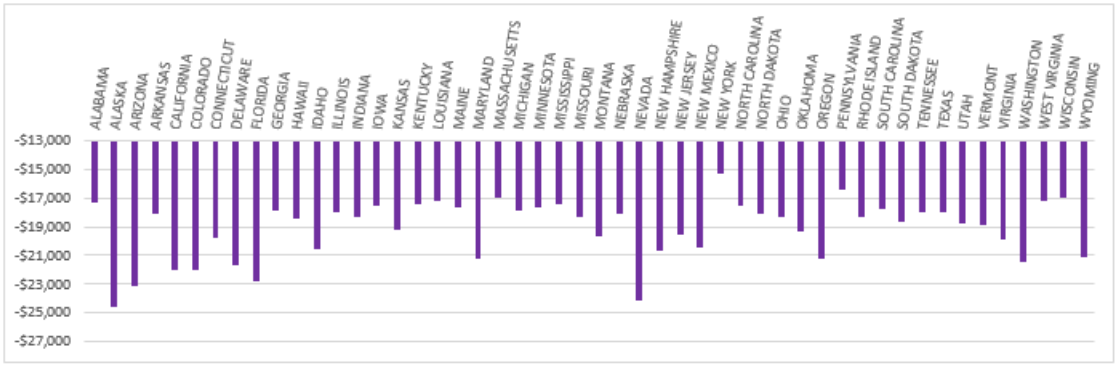
Figure 4.6 shows the benefit from out-of-state-weighted educational spending evaluated at the mean for each state. In other words, this figure shows the spillover received by each state. For example, from the graph below we can see that Alabama receives just over $3,000 in benefit from the educational spending of all other states. Finally, Figure 4.7 illustrates the total net earnings from educational spending for each state. This total net earnings is found by adding the net earnings received from in-state investment to the benefit received from out-of-state investment, relating back to my theoretical model. Overall, when evaluated at the mean, the average total net earnings from educational spending is -$19,136. This value indicates that most states are setting educational spending levels too high in terms of future earnings growth. Net earnings benefits evaluated at the 25th and 75th percentiles show similar results. These results are included in the Appendix in Figure A.1 and A.2. In Table A.4 of the Appendix, we also observe that the coefficients for K-12 enrollment and college enrollment rate are negative and statistically insignificant for all specifications. Col-

Figure 4.6: Spillover of Earnings Benefits from Out-of-State Educational Spending



lege expenditures per pupil, however, are negative and statistically significant at the 1% level.

Figure 4.7: Total Net Earnings from Educational Spending



Taking a look at the overall results, these outcomes may not be what we would expect to see. However, these results may be indicating that people who are educated in one state and then work in another are different than the people who are educated in one state and then work in the same state. In Figure 4.5, we see a negative impact on earnings from those who are educated and then work in the same state, but in Figure 4.6, we see a mix of negative and positives impacts on earnings from those who

are educated in one state and work in another. This may indicate that for the states experiencing positive impacts from out-of-state investment, the people who move into the state to work are somehow different than those who received education there. The people moving into these states may also be different from those who move into the states that are experiencing negative impacts from out-of-state investment.

If the government chooses the optimal level of educational spending, we would not expect to see negative benefits from education as found in this investigation. Another possible explanation for these unexpected negative results is the fact that this educational spending my be crowding out private investment and other public spending. My theoretical model suggests that as educational spending increases, consumption spending decreases. However, it may be the case that increases in educational spending cause a decrease in private and public investments such as those in business, infrastructure, or the like. This suggests that I may be estimating an equation in which the marginal effect on wages from educational spending is less than other private or public investment, which gives the negative benefit from educational spending found here.[14]

4.3.2 Educational Spending on Employment

Also in the Appendix, Table A.6 shows the results for educational spending on employment growth. Unfortunately, the regression results from this estimation do not provide much insight into the relationship between educational spending or educational achievement and employment growth. In this table, almost all variables are statistically insignificant. However, the coefficients on the interaction terms of educa-

[14]Refer back to Chapter 3 for more details of the theoretical model. The following equation shows the model I may in fact be estimating. P represents other private/public investment.

$$\beta\left(\frac{L_1^{AA}}{N_A}\frac{\partial w_1^{AA}}{\partial E_0^A}+\frac{L_1^{BA}}{N_A}\frac{\partial w_1^{BA}}{\partial E_0^A}\times\frac{L_1^{AA}}{L_1^{BA}}\right)-\beta\left(\frac{L_1^{AA}}{N_A}\frac{\partial w_1^{AA}}{\partial P_0^A}+\frac{L_1^{BA}}{N_A}\frac{\partial w_1^{BA}}{\partial P_0^A}\times\frac{L_1^{AA}}{L_1^{BA}}\right)=0 \qquad (4.11)$$

tional spending and the percent of the population white are negative and statistically significant at the 5% and 1% level, depending on the specification. Testing of the total differential of educational spending for all three specifications shows that it is not statistically different from zero, and thus educational spending has no statistically significant effect on employment growth. Also, examining the marginal effects of all educational achievement levels shows that for this dataset, educational achievement does not have a significant impact on employment growth.

4.3.3 NAEP Test Scores on Earnings and Employment

Table 4.3 below displays regression results for earnings growth and NAEP test scores. For the own, average-weighted, and in-state-weighted NAEP test scores, the effect on earnings growth is positive, although the coefficients are nearly zero and some statistically insignificant. The coefficient on out-of-state-weighted NAEP test scores is negative and statistically significant at the 5% level, although the value is nearly zero as well. These results are not all that surprising as many researchers such as Ludwig and Miller (2005), Deming (2009), Jackson (2009), Chetty et al. (2011), and Heckman et al. (2013) have found that 8th grade test scores are not the best measure of learning abilities and may be unrelated to future earnings.

Again, to correctly interpret the effects of NAEP test scores and educational achievement on earnings growth, examination of the marginal effects is necessary because the variables enter the regression multiple times. Again, we see the marginal effects of high school diploma and some college are negative and not statistically significant, while the marginal effects of college are positive and statistically significant at the 1% level. For the average-weighted educational spending specification, the marginal effect of college is 0.076 and implies that as the percent of the population with a college degree increases by 1 percentage point, future earnings growth increases by .076%. The negative and positive signs associated with these marginal effects

match those of the regressions of educational spending on earnings, as previously discussed. For all four weighted measures of the NAEP test scores, the total effect of test scores is 0.0002. This value indicates that at the mean, as NAEP scores increase by 1 point, future earnings growth increases by 0.02%. This is an encouraging finding as the results show a positive outcome from an increase in test scores (and therefore quality of education), which agrees with Hanushek et al. (2015) from Section 2.2.3.

From Table A.7 in the Appendix, we see the results of NAEP test scores on employment growth. Calculation of the total differential of NAEP test scores and testing whether it is statistically different than zero, finds that the total differential is not different from zero and thus, NAEP test scores do not have a significant effect on employment growth. Examination of the marginal effects of a high school diploma shows that a high school diploma as the highest level of educational achievement lowers employment growth, although this is only statistically significant for the in-state-weighted NAEP test scores. Almost the opposite is true when looking at the marginal effects of some college. These effects are positive across all specifications but are only statistically significant for the own-NAEP and average-weighted NAEP test scores. The effects of college are rather small in magnitude, vary in sign, and are statistically insignificant. Overall, it appears that NAEP test scores are not a good predictor of future employment growth.

4.3.4 Educational Spending and NAEP Test Scores on Earnings

Found in the Appendix, Table A.8 shows the results of an additional specification in which I estimate educational spending and NAEP test scores together on earnings growth. From this table, we again see the marginal effect of high school is negative (although statistically insignificant), the marginal effect of some college is negative and statistically significant at the 5% level, and the marginal effect of college is positive and statistically significant at the 1% level. On the encouraging side, these findings

Table 4.3: NAEP Test Score on Earnings Growth

	(1)	(2)	(3)
Own NAEP_{t-10}	0.001^{**}		
Own $\text{NAEP}_{t-10} \times$ HS	-0.003^{**}		
Own $\text{NAEP}_{t-10} \times$ Some College	0.002^{**}		
Own $\text{NAEP}_{t-10} \times$ College	-0.003		
Average-weighted NAEP_{t-10}		0.001	
Average-weighted $\text{NAEP}_{t-10} \times$ HS		-0.003	
Average-weighted $\text{NAEP}_{t-10} \times$ Some College		0.004^{***}	
Average-weighted $\text{NAEP}_{t-10} \times$ College		-0.004^{**}	
In-state-weighted NAEP_{t-10}			0.000
In-state-weighted $\text{NAEP}_{t-10} \times$ HS			-0.001
In-state-weighted $\text{NAEP}_{t-10} \times$ Some College			0.000
In-state-weighted $\text{NAEP}_{t-10} \times$ College			-0.001
Out-of-state-weighted NAEP_{t-10}			-0.000^{**}
High School Diploma_{t-10}	0.827^{**}	0.694	0.097
Some College (1-3 years)$_{t-10}$	-0.627^{**}	-1.066^{***}	-0.018
College (4+ years)$_{t-10}$	0.746^{*}	1.289^{**}	0.171^{*}

Note: Full regression results are shown in the Appendix, Table 9. *** p<0.01, ** p<0.05, * p<0.1.

are consistent with the results previously found in other specifications. Unfortunately, these regression results do not provide much evidence for the relationship between educational spending and earnings growth as all total marginal effects of educational spending are small in magnitude and statistically insignificant.

4.4 Caveats, Contributions, and Extensions

There are three main caveats that warrant mention at this point. First, different changes in state-level policies such as educational quality and achievement requirements could have various effects on state-level education. These policy changes will be accounted for and addressed in the empirical estimations in the future. In addition, following the work of Hanushek et al. (1996), an investigation at disaggregated levels of schooling data, for instance at the county or district level, would likely result in more reliable estimates of the true impact of education and the presence of educa-

tional investment spillovers on future earnings and employment. As found in Chapter 5, estimation employing micro-data is used to more accurately measure the effects of education and the presence of educational spillovers. An additional extension to this chapter includes more narrowly focusing on the size of educational investment spillovers. Furthermore, while I investigate if education expenditures are set at optimal levels in order to maximize future earnings, I need to stress that I am only examining benefits of education in terms of earnings and not taking into account all of the other benefits from education. Because of this, while my results indicate that the government may not be choosing an optimal level of education expenditure, if I would estimate my model including every benefit from education, I may in fact see that the level of education expenditure is optimal. My results are therefore somewhat ambiguous about whether education is set at an optimal level and left to the discretion of the reader. For more discussion pertaining my results, look to Chapter 6, the conclusion on this dissertation.

This chapter adds to the literature because its main focus is educational investment spillovers rather than educational returns. Whereas existing literature focus on human capital formation as the mechanism through which education affects the individual, I turn my attention away from just the human capital or quality of education aspect and focus on a variety of educational investment types. This focus allows for investigation into whether these investments affect earnings and employment across state borders. My theoretical predictions also allow me to empirically test whether education investments are set so that the earnings benefits from education are greater than the cost. The results of this chapter indicate that some state level educational investments do spill over into other states' labor market outcomes. Results from this investigation are not only important to the literature but they are also important for those who are setting policies in regards to education. If in fact the results found in this study prove reliable, future policy setters will have other state's labor markets to

consider. It is important to note that a true evaluation of the financial investments in education requires a "comprehensive assessment of all of the returns to schooling -market, nonmarket, and external/public goods effects" (Wolfe and Haveman, 2002). This statement motivates future work involving all aspects of any returns to educational investments.

In conclusion of this chapter, it is important to see that the results of this state-level investigation raised a few questions that are more complicated to answer at the state level. Specifically, why is the total earnings benefit from educational investments negative? Are residence who migrate to another state systematically or demographically different than those who do not move across state borders? Do residence living near a state border or farther from the border impact labor markets differently? As you will see in the next chapter, this investigation is extended into individual-level data. This estimation taken down to the micro-data level offers some interesting details and answers to questions raised by this state-level investigation.

Chapter 5 Educational Investment Spillover Effects using Micro-Data

In the previous chapter, I use state-level data in order to examine the impact of educational investments in public education on aggregate state labor markets, specifically earnings and employment. Using data on K-12 educational spending, 8th grade cognitive test scores, and educational demographics of a state's labor force, I observe the impact these state-level investments have on employment and earnings growth. Taking interstate migration into account, I separate the benefits from educational investment into benefits due to in-state investment and benefits due to out-of-state investment. By doing so I identify whether or not educational investment spillovers exist between states. Results from this investigation show that some state-level educational investments do spill over into other states' labor market outcomes.

The results from Chapter 4 have sparked many new directions for research interests in this topic. For example, the results in the previous chapter show that some states experience a positive spillover while other states experience a negative spillover from labor migration. This brings to question what is causing this difference between states? Also, what is causing this negative spillover? Are the individuals who move across state borders somehow different than the individuals who stay within the state? In this chapter, I extend the estimation of Chapter 4 in hopes of answering some of these questions.

For this chapter, I employ the same methodology as the previous chapter, however, here I use individual-level data rather than state-level data and focus on the distinctions between individual workers. One reason for doing this is to provide a stronger link between educational investments and future earnings and employment. Using individual-level data allows me to narrow the age range of individuals used in estimation to only those aged 24-28. This promotes a stronger connection between

the 10-year lag on educational investments and future earnings because individuals aged 24-28 years old now would have been 14-18 years old 10 years ago and would have been in high school receiving the educational investments under investigation. Examining the same research topic as Chapter 4, but now at the micro-data level allows me to further support the results of the previous chapter by capturing a more accurate picture of the spillovers occurring. Because I have individual level data, I can more precisely see the amount of educational spending associated with each individual and their future earnings. Therefore, using individual-level data gives more reliable estimates of the true impact of education and the presence of educational investment spillovers on future earnings.

In this chapter, I use 14 years of individual-level data from 2001-2014. The majority of this data come from the American Community Survey (ACS), while supplemental state-level data come from various publicly available data sources as used in Chapter 4. Individual-level data used here includes migration patterns, educational attainment, income levels, and demographic characteristics for all individuals. State-level data includes public K-12 educational spending, taxes per capita, and other government expenditures. Evaluation of the relationship between educational investment and future earnings is estimated with a Heckman two-step selection model, selecting on whether the individual has moved out of their state of birth.

Results from this micro-data estimation support the results in Chapter 4 in that educational investment spillovers across state borders do occur and are statistically significant. The results of this chapter suggest that as educational spending outside of the state ten years ago increased by $1,000, future earnings inside the state increase by 0.20% due to migration into the state. In terms of earnings, the cost of $1,000 generates a $62.76 spillover of benefits. Again, we see that in-state educational investments cause a negative impact on future earnings or private returns to those educated and working within the state. Regression results indicate that as educa-

tional spending within the state increases by $1,000, future earnings within the same state decrease somewhere between 0.60% and 1.10%.

The remainder of this chapter is organized as follows. Section 5.1 provides a description of the individual-level data, Section 5.2 explains my empirical methodology, and Section 5.3 discusses my results. Finally, Section 5.4 discusses contributions, offers extensions for future work, and concludes.

5.1 Data

To examine the effects of education on earnings, I employ a 14-year panel from 2001-2014 of individual-level data. This panel includes data from the American Community Survey (ACS) and includes only individuals aged 24-28 years old to create a stronger connection between lagged educational spending and future earnings. This dataset includes demographic variables as well as migration patterns, educational achievement, and income levels for all individuals.

This dataset also includes state-level variables such as public K-12 educational spending, taxes per capita, and state own revenue as a percentage of GSP collected from various public sources.[1] As in Chapter 4, public K-12 education data are obtained from the National Center for Education Statistics (NCES) and the Annual Digest of Education Statistics and include state and local current expenditures per pupil recorded at an annual frequency under the spring of the academic year.[2] Total current expenditures per pupil collected at the state level include all funds originating from the federal, state, and local governments. To accurately capture state-to-state

[1] Unfortunately, educational spending data is not available at the individual, county, or puma level, so assigning state-level data is the only currently available option. Taxes and revenues are also only measured at the state level.

[2] For example, academic year 2001-2002 is recorded under the year 2002.

spillovers in this analysis, I use only the state and local expenditures per student.[3] Educational spending values are lagged 10 years and assigned at the state level associated with the individual's state of birth.[4] Because I assign educational spending to each individual based on their state of birth, only individuals born in the U.S. are used for this study. The other state-level control variables are identical to those in Chapter 4 and are assigned to each individual based on the individual's current state of residence. These variables are measured at the state level because matching data at the individual level is not available. Table 5.1 below provides a description of all the variables used for estimation. All data are adjusted for inflation and expressed in 2015 dollars.[5] Summary statistics of data values are shown below in Table 5.2.

Table 5.1: Variable Descriptions

Dependent Variable:	**i. Earnings**	
Variable of Interest:	**K-12 Public Educational Spending**	
Control Variables:	**Demographics**	**Education Level**
	- Male	- High school diploma, graduate, or GED
	- White	- Some college (1-3 years)
	- Age	- College graduate (4+ years)
	- Military experience	
	- Child now present in home	
	- Ever married	
	- Disabled	
	Migration	**Other:**
	- Out of state - Moved across state line	- Employed
	- In state - Moved houses within same state	- In the Labor force
		- Taxes per Capita
		- Agriculture as a % of GSP
		- Manufacturing as a % of GSP
		- Other Gov't Expenditure as a % of GSP

Notes: K-12 Public Educational Spending is measured at the per pupil level. Earnings here measures income earned from wages or a person's own business or farm.

Because of the high degree of mobility of U.S residents, accounting for migration

[3]Federal revenues are subtracted from the total current expenditures per pupil, so expenditures per pupil are only from state and local sources. Federal revenues are also collected from the NCES and Annual Digest of Education Statistics.

[4]I use state of birth as a proxy to measure where an individual received their elementary and secondary education. This follows Card and Krueger (1992): In the United States, 86% of children aged 0-14 live in their state of birth.

[5]IPUMS analysis suggests no need to use the Census Bureau's adjustment factor for income variables obtained from the ACS.

Table 5.2: Summary Statistics

Variable	Mean	Std. Dev.
Income/Wages	30439.32	26059.65
Earnings	31382.78	26711.32
Log of Income/Wages	10.06	0.96
Log of Earnings	10.05	0.98
Employed	0.91	0.29
Education Spending$_{t-10}$ (1991-2005)	6.15	1.72
Male	0.51	0.50
Age	25.99	1.41
White	0.83	0.38
Ever Married	0.40	0.49
Disabled	0.04	0.20
Military Experience	0.06	0.23
Child Present	0.28	0.45
Currently in School	0.17	0.38
High School Graduate (diploma or GED)	0.21	0.41
Some College (1-3 years)	0.35	0.48
College (4+ years)	0.35	0.48
Out of State Move	0.32	0.47
Tax Per Capita$_{t-2}$	2.26	0.62
State Own Revenue as a % of GSP$_{t-10}$	0.12	0.02
Other government expenditure as a % of GSP$_{t-10}$	0.12	0.03
Agriculture as a % of GSP (contemporaneous)	0.01	0.01
Manufacturing as a % of GSP (contemporaneous)	0.13	0.05

Note: N=1,371,859 (Log of Earnings, N=1,289,926 due to negative and zero earnings in this dataset). Statistics are from 2001-2014 and are expressed in 2015 dollars. This dataset includes only individuals born in the U.S. Education Spending is measured in per pupil terms and are measured in 1000s of dollars. Taxes Per Capita are also measured in 1000s of dollars. The District of Columbia is omitted due to missing data.

becomes a very important step in determining whether educational investments cause spillovers on earnings. For example, the workforce in the state of Kentucky is not only made up of individuals who were educated there, but also those who were educated in any other state and then migrated to Kentucky. To account for state-to-state migration, I incorporate indicator variables to measure whether the individual has moved out of their state of birth. Accounting for this cross-border move allows me to identify the educational spillover that is occurring; that is, the out-of-state cost and future earnings benefit of education. Also considering those individuals who moved

within state or not at all allows me to identify in-state costs and future earnings benefits of education. Summary statistics broken down by out-of-state-movers and in-state/non-movers is below in Table 5.3. As shown in this table, individuals who have moved out of the state in which they were born on average have higher earnings, are more educated, and have a higher probability of having military experience, as theory suggests.

Table 5.3: Summary Statistics - Based on Migration

Variable	Non-Movers Mean	Out of State Movers Mean
Income/Wages	29163.36	33183.84
Earnings	30117.44	34104.48
Log of Income/Wages	10.02	10.13
Log of Earnings	10.02	10.13
Employed	0.90	0.92
Education Spending$_{t-10}$ (1991-2005)	6.13	6.21
Male	0.51	0.51
Age	25.97	26.05
White	0.82	0.85
Ever Married	0.39	0.43
Disabled	0.04	0.04
Military Experience	0.04	0.10
Child Present	0.29	0.25
Currently in School	0.16	0.19
High School Graduate (diploma or GED)	0.23	0.17
Some College (1-3 years)	0.36	0.33
College (4+ years)	0.31	0.44
Out of State Move	0	1
Tax Per Capita$_{t-2}$	2.29	2.19
State Own Revenue as a % of GSP$_{t-10}$	0.12	0.12
Other government expenditure as a % of GSP$_{t-10}$	0.12	0.12
Agriculture as a % of GSP (contemporaneous)	0.01	0.01
Manufacturing as a % of GSP (contemporaneous)	0.13	0.13

Note: Non-movers: N=936,481. Movers: N=435,378. Statistics are from 2001-2014 and are expressed in 2015 dollars. This dataset includes only individuals born in the U.S. Education Spending is measured in per pupil terms and are measured in 1000s of dollars. Taxes Per Capita are also measured in 1000s of dollars. The District of Columbia is omitted due to missing data.

5.1.1 Trends in Data

For each of the 1,371,859 individuals used in this study, I see where they were born, where they lived 1 year prior to the survey, and where they lived at the time of the survey. In this dataset, 435,378 individuals now live in a different state compared to where they were born. In addition, in the last year, 70,871 individuals moved across state borders while 340,719 moved within state borders and 953,446 continue to live in the same house. To evaluate the impacts of educational investment on future earnings, it is important to note the trends in educational spending as well as earnings. Figure 4.2 from Chapter 4 illustrates the relationship between earnings and lagged educational spending. As the figure shows, across all lag options (1 year, 5 year, and 10 year) the relationship between earnings and education expenditure is positive. For more details on the relationship between earnings and educational spending, please review Section 4.1.1 of Chapter 4.

5.2 Empirical Methodology

In this chapter, my goal is to quantify the impact of lagged educational investment on future earnings. More specifically, I aim to separately identify private returns and public returns (or spillovers) to educational spending while using individual-level data. With individual-level data on earnings and employment, it is common to see individuals who report not being employed and thus having zero earnings. Due to these survey responses, these individuals can be misspecified in estimation and the true impact of educational spending on future earnings could be biased due to selection by the individual to not work. In addition, with migration data being incorporated for each individual, whether a person chooses to move out of their state of birth or to remain in the state can also cause biased results. Because of this knowledge about the data, modeling the relationship between educational spending and future

earnings must be done carefully. Thereofore, I evaluate the relationship between educational investment and future earnings using maximum likelihood estimation with a Heckman two-step selection model as shown below:

$$log(Y_{ijt}) = \beta_0 + \beta_1 E_{jt-10} + \beta_2 E^2_{jt-10} + \beta_3 AE_{jt-10} + \beta_4 X_{ijt} + \rho_j + \gamma_i + \mu_t + \upsilon_{it} + \varepsilon_j + \nu_{jt} \quad (5.1)$$

where Y_{ijt} is earnings of the individual, E_{jt-10} is educational investment lagged ten years of the state in which the individual was born, E^2_{jt-10} is the square of this educational investment lagged ten years, AE_{jt-10} is the state-level weighted-average educational spending from Chapter 4 assigned to the individual based on where they currently live, X_{ijt} is a vector containing other individual-level and state-level variables and controls such as demographic variables, other types of government expenditures, and industry shares of annual state GDP, ρ_j are state fixed effects, γ_i are individual fixed effects, and μ_t are year fixed effects.[6] Modeling my estimation in this way allows me to separate the impact of educational spending into private returns and public returns or spillovers. From this estimation, $\beta_1 + \beta_2$ measures the private returns to this educational spending and β_3 quantifies the spillover effect from this educational spending.

To simplify this estimation, I only include individuals in this sample who are employed so that I can examine the relationship of passed educational spending and future earnings. It is important to note that doing so could cause selection bias issues, but for now these issues are being passed over.[7]

When implementing this Heckman selection model, I first determine the probably

[6]The covariates were chosen because they are potential factors that affect the productivity of labor in addition to the level of education. Variables focusing on the determination of education spending were left out.

[7]More details about this selection bias issue can be found at the end of this section.

of being “observed" in the sample by selecting on whether the individual has moved out of their state of birth. In this way, I am controlling for selection bias based on not estimating those who have not moved out of their state of birth (outofstate=0). Then I take this correction for selection and incorporate it into a regression estimating the impact of educational spending on earnings.

In this estimation, I essentially ignore whether or not the individual is employed.[8] Although the dataset includes individuals who work and who do not work, I only keep those who work for this estimation. I realize this potentially causes econometric issues that need to be addressed in the future, but this would most likely involve a more complicated multinomial probit model. Because the option to work or not work causes selection bias in this sample, I need to control for this bias to properly estimate this relationship. Advancing this estimation technique is forthcoming.

5.3 Results

Results from my two-step Heckman selection model are displayed below in Table 5.4. Across all specifications in this table, we see that coefficient results are very similar in magnitude and statistical significance.

Overall, lagged educational spending has a negative impact on future earnings for those who receive education in one state and in the future work in the same state. The linear term of educational spending for in the state where the individual received education is negative and statistically significant at the 1% level for all specifications, whereas the squared term of educational spending is positive and then equal to zero and statistically insignificant. To see the marginal effect of this educational spending on an individual's private returns in terms of earnings, for specifications (1)-(3), the coefficient on the linear term of educational spending is sufficient. For

[8]In Appendix Section A.3.1 I estimate the probability of being employed. Results are shown in Table A.9 of this section.

example, in specification (3), we see a value of -0.006. This indicates that as the educational spending increases by $1,000, future earnings decrease by 0.60%. For specifications (4)-(5), the coefficients on the linear and squared terms, as well as the interaction terms with educational attainment are needed to calculate the marginal effect of educational spending. For specifications (4)-(5), the marginal effects are approximately equal to -0.006 and -0.011, respectively. These values indicate that educational spending increases of $1,000 decrease future earnings by 0.60% and 1.10%. The total differentials calculated for all specification are statistically significant at the 1% level. Similar to the results of Chapter 4, we again see a negative relationship between in-state educational spending and future earnings.

The spillover effect generated from educational spending is also shown in the table below. Across all specifications, the coefficient on the lagged average-weighted educational spending variable is positive and statistically significant. Magnitudes across specifications are nearly identical for this variable as well. Interpretation of this variable quantifies the effect of out-of-state educational spending. For example, for specification (5), we see a value of 0.002 which is statistically significant at the 5% level. This indicates that as educational spending increases by $1,000 outside of the state, earnings inside the state increase by 0.20% due to migration into the state. Again, similar to the results of Chapter 4, we see a positive spillover effect on future earnings from out-of-state educational spending.

From the table below we can also see that the coefficients associated with high school graduate, some college, and college are all positive and statistically significant at the 1% level. Examining the marginal effects of each level of educational attainment results in very close values across specifications. It is encouraging to see that as individuals increase their level of educational attainment, they also increase their future earnings. For example, in specification (4), interpretation of the effect of having a college degree indicates that those who have 4 years or more of college earn

79.3% higher earnings than those with less than a high school diploma/GED.[9]

Table 5.4: Educational Spending on Earnings - Heckman

	(1)	(2)	(3)	(4)	(5)
K-12 Educational Spending$_{t-10}$	-0.005^{***}	-0.006^{***}	-0.006^{***}	-0.018^{***}	-0.030^{***}
	(0.001)	(0.001)	(0.001)	(0.004)	(0.005)
K-12 Education Spending$^2{}_{t-10}$				0.001^{***}	0.000
				(0.000)	(0.000)
AE Spending$_{t-10}$	0.002^{**}	0.002^{*}	0.003^{**}	0.003^{***}	0.002^{**}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Educational Spending$_{t-10}$ × HS					0.008^{**}
					(0.004)
Educational Spending$_{t-10}$ × SC					0.009^{***}
					(0.003)
Educational Spending$_{t-10}$ × C					0.033^{***}
					(0.003)
High School Graduate	0.280^{***}		0.231^{***}	0.231^{***}	0.180^{***}
	(0.007)		(0.007)	(0.007)	(0.024)
Some College (1-3 years)	0.286^{***}		0.372^{***}	0.372^{***}	0.317^{***}
	(0.006)		(0.006)	(0.006)	(0.022)
College (4+ years)	0.592^{***}		0.948^{***}	0.948^{***}	0.739^{***}
	(0.007)		(0.013)	(0.013)	(0.024)
Inverse Mills ratio	-0.528^{***}	-1.617^{***}	0.636^{***}	0.635^{***}	0.626^{***}
	(0.010)	(0.014)	(0.041)	(0.041)	(0.041)

Note: Total Observations: 1,245,788. Censored Observations: 844,008. Full regression results are shown in the Appendix, Table A.8. AE Spending is average-weighted educational spending from Chapter 4. In the variables Educational Spending$_{t-10}$ × SC and Educational Spending$_{t-10}$ × C, SC indicates "some college" and C indicates "college". Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

[9]Because the variable *college* is included in both the outcome equation and selection equation, the marginal effect is calculated a little differently than if it had only entered the outcome equation.

5.3.1 Calculation of Lifetime Earnings Benefits vs. Costs

It is then possible to calculate the present value of benefits for the individual.[10] To do so, the total differentials of in-state and out-of-state educational spending evaluated at the mean are multiplied by the mean of earnings of individuals. We see that the in-state education spending impact on earnings is negative and the out-of-state impact on earnings is positive. For in-state educational spending increases of $1,000 this gives a -$180.70 and -$331.28 impact on future earnings. For out-of-state educational spending increases of $1,000 this gives a $60.23 impact on future earnings.

To determine the benefits of this educational spending in terms of future lifetime earnings, this value is then discounted for 40 years. Proper discounting is done using a 3% discount rate, as is standard.[11] This final value gives the appropriately discounted present value of the earnings benefits from educational spending. Overall, the discounted future earnings benefits of the in-state educational spending per additional $1,000 is between -$4,357 and -$7,988, while the future earnings benefits associated with out-of-state educational spending per additional $1,000 is $1,452.

Next, as done in Chapter 4, I determine if educational spending is set so that the future lifetime earnings benefits are greater than the cost. Applying a $1,000 increase per pupil per year for grades K-12 assumes that the total amount spent on education is $13,000 per pupil. Then, due to using a ten-year lag on the education variables, this $13,000 needs to be properly discounted for those 10 years. Again using a 3% discount rate, this $13,000 becomes $17,470 as the total education cost. Finally, to calculate the net benefit of education, this cost value is subtracted from the benefits previously found. Doing so for the in-state educational spending results in negative net benefits of -$20,487 and -$24,118, while the out-of-state educational spending

[10] Equations for a very similar procedure are shown in Chapter 4.

[11] Varied discount rate and found similar results. Hanushek et al. (2015) use a 3% discount rate.

also results in negative net benefits although slightly smaller at -$14,678. Then, to see the total social net benefit of future earnings, I add the in-state net benefits to the out-of-state net benefits. This results in -$35,165 to -$38,796 in future earnings. These results indicate that we may be overproviding educational spending.

Although these results may not be what we expect to find, the results still offer some insight into this area of research. Similar to the results of Chapter 4, we see a negative impact on earnings from those who are educated and then work in the same state and we see a positive impact on earnings from those who are educated in one state and work in another. As suggested in Chapter 4, because of this positive impact from out-of-state movers, these individuals may be somehow different than those individuals who do not move across state borders. As shown in the summary statistics of Table 5.3, we know that movers earn higher earnings and are more educated. While I cannot pinpoint why these individuals are more educated and earn higher earnings, I can say that these individuals may be the driving factor behind this positive spillover of benefits to future earnings.

5.4 Caveats, Contributions, and Extensions

There are a few ways that this chapter can be improved upon. As mentioned in the empirical methodology section, this investigation may require a more sophisticated estimation technique in order to avoid selection bias found in the variables that measure whether an individual is employed and whether the individual has moved out of their state of birth. Advanced methods for this estimation are currently being examined and are forthcoming. Regarding the data in estimation, educational spending is assigned at the state-level rather than the individual, county, or puma levels. This was necessary due to the data for educational spending not being available during the timeframe of this analysis. Having this data would allow for an even more accurate depiction of how educational spending affects future earnings across state borders.

If/when this data becomes available, this change will be one of the first modifications I make.

This chapter contributes to the literature because of its main focus on educational investment spillovers across people and across state borders using individual-level data. The results of this chapter indicate that state-level educational investments impact future earnings across state borders due to labor migration. This suggests that the results are not only important to the literature but also to policy makers. As this chapter shows, educational investments chosen in one state impact the future earnings of those in other states when individuals move across state lines. Being aware of this impact, is therefore, very important when setting policies that could encourage movement between states. The results of this chapter are also important because the values here prove an assumption society has already made. Through human interaction, we know individuals affect one another's daily lives. Given these results, it is important to understand that individuals can also impact the future earnings and sucesses of everyone they interact with, especially those who move across borders. Future extensions to this chapter include more precise estimation techniques and data as mentioned above. In addition, examining policies that have affected migration patterns in the past could offer interesting insights to the relationship between educational spending and future earnings.

Chapter 6 Conclusion

The results of this dissertation indicate that the total net earnings from K-12 educational spending is negative. The estimation I offer here provides a different perspective on how we see the benefits resulting from educational investment. While some may be surprised by the negative results, there are many reasons behind this negative finding.

Like I stated in the results and conclusion of Chapter 4, these negative net earnings may simply be indicating that the government is overspending on education. While we like to think that our government has our best interest in mind when setting education policies, it is crucial to remember that our government is made up of different parties with different political interests and goals. Because of this, it is possible that educational spending is not always set at optimal levels. If education is overprovided, a decrease in educational investment could lead to positive net earnings as described by my theoretical model illustration. In addition, these negative results may be indicating that public educational investments are crowding out other public and private investments that more prominently affect future earnings benefits. Again, a decrease in educational investment could result in positive net earnings if this decrease causes an increase in other investments that positively affect future earnings.

Furthermore, it is important to recognize that I do not account for the other numerous benefits gained from investments in education. As mentioned in Chapter 2, increased education leads to many non-monetary benefits to society. These benefits include better health, lower crime rates, and the promotion of civic activity, just to name a few. Without including every benefit of education, it is impossible to know for sure whether the benefits from the levels of education used in this dissertation are greater than the cost of education. I leave it up to the reader's discretion whether the

numerous non-monetary benefits hold a value that outweigh the negative earnings benefits found in this dissertation.

From the results found in this dissertation, one specific aspect stands clear in support of policy implications: there are cross-border spillovers from education investment. This finding shows that each state's policies regarding education influence other states, especially when those in the population migrate to another state. This relationship between states implies that a federal policy for education may promote positive earnings benefits from education investment. Similar to Hanushek et al. (2015), this dissertation supports education policies and reform that focus on all states and their interrelationships rather than each individual state separately. Future work on this topic would include a closer look at past policy changes and associated outcomes as well as counterfactual federal policies regarding education investment and quality. In addition, if data are available, investigating the existence of education spillovers at the county/district level could provide interesting insight into whether current state and local policies are the best option. While providing insights and a different perspective on the benefits of education investment at the state and individual levels, the results of this dissertation strongly encourage future research in this area.

Appendix A

A.1 Chapter 3 Appendix

My theoretical model operates in a balanced-budget framework. For simplicity purposes, I set $E_0^A = T_0^A$ so that taxes are not shown in the equation. The model starts with $-E_0^A$. This term represents the loss in wages due to taxes. No wages are shown for time 0 because these wages are already determined and do not have an effect on this model. State A is only concerned about the wages of those working in state A: (w^A). Because of migration, the wages of state A include those educated in and now working in state A as well as those who were educated in state B and now work in State A: $w^A = \frac{L_1^{BA}}{L_1^{AA}} w^{AA} + \frac{L_1^{AA}}{L_1^{AA}} w^{BA}$. w^{AA} depends on the education of state A but also the education of state B as shown in the theoretical model: $w_1^{AA}(E_0^A, E_0^B \times \frac{L_1^{BA}}{L_1^{AA}})$ in which $\frac{L_1^{BA}}{L_1^{AA}}$ is weighting E_0^B for migration, and has a value less than 1. The second term of the w_1^{AA} function thus takes spillovers into account. The people educated in B who then move to A could influence those people educated in A, thus having an impact on the wages of those in state A.

A.2 Chapter 4 Appendix

Table A.1: Summary Statistics

Variable	Mean	Std. Dev.
Earnings Growth	0.01	0.02
Employment Growth	0.01	0.02
Own Education Spending$_{t-10}$	3.68	2.25
K-12 Enrollment Rate$_{t-10}$	0.18	0.03
College Enrollment Rate$_{t-10}$	0.05	0.01
College Exp.$_{t-10}$	12.53	3.34
% of population born in current state of residence	0.72	0.13
Tax Per Capita$_{t-2}$	1.63	0.89
Own NAEP test score$_{t-10}$	270.00	12.00
State Own revenue as a percentage of GSP$_{t-10}$	0.12	0.03
Other government expenditure as a % of GSP$_{t-10}$	0.12	0.03
Agriculture as a % of GSP (contemporaneous)	0.02	0.02
Manufacturing as a % of GSP (contemporaneous)	0.15	0.07
% of Adults (25+ years) with a highschool diploma	0.32	0.04
% of Adults (25+ years) with some college (1-3 years)	0.22	0.07
% of Adults (25+ years) with college (4+ years)	0.32	0.05

Note: N=1,650. Statistics are for 50 states from 1982-2014 and are in 2015 dollars. Earnings, Education Exp, College Exp, and Taxes are measured in per capita/per pupil terms. Earnings are measured in dollars. Education Exp, College Exp, and Taxes are measured in 1000s of dollars. Educational attainment values are measured as highest attainment achieved.

Table A.2: Percent of Population born in current state or residence, 1970 & 2010.

State	% of 1970 population born in current state of residence	% of 2010 population born in current state of residence	1970: Top 4 most popular states where current residence were born
ALABAMA	84.99	70.0	Georgia, Mississippi, Tennessee, Florida
ALASKA	40.92	39.0	California, Washington, Texas, Oregon
ARIZONA	45.47	37.7	Illinois, Texas, California, Ohio
ARKANSAS	77.73	61.3	Texas, Missouri, Oklahoma, Mississippi
CALIFORNIA	57.48	53.8	Texas, Illinois, New York, Oklahoma
COLORADO	52.18	42.5	Kansas, Nebraska, Illinois, Iowa
CONNECTICUT	71.74	55.1	New York, Massachusetts, Pennsylvania, Maine
DELAWARE	61.89	45.3	Pennsylvania, Maryland, New York, Virginia
DISTRICT OF COLUMBIA	58.92	37.3	Virginia, North Carolina, South Carolina, Maryland
FLORIDA	48.41	35.2	New York, Georgia, Pennsylvania, Ohio
GEORGIA	79.41	55.2	Alabama, Florida, Tennessee, South Carolina
HAWAII	76.89	55.0	California, New York, Pennsylvania, Illinois
IDAHO	57.81	46.9	Utah, Washington, California, Oregon
ILLINOIS	77.85	67.1	Mississippi, Missouri, Wisconsin, Indiana
INDIANA	75.04	68.3	Kentucky, Illinois, Ohio, Tennessee
IOWA	82.02	71.7	Illinois, Missouri, Nebraska, Minnesota
KANSAS	67.94	58.2	Missouri, Oklahoma, Nebraska, Texas
KENTUCKY	84.57	70.3	Ohio, Tennessee, Indiana, Illinois
LOUISIANA	84.12	78.8	Mississippi, Texas, Arkansas, Alabama
MAINE	83.51	64.0	Massachusetts, New Hampshire, New York, Connecticut
MARYLAND	62.54	47.6	District of Columbia, Pennsylvania, Virginia, New York
MASSACHUSETTS	84.09	63.1	New York, Maine, Connecticut, Rhode Island
MICHIGAN	77.68	76.6	Ohio, Illinois, Pennsylvania, Indiana
MINNESOTA	80.12	68.8	Minnesota, Wisconsin, Iowa, North Dakota
MISSISSIPPI	85.79	71.9	Alabama, Louisiana, Tennessee, Arkansas
MISSOURI	76.07	65.9	Illinois, Kansas, Arkansas, Iowa
MONTANA	63.08	54.1	North Dakota, Minnesota, Washington, Idaho
NEBRASKA	76.72	65.6	Iowa, Kansas, Missouri, South Dakota
NEVADA	38.08	24.3	California, Utah, Texas, New York
NEW HAMPSHIRE	66.78	42.7	Massachusetts, Maine, Vermont, New York
NEW JERSEY	71.51	52.4	New York, Pennsylvania, North Carolina, Virginia
NEW MEXICO	60.15	51.7	Texas, Oklahoma, Colorado, California
NEW YORK	87.51	63.6	Pennsylvania, New Jersey, South Carolina, North Carolina
NORTH CAROLINA	83.89	58.5	South Carolina, Virginia, Georgia, New York
NORTH DAKOTA	79.23	68.6	Minnesota, South Dakota, Iowa, Montana
OHIO	76.03	75.1	Kentucky, Pennsylvania, West Virginia, Indiana
OKLAHOMA	67.88	60.8	Texas, Arkansas, Kansas, Missouri
OREGON	54.01	45.5	California, Washington, Idaho, Nebraska
PENNSYLVANIA	88.13	74.0	New York, New Jersey, Ohio, Virginia
RHODE ISLAND	77.57	59.3	Massachusetts, New York, Connecticut, Pennsylvania
SOUTH CAROLINA	81.2	58.6	North Carolina, Georgia, New York, Virginia
SOUTH DAKOTA	75.33	65.1	Iowa, Minnesota, North Dakota, Nebraska
TENNESSEE	79.17	61.0	Mississippi, Alabama, Kentucky, Virginia
TEXAS	78.94	60.5	Oklahoma, Louisiana, Arkansas, California
UTAH	75.37	62.3	Idaho, California, Colorado, Wyoming
VERMONT	75.14	51.1	New York, Massachusetts, New Hampshire, Connecticut
VIRGINIA	68.84	49.9	North Carolina, West Virginia, Pennsylvania, New York
WASHINGTON	57.7	46.9	California, Oregon, Minnesota, North Dakota
WEST VIRGINIA	85.05	71.1	Ohio, Virginia, Pennsylvania, Kentucky
WISCONSIN	83.89	72.1	Illinois, Minnesota, Michigan, Iowa
WYOMING	52.11	41.5	Nebraska, Colorado, Iowa, Texas

Table A.3: Educational Spending on Earnings Growth

	(1)	(2)	(3)
Earnings Growth$_{t-1}$	−0.144**	−0.143**	−0.142**
	(0.060)	(0.058)	(0.058)
(OE) Own Educational Spending$_{t-10}$	0.001		
	(0.003)		
Own Education Spending$^2{}_{t-10}$	−0.000		
	(0.000)		
(AE) Average-weighted Educational Spending$_{t-10}$		0.001	
		(0.003)	
Average-weighted Education Spending$^2{}_{t-10}$		−0.000	
		(0.000)	
(IE) In-state-weighted Educational Spending$_{t-10}$			−0.000
			(0.002)
In-state-weighted Education Spending$^2{}_{t-10}$			−0.000**
			(0.000)
(TE) Out-of-state-weighted Educational Spending$_{t-10}$			0.004
			(0.005)
Out-of-state-weighted Education Spending$^2{}_{t-10}$			−0.002
			(0.001)

Table 3(continued): Educational Spending on Earnings Growth

High school diploma$_{t-10}$	-0.038^{**}	-0.036^{*}	-0.039^{**}
	(0.019)	(0.019)	(0.017)
Some College (1-3 years)$_{t-10}$	-0.049^{**}	-0.055^{**}	-0.056^{**}
	(0.023)	(0.023)	(0.025)
College (4+ years)$_{t-10}$	0.081^{**}	0.088^{***}	0.071^{**}
	(0.032)	(0.032)	(0.034)
K-12 Enrollment Rate$_{t-10}$	-0.032	-0.036	-0.039
	(0.055)	(0.057)	(0.054)
College Enrollment Rate$_{t-10}$	-0.008	-0.005	-0.001
	(0.056)	(0.056)	(0.063)
College Expenditure$_{t-10}$	-0.001^{***}	-0.001^{***}	-0.001^{***}
	(0.000)	(0.000)	(0.000)
Taxes Per Capita$_{t-2}$	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Other Gov't Expenditure as a % of GSP$_{t-10}$	0.092^{***}	0.088^{***}	0.093^{***}
	(0.028)	(0.026)	(0.027)
Agriculture as a % of GSP (contemp.)	0.194^{***}	0.197^{***}	0.191^{***}
	(0.064)	(0.062)	(0.063)
Manufacturing as a % of GSP (contemp.)	0.044^{***}	0.043^{***}	0.043^{***}
	(0.012)	(0.011)	(0.011)
Observations	1,650	1,650	1,650
Number of Groups (States)	50	50	50
Number of Instruments	44	44	46
F-Statistic	556.69	857.51	960.87
AR(1)	0.000	0.000	0.000
AR(2)	0.736	0.707	0.688
Hansen Test	0.484	0.531	0.555
Difference-in-Hansen Test	0.484	0.531	0.555
Marginal Effect of High School Diploma	-0.038^{**}	-0.036^{*}	-0.039^{**}
Marginal Effect of Some College	-0.049^{**}	-0.055^{**}	-0.056^{**}
Marginal Effect of College	0.081^{**}	0.088^{***}	0.071^{**}
Total Effect of Educational Spending	-0.001	-0.002	-0.002
Total Effect of Educational Spending (out-of-state)			0.001

Note: Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A.4: Educational Spending on Earnings Growth

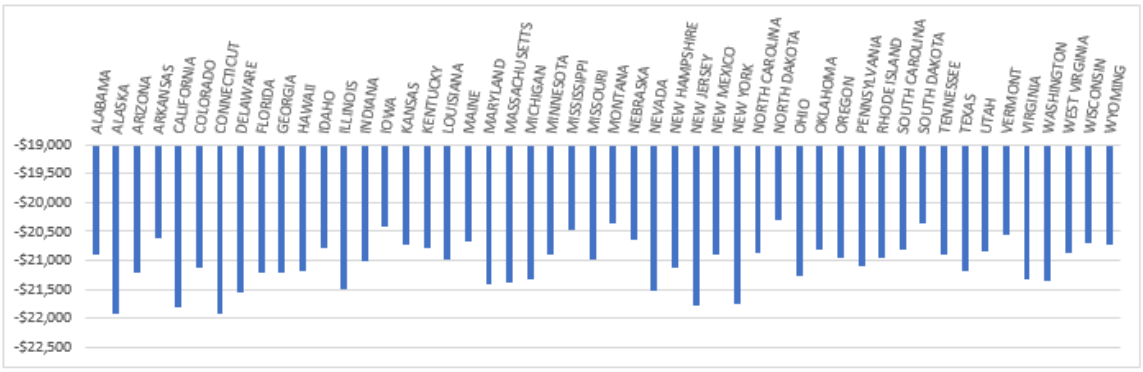
	(1)	(2)	(3)
Earnings Growth$_{t-1}$	-0.146^{***}	-0.146^{***}	-0.144^{***}
	(0.051)	(0.052)	(0.054)
(OE) Own Educational Spending$_{t-10}$	-0.007		
	(0.004)		
Own Education Spending$^2{}_{t-10}$	0.000^{*}		
	(0.000)		
Own Educational Spending$_{t-10}$ × HS	0.009		
	(0.007)		
Own Educational Spending$_{t-10}$ × Some College	0.023^{**}		
	(0.010)		
Own Educational Spending$_{t-10}$ × College	-0.037^{**}		
	(0.015)		
(AE) Average-weighted Educational Spending$_{t-10}$		-0.008^{*}	
		(0.004)	
Average-weighted Education Spending$^2{}_{t-10}$		0.000	
		(0.000)	
Average-weighted Educational Spending$_{t-10}$ × HS		0.013^{*}	
		(0.007)	
Average-weighted Educational Spending$_{t-10}$ × Some College		0.020^{*}	
		(0.011)	
Average-weighted Educational Spending$_{t-10}$ × College		-0.031^{*}	
		(0.016)	
(IE) In-state-weighted Educational Spending$_{t-10}$			-0.005
			(0.006)
In-state-weighted Education Spending$^2{}_{t-10}$			0.000
			(0.000)
In-state-weighted Educational Spending$_{t-10}$ × HS			0.009
			(0.008)
In-state-weighted Educational Spending$_{t-10}$ × Some College			0.020^{*}
			(0.012)
In-state-weighted Educational Spending$_{t-10}$ × College			-0.032^{**}
			(0.016)
(TE) Out-of-state-weighted Educational Spending$_{t-10}$			0.004
			(0.005)
Out-of-state-weighted Education Spending$^2{}_{t-10}$			-0.002
			(0.001)

Table 4(continued): Educational Spending on Earnings Growth

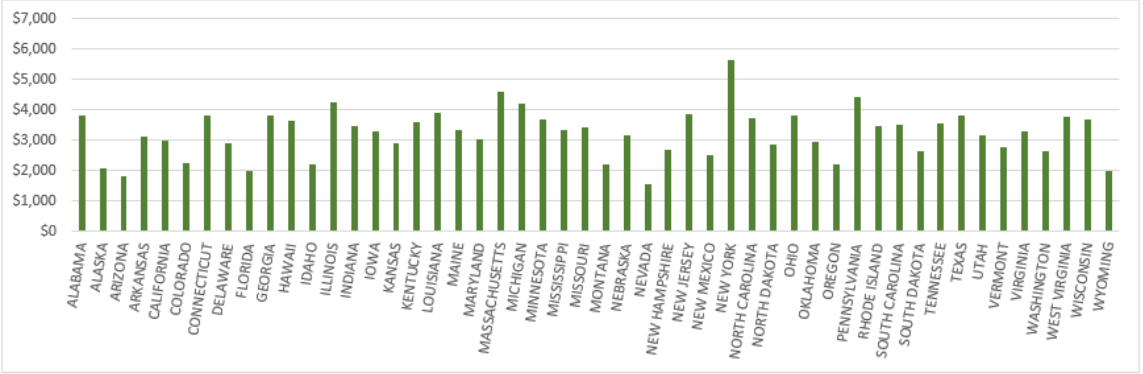
High School$_{t-10}$	-0.062^{**}	-0.073^{***}	-0.063^{**}
	(0.026)	(0.024)	(0.024)
Some College (1-3 years)$_{t-10}$	-0.160^{***}	-0.147^{**}	-0.131^{**}
	(0.057)	(0.065)	(0.052)
College (4+ years)$_{t-10}$	0.280^{***}	0.259^{***}	0.187^{***}
	(0.084)	(0.090)	(0.069)
K-12 Enrollment Rate$_{t-10}$	-0.033	-0.033	-0.017
	(0.055)	(0.058)	(0.058)
College Enrollment Rate$_{t-10}$	-0.024	-0.022	-0.021
	(0.065)	(0.065)	(0.066)
College Expenditure$_{t-10}$	-0.001^{***}	-0.001^{***}	-0.001^{***}
	(0.000)	(0.000)	(0.000)
Taxes Per Capita$_{t-2}$	0.001	0.001	0.002
	(0.001)	(0.001)	(0.001)
Other Gov't Expenditure as a % of GSP$_{t-10}$	0.074^{***}	0.078^{***}	0.084^{***}
	(0.027)	(0.026)	(0.025)
Agriculture as a % of GSP (contemp.)	0.229^{***}	0.226^{***}	0.218^{***}
	(0.068)	(0.068)	(0.071)
Manufacturing as a % of GSP (contemp.)	0.040^{***}	0.041^{***}	0.042^{***}
	(0.012)	(0.012)	(0.013)
Observations	1,650	1,650	1,650
Number of Groups (States)	50	50	50
Number of Instruments	47	47	49
F-Statistic	478.76	661.72	617.27
AR(1)	0.000	0.000	0.000
AR(2)	0.789	0.781	0.748
Hansen Test	0.538	0.544	0.554
Difference-in-Hansen Test	0.538	0.544	0.554
Marginal Effect of High School Diploma	-0.030	-0.027	-0.040^{*}
Marginal Effect of Some College	-0.079^{**}	-0.076^{**}	-0.079^{**}
Marginal Effect of College	0.147^{***}	0.148^{***}	0.106^{***}
Total Effect of Educational Spending	-0.003^{**}	-0.003^{**}	-0.003
Total Effect of Educational Spending (out-of-state)			0.001

Note: Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

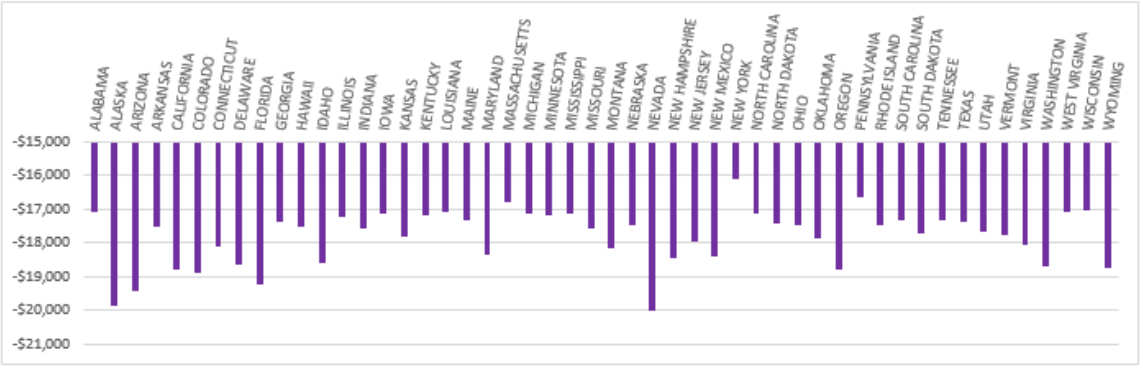
Figure A.1: Earnings Benefits for 25th percentile



(a) In-State Educational Spending Net Benefit: 25th percentile

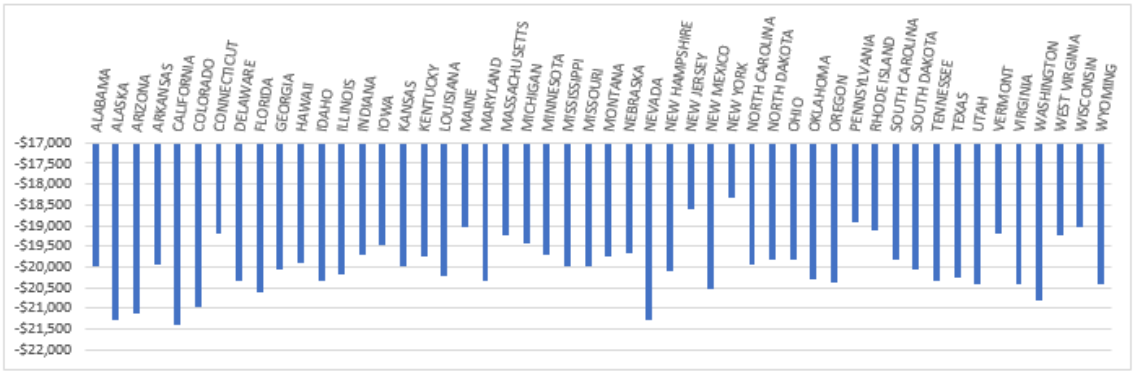


(b) Spillover of Earnings Benefits from Out-of-State Educational Spending: 25th percentile

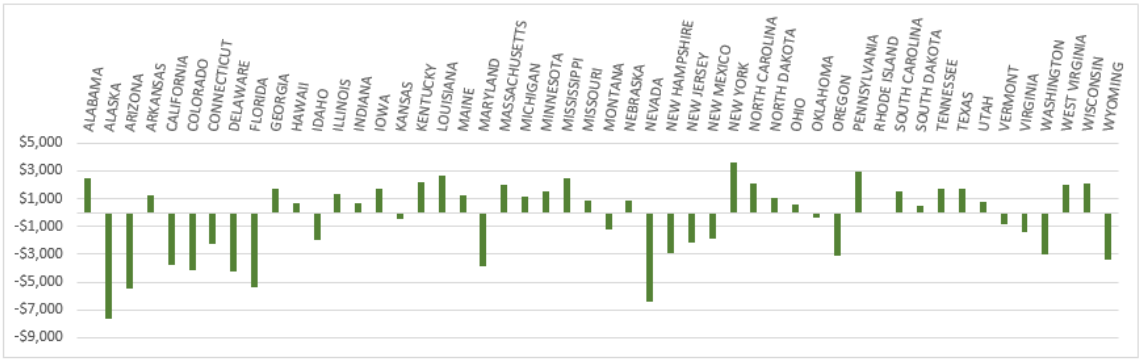


(c) Total Benefit from Educational Spending: 25th percentile

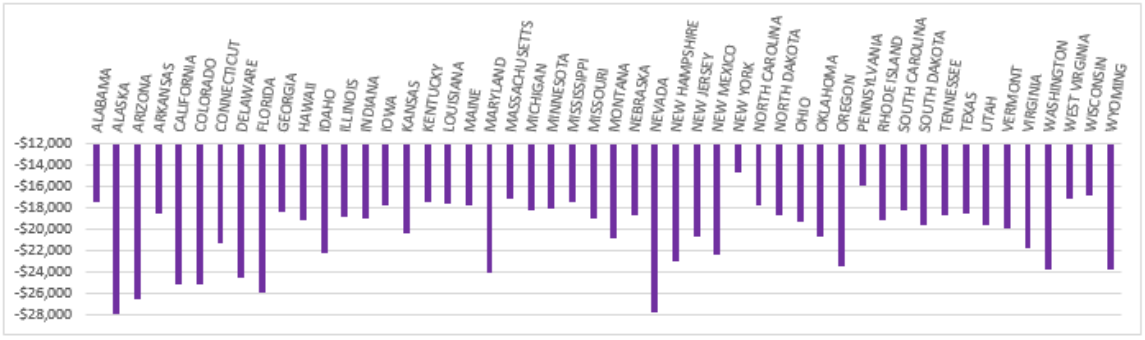
Figure A.2: Earnings Benefits for 75th percentile



(a) In-State Educational Spending Net Benefit: 75th percentile



(b) Spillover of Earnings Benefits from Out-of-State Educational Spending: 75th percentile



(c) Total Benefit from Educational Spending: 75th percentile

Table A.5: NAEP Test Score on Earnings Growth

	(1)	(2)	(3)
Earnings Growth$_{t-1}$	-0.133^{***}	-0.131^{***}	-0.139^{***}
	(0.042)	(0.040)	(0.042)
Own NAEP$_{t-10}$	0.001^{**}		
	(0.000)		
Own NAEP$_{t-10}$ × HS	-0.003^{**}		
	(0.001)		
Own NAEP$_{t-10}$ × Some College	0.002^{**}		
	(0.001)		
Own NAEP$_{t-10}$ × College	-0.003		
	(0.002)		
Average-weighted NAEP$_{t-10}$		0.001	
		(0.001)	
Average-weighted NAEP$_{t-10}$ × HS		-0.003	
		(0.002)	
Average-weighted NAEP$_{t-10}$ × Some College		0.004^{***}	
		(0.001)	
Average-weighted NAEP$_{t-10}$ × College		-0.004^{**}	
		(0.002)	
In-state-weighted NAEP$_{t-10}$			0.000
			(0.000)
In-state-weighted NAEP$_{t-10}$ × HS			-0.001
			(0.001)
In-state-weighted NAEP$_{t-10}$ × Some College			0.000
			(0.000)
In-state-weighted NAEP$_{t-10}$ × College			-0.001
			(0.001)
Out-of-state-weighted NAEP$_{t-10}$			-0.000^{**}
			(0.000)
High school diploma$_{t-10}$	0.827^{**}	0.694	0.097
	(0.372)	(0.484)	(0.154)
Some College (1-3 years)$_{t-10}$	-0.627^{**}	-1.066^{***}	-0.018
	(0.297)	(0.369)	(0.077)
College (4+ years)$_{t-10}$	0.746^{*}	1.289^{**}	0.171^{*}
	(0.418)	(0.528)	(0.102)

Table 5(continued): NAEP Test Score on Earnings Growth

K-12 Enrollment Rate$_{t-10}$	-0.017	-0.012	-0.028
	(0.046)	(0.047)	(0.045)
College Enrollment Rate$_{t-10}$	0.019	0.012	0.020
	(0.069)	(0.069)	(0.076)
College Expenditure$_{t-10}$	-0.001^{***}	-0.001^{***}	-0.001^{***}
	(0.000)	(0.000)	(0.000)
Taxes Per Capita$_{t-2}$	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
Other Gov't Expenditure as a % of GSP$_{t-10}$	0.076^{***}	0.073^{***}	0.081^{***}
	(0.021)	(0.021)	(0.022)
Agriculture as a % of GSP (contemp.)	0.229^{***}	0.222^{***}	0.237^{***}
	(0.057)	(0.056)	(0.067)
Manufacturing as a % of GSP (contemp.)	0.055^{***}	0.054^{***}	0.055^{***}
	(0.014)	(0.014)	(0.014)
Observations	1,650	1,650	1,650
Number of Groups (States)	50	50	50
Number of Instruments	49	49	50
F-Statistic	3,348.57	1,756.25	2,147.97
AR(1)	0.001	0.001	0.001
AR(2)	0.698	0.673	0.758
Hansen Test	0.630	0.678	.531
Difference-in-Hansen Test	0.630	0.678	.531
Marginal Effect of High School Diploma	-0.030^{**}	-0.028^{*}	-0.023
Marginal Effect of Some College	-0.033	-0.037	-0.009
Marginal Effect of College	0.069^{***}	0.076^{***}	0.067^{***}
Total Effect of NAEP Scores	0.000^{**}	0.000^{**}	0.000^{**}
Total Effect of NAEP Scores (out-of-state)			0.000^{**}

Note: Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A.6: Educational Spending on Employment Growth

	(1)	(2)	(3)
Employment Growth$_{t-1}$	0.615***	0.615***	0.614***
	(0.063)	(0.063)	(0.062)
(OE) Own Educational Spending$_{t-10}$	0.001		
	(0.002)		
Own Educational Spending$_{t-10}$ × HS	0.001		
	(0.005)		
Own Educational Spending$_{t-10}$ × SC	−0.004		
	(0.003)		
Own Educational Spending$_{t-10}$ × C	0.004		
	(0.006)		
(AE) Average-weighted Educational Spending$_{t-10}$		0.001	
		(0.002)	
Average-weighted Education Spending$^2{}_{t-10}$ (1,000s)		0.052	
		(0.144)	
Average-weighted Educational Spending$_{t-10}$ × HS		0.003	
		(0.005)	
Average-weighted Educational Spending$_{t-10}$ × SC		−0.005	
		(0.004)	
Average-weighted Educational Spending$_{t-10}$ × C		0.004	
		(0.007)	
Average-weighted Educational Spending$_{t-10}$ × W		−0.003***	
		(0.001)	
(IE) In-state-weighted Educational Spending$_{t-10}$ (1,000s)			0.249
			(2.043)
In-state-weighted Education Spending$^2{}_{t-10}$ (1,000s)			0.112
			(0.143)
In-state-weighted Educational Spending$_{t-10}$ × HS			0.001
			(0.006)
In-state-weighted Educational Spending$_{t-10}$ × SC (1,000s)			0.263
			(4.397)
In-state-weighted Educational Spending$_{t-10}$ × C			0.005
			(0.006)
In-state-weighted Educational Spending$_{t-10}$ × W			−0.003**
			(0.001)
(TE) Out-of-state-weighted Educational Spending$_{t-10}$			−0.003
			(0.003)
Out-of-state-weighted Education Spending$^2{}_{t-10}$ (1,000s)			0.204
			(0.373)

Table 6(continued): Educational Spending on Employment Growth

High school diploma$_{t-10}$	−0.020	−0.029	−0.017
	(0.021)	(0.022)	(0.019)
Some College (1-3 years)$_{t-10}$	0.045**	0.050*	0.019
	(0.022)	(0.025)	(0.020)
College (4+ years)$_{t-10}$	−0.025	−0.028	−0.016
	(0.034)	(0.038)	(0.023)
Percent of Labor Force White$_{t-10}$	0.015***	0.016***	0.015***
	(0.006)	(0.005)	(0.005)
K-12 Enrollment Rate$_{t-10}$	−0.005	0.000	−0.000
	(0.019)	(0.020)	(0.019)
% Born in current state of residence	−0.003	−0.004	−0.012
	(0.002)	(0.003)	(0.010)
College Enrollment Rate$_{t-10}$	−0.056	−0.057	−0.053
	(0.038)	(0.037)	(0.035)
College Expenditure$_{t-10}$ (1,000s)	−0.024	−0.046	−0.013
	(0.086)	(0.089)	(0.092)
Taxes Per Capita$_{t-2}$	−0.001**	−0.001*	−0.001*
	(0.000)	(0.000)	(0.000)
State Own Revenue as a % of GSP$_{t-10}$	−0.000	−0.006	−0.004
	(0.017)	(0.017)	(0.017)
Other Gov't Expenditure as a % of GSP$_{t-10}$	−0.004	−0.003	−0.005
	(0.014)	(0.014)	(0.014)
Agriculture as a % of GSP (contemp.)	−0.002	0.001	0.002
	(0.018)	(0.017)	(0.018)
Manufacturing as a % of GSP (contemp.)	−0.007*	−0.006	−0.008*
	(0.004)	(0.004)	(0.004)
Observations	1,200	1,200	1,200
Number of Groups (States)	50	50	50
Number of Instruments	45	45	47
F-Statistic	3,286.86	2,534.33	7,821.68
AR(1)	0.000	0.000	0.000
AR(2)	0.219	0.218	0.219
Hansen Test	0.729	0.739	0.792
Difference-in-Hansen Test	0.729	0.739	0.792
Marginal Effect of High School Diploma	-0.020	-0.029	-0.017
Marginal Effect of Some College	0.045**	0.050*	0.019
Marginal Effect of College	-0.025	-0.028	-0.016
Total Effect of Educational Spending	-0.001	-0.000	-0.001
Total Effect of Educational Spending (out-of-state)			-0.003

Note: HS: High School, SC: Some College, C: College, W: white. Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A.7: NAEP Test Score on Employment Growth

	(1)	(2)	(3)
Employment Growth$_{t-1}$	0.617***	0.617***	0.615***
	(0.062)	(0.062)	(0.063)
Own NAEP$_{t-10}$ (1,000s)	0.136		
	(0.300)		
Own NAEP$_{t-10}$ × HS	−0.001		
	(0.001)		
Own NAEP$_{t-10}$ × Some College	−0.001**		
	(0.001)		
Own NAEP$_{t-10}$ × College	0.002***		
	(0.001)		
Own NAEP$_{t-10}$ × % White (1,000s)	0.008		
	(0.007)		
Average-weighted NAEP$_{t-10}$ (1,000s)		0.056	
		(0.354)	
Average-weighted NAEP$_{t-10}$ × HS (1,000s)		−0.470	
		(1.067)	
Average-weighted NAEP$_{t-10}$ × Some College		−0.001*	
		(0.001)	
Average-weighted NAEP$_{t-10}$ × College		0.002***	
		(0.001)	
Average-wegihted NAEP$_{t-10}$ × % White (1,000s)		0.007	
		(0.008)	
In-state-weighted NAEP$_{t-10}$ (1,000s)			−0.084
			(0.118)
In-state-weighted NAEP$_{t-10}$ × HS (1,000s)			−0.017
			(0.218)
In-state-weighted NAEP$_{t-10}$ × Some College (1,000s)			−0.120
			(0.122)
In-state-weighted NAEP$_{t-10}$ × College			0.001**
			(0.000)
In-state-weighted NAEP$_{t-10}$ × % White (1,000s)			0.019
			(0.014)
Out-of-state-weighted NAEP$_{t-10}$ (1,000s)			−0.000
			(0.000)

Table 7(continued): NAEP Test Score on Employment Growth

High School Diploma$_{t-10}$	0.170	0.114	−0.017
	(0.232)	(0.292)	(0.045)
Some College (1-3 years)$_{t-10}$	0.405**	0.401*	0.035
	(0.171)	(0.218)	(0.029)
College (4+ years)$_{t-10}$	−0.518***	−0.570***	−0.113**
	(0.165)	(0.205)	(0.051)
K-12 Enrollment Rate$_{t-10}$	0.010	0.008	0.022
	(0.018)	(0.019)	(0.017)
% Born in current state of residence	−0.002	−0.003	−0.131
	(0.003)	(0.003)	(0.083)
College Enrollment Rate$_{t-10}$	−0.052	−0.050	−0.055
	(0.035)	(0.036)	(0.035)
College Expenditure$_{t-10}$ (1,000s)	−0.016	−0.013	0.079
	(0.081)	(0.081)	(0.090)
Taxes Per Capita$_{t-2}$	−0.001***	−0.001***	−0.001**
	(0.000)	(0.000)	(0.000)
State Own Revenue as a % of GSP$_{t-10}$	−0.005	−0.010	−0.017
	(0.017)	(0.017)	(0.016)
Other Gov't Expenditure as a % of GSP$_{t-10}$	−0.002	0.000	0.009
	(0.014)	(0.014)	(0.013)
Agriculture as a % of GSP (contemp.)	0.018	0.012	0.018
	(0.019)	(0.019)	(0.018)
Manufacturing as a % of GSP (contemp.)	−0.006	−0.008*	−0.005
	(0.004)	(0.004)	(0.004)
Observations	1,200	1,200	1,200
Number of Groups (States)	50	50	50
Number of Instruments	43	43	44
F-Statistic	1,169.20	1,055.93	1,225.79
AR(1)	0.000	0.000	0.000
AR(2)	0.230	0.223	0.225
Hansen Test	0.874	0.828	0.970
Difference-in-Hansen Test	0.874	0.828	0.970
Marginal Effect of High School Diploma	-0.011	-0.013	−0.021**
Marginal Effect of Some College	0.031***	0.030**	0.012
Marginal Effect of College	-0.008	-0.012	0.001
Total Effect of NAEP Scores	-0.000	0.000	0.000
Total Effect of NAEP Scores(out-of-state)			-0.0000

Note: Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A.8: Educational Spending and NAEP Test Scores on Earnings Growth

	(1)	(2)	(3)
Earnings Growth$_{t-1}$	-0.143^{***}	-0.143^{***}	-0.145^{***}
	(0.047)	(0.047)	(0.049)
(OE) Own Educational Spending$_{t-10}$	-0.006		
	(0.005)		
Own Education Spending$^2{}_{t-10}$	0.000		
	(0.000)		
Own Educational Spending$_{t-10}$ × HS	0.010		
	(0.007)		
Own Educational Spending$_{t-10}$ × SC	0.022^{**}		
	(0.010)		
Own Educational Spending$_{t-10}$ × C	-0.036^{**}		
	(0.014)		
Own NAEP$_{t-10}$	-0.000^{*}		
	(0.000)		
(AE) Average-weighted Educational Spending$_{t-10}$		-0.007	
		(0.005)	
Average-weighted Education Spending$^2{}_{t-10}$		0.000	
		(0.000)	
Average-weighted Educational Spending$_{t-10}$ × HS		0.014^{**}	
		(0.007)	
Average-weighted Educational Spending$_{t-10}$ × SC		0.019^{*}	
		(0.011)	
Average-weighted Educational Spending$_{t-10}$ × C		-0.029^{*}	
		(0.016)	
Average-weighted NAEP$_{t-10}$		-0.000	
		(0.000)	
(IE) In-state-weighted Educational Spending$_{t-10}$			-0.003
			(0.006)
In-state-weighted Education Spending$^2{}_{t-10}$			0.000
			(0.000)
In-state-weighted Educational Spending$_{t-10}$ × HS			0.006
			(0.008)
In-state-weighted Educational Spending$_{t-10}$ × SC			0.018
			(0.012)
In-state-weighted Educational Spending$_{t-10}$ × C			-0.038^{**}
			(0.015)
In-state-weighted NAEP$_{t-10}$			-0.000
			(0.000)

Table 8(continued): Educational Spending and NAEP Test Scores on Earnings Growth

(TE) Out-of-state-weighted Educational Spending$_{t-10}$			0.012*
			(0.006)
Out-of-state-weighted Education Spending$^2_{t-10}$			−0.002**
			(0.001)
Out-of-state-weighted NAEP$_{t-10}$			−0.000**
			(0.000)
High School Diploma$_{t-10}$	−0.061**	−0.072***	−0.046*
	(0.027)	(0.025)	(0.024)
Some College (1-3 years)$_{t-10}$	−0.152***	−0.136**	−0.105**
	(0.055)	(0.063)	(0.046)
College (4+ years)$_{t-10}$	0.285***	0.258***	0.205***
	(0.079)	(0.084)	(0.068)
K-12 Enrollment Rate$_{t-10}$	−0.010	−0.013	0.000
	(0.058)	(0.061)	(.)
College Enrollment Rate$_{t-10}$	−0.042	−0.033	−0.041
	(0.068)	(0.068)	(0.068)
College Expenditure$_{t-10}$	−0.001***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)
Taxes Per Capita$_{t-2}$	0.001	0.001	0.002*
	(0.001)	(0.001)	(0.001)
Other Gov't Expenditure as a % of GSP$_{t-10}$	0.069**	0.073***	0.078***
	(0.027)	(0.026)	(0.025)
Agriculture as a % of GSP (contemp.)	0.258***	0.251***	0.236***
	(0.075)	(0.077)	(0.079)
Manufacturing as a % of GSP (contemp.)	0.048***	0.047***	0.046***
	(0.013)	(0.014)	(0.015)
Observations	1,650	1,650	1,650
Number of Groups (States)	50	50	50
Number of Instruments	48	48	51
F-Statistic	1,495.09	1,765.06	1,981.19
AR(1)	0.000	0.000	0.000
AR(2)	0.778	0.775	0.789
Hansen Test	0.654	0.644	0.577
Difference-in-Hansen Test	0.654	0.644	0.577
Marginal Effect of High School Diploma	-0.023	-0.021	-0.031
Marginal Effect of Some College	−0.071**	−0.066**	−0.059**
Marginal Effect of College	0.157***	0.153***	0.109***
Total Effect of Educational Spending	-0.002	-0.002	-0.002
Total Effect of Educational Spending (out-of-state)			0.007

Note: Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

A.3 Chapter 5 Appendix

A.3.1 Probit for Employment

For a more detailed looked into my dataset, I estimate the probability of being employed for the individual. For this estimation all individuals are included, even those who are not in the labor force. For this model, the dependent variable is an indicator for whether or not the individual is employed. The probit model below describes this estimation where Φ represents the cumulative normal distribution and X is a vector containing all individual characteristics.

$$Prob(Employed) = \Phi(X_i'\beta) \tag{A.1}$$

Results of this model are shown below in Table A.9. The results of this model show what we would expect to see. If the individual is male, they are 8.4 percentage points more likely to be employed compared to their female counterparts. As age increases by 1 year, the individual is 0.52% more likely to be employed. If the individual is white, they are 8.86 percentage points more likely to be employed than any other race. Individuals who have ever been married are 1.3 percentage points more likely to be employed than those who have never been married. If disabled, the individual is 30.3 percentage points less likely to be employed. If the individual has military experience, they are 4.9 percentage points more likely to be employed. If the individual has a child present in the home, they are 4.1 percentage points less likely to be employed. If the individual is currently enrolled in school, they are 15.6 percentage points less likely to be employed. Those with a high school diploma as their highest level of educational attainment are 12.9 percentage points more likely to be employed compared to those with less than a high school diploma. Individuals with 1-3 years of college are 21.4 percentage points more likely to be employed and individuals with 4+ years of college are 27.6 percentage points more likely to employed compared to individuals with less

than a high school diploma.

Overall, the probit results indicate that individuals who are male, older, white, ever married, and who have military experience are more likely to be employed. In addition, increasing one's educational attainment increases their chance of being employed while having a disability, being in school, or having a child present in the home decreases their chance of being employed.

Table A.9: Employed - Probit Model

	(1)	(2)
Male	0.048***	0.084***
	(0.001)	(0.001)
Age	0.009***	0.005***
	(0.0002)	(0.0002)
White	0.117***	0.089***
	(0.001)	(0.001)
Ever married	0.024***	0.013***
	(0.001)	(0.001)
Disabled	-0.367***	-0.303***
	(0.001)	(0.001)
Military Experience	0.062***	0.049***
	(0.001)	(0.001)
Child Present	-0.092***	-0.041***
	(0.001)	(0.001)
Currently in School	-0.084***	-0.156***
	(0.001)	(0.001)
High School Graduate		0.129***
		(0.001)
Some College (1-3 years)		0.214***
		(0.001)
College (4+ years)		0.276***
		(0.001)
Moved out of State		-0.009***
		(0.001)
Observations	2167881	2167881
Pseudo R^2	0.055	0.102

Notes: Age only includes those aged 24-28. The education variables indicate the highest level of education attained. –Marginal effects; Robust standard errors in parentheses; –* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.10: Educational Spending on Earnings - Heckman

	(1)	(2)	(3)	(4)	(5)
K-12 Educational Spending$_{t-10}$	−0.005***	−0.006***	−0.006***	−0.018***	−0.030***
	(0.001)	(0.001)	(0.001)	(0.004)	(0.005)
K-12 Education Spending$^2_{t-10}$				0.001***	0.000
				(0.000)	(0.000)
Average-weighted Educational Spending$_{t-10}$	0.002**	0.002*	0.003**	0.003***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Educational Spending$_{t-10}$ × HS					0.008**
					(0.004)
Educational Spending$_{t-10}$ × Some College					0.009***
					(0.003)
Educational Spending$_{t-10}$ × College					0.033***
					(0.003)
High School Graduate	0.280***		0.231***	0.231***	0.180***
	(0.007)		(0.007)	(0.007)	(0.024)
Some College (1-3 years)	0.286***		0.372***	0.372***	0.317***
	(0.006)		(0.006)	(0.006)	(0.022)
College (4+ years)	0.592***		0.948***	0.948***	0.739***
	(0.007)		(0.013)	(0.013)	(0.024)
Inverse Mills ratio	−0.528***	−1.617***	0.636***	0.635***	0.626***
	(0.010)	(0.014)	(0.041)	(0.041)	(0.041)
Sigma	0.973	1.617	1.001	1.001	0.996
Chi-Squared	15,162.423	17,885.678	33,057.251	33078.73	33482.15
Demographic Variables	No	Yes	Yes	Yes	Yes

Note: Total Observations: 1,245,788. Censored Observations: 844,008. Educational Spending is measured in 1,000s of dollars. Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A.11: Educational Spending on Earnings - State-level Controls

	(1)	(2)	(3)	(4)	(5)
K-12 Educational Spending$_{t-10}$	-0.030^{***}	-0.026^{***}	-0.024^{***}	-0.027^{***}	-0.018^{***}
	(0.005)	(0.003)	(0.003)	(0.003)	(0.005)
Average-weighted Educational Spending$_{t-10}$	0.002^{**}	0.002^{*}	-0.026^{***}	-0.029^{***}	-0.026^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Educational Spending$_{t-10}$ × HS	0.008^{**}	0.008^{**}	0.007^{*}	0.008^{**}	0.007^{*}
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Educational Spending$_{t-10}$ × Some College	0.009^{***}	0.009^{***}	0.009^{**}	0.009^{***}	0.009^{**}
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Educational Spending$_{t-10}$ × College	0.033^{***}	0.034^{***}	0.032^{***}	0.033^{***}	0.032^{***}
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
High School Graduate	0.180^{***}	0.181^{***}	0.178^{***}	0.237^{***}	0.178^{***}
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Some College (1-3 years)	0.317^{***}	0.317^{***}	0.318^{***}	0.235^{***}	0.318^{***}
	(0.022)	(0.022)	(0.022)	(0.023)	(0.022)
College (4+ years)	0.739^{***}	0.738^{***}	0.759^{***}	0.379^{***}	0.757^{***}
	(0.024)	(0.024)	(0.024)	(0.022)	(0.024)
Taxes per Capita$_{t-2}$			0.065^{***}	0.063^{***}	0.065^{***}
			(0.000)	(0.000)	(0.000)
Inverse Mills ratio	0.626^{***}	0.626^{***}	0.702^{***}	-0.586^{***}	0.703^{***}
	(0.041)	(0.041)	(0.042)	(0.009)	(0.042)
Sigma	0.996	0.996	1.029	0.998	1.029
Chi-Squared	33482.15	33477.10	36256.34	13739.19	36252.32
Demographic Variables	Yes	Yes	Yes	No	Yes
State-level Controls	No	No	Yes	Yes	Yes

Note: Total Observations: 1,245,788. Censored Observations: 844,008. Educational Spending and taxes per capita are measured in 1,000s of dollars. The square of educational spending is included in (1) & (3) but has a coefficient of a statistically insignificant zero. Standard errors are shown in parentheses *** p<0.01, ** p<0.05, * p<0.1.

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