2019

Analyzing the Impact of Educational Attainment on Subpar Income Dynamics in Appalachia

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This thesis analyzes the relationship between educational attainment and individual economic outcomes throughout the 420 counties of the Appalachian region of the United States. In doing so, this thesis seeks to better understand the impact of education on a region whose income dynamics have lagged significantly behind the rest of the United States for over a half-century. Initial analysis finds that Appalachian counties' incomes per capita lag consistently behind the remainder of the United States, although they receive similar levels of supplementary income benefits. In general, educational attainment, income and income maintenance benefits have all risen over time across the region. Using fixed effects models for both region and time, this thesis finds an unequivocally positive relationship between all levels of educational attainment and per capita income at the county level. Additionally, these models find that an increase in bachelor's degree attainment results in a greater increase in per capita income than an equal increase in high school diploma attainment; however, this difference is relatively small. Similar analysis of the impact of education on supplemental income benefits produced ambiguous results. While fixed effects models for region and time produced negative slope estimates, variance across models and higher standard errors make some of these results difficult to interpret. This ambiguity may be a result of a limited selection of data or significant variation in income maintenance benefits by county. Collectively, this thesis produces encouraging results for future research and policy analysis, finding that educational attainment has had a significant influence on individual earnings across the Appalachian region of the United States in the last half-century.

Keywords
Appalachia, income dynamics, poverty, educational attainment, economic policy, education policy

Disciplines
Appalachian Studies | Economic Policy | Education Economics | Education Policy | Growth and Development | Income Distribution | Political Economy | Regional Economics

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by

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An Undergraduate Thesis submitted in partial fulfillment of the requirements for the Joseph Wharton Scholars

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The Wharton School, University of Pennsylvania
May 2019

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I. Introduction

On November 9, 2016, fewer than 24 hours after the election of Donald Trump to the United States presidency, the New York Times published an article purporting to have identified the voter base responsible for one of the greatest political upsets in modern history. Headlined by a photo of voters sitting in a bar in Ambridge, Pennsylvania, the article began with the following assertion: "Donald J. Trump's America flowered through the old union strongholds of the Midwest, along rivers and rail lines that once moved coal from southern Ohio and the hollows of West Virginia to the smelters of Pennsylvania" (Confessore 2016). This imagery and prose was not selected accidentally, and in the weeks that followed the 2016 US Presidential election, a nationwide quest seemed to be underway to identify the persona and culture of this previously unseen voter base. More specifically, these inquiries often sought to understand a very specific subculture of the United States — Appalachia — and decipher the origins of its sudden emergence as a region of interest with extremely conservative values and a deep distrust in the modern American political system. Prior to 2016, Appalachia had been stereotypically characterized as a former Democratic stronghold, focused on agriculture and coal mining, that had grown increasingly apolitical and disinterested in national affairs. Having now reemerged as a new and unprecedented political force, an ongoing interest in the region surged books like J.D. Vance's *Hillbilly Elegy*, a memoir characterizing the hardships of life in modern Appalachia, to a spot on the New York Times Best Seller List for over a full calendar year (New York Times, 2017).

The surge in interest towards all-things-Appalachian has unequivocally led to an increase in productive discussions concerning many of the previously neglected issues in the region. In the past few years, increased attention and resources have been devoted to major crises, such as wildly disproportionate rates of addiction to opioids or the rapid decline of industry. Still, despite a fresh interest in the issues of the Appalachian region of the United States, the underlying problems that have fueled a political shift in the region have existed for decades prior, going largely unnoticed by policymakers and the general public alike.

Economic hardships can be found at the center of all modern struggles in the Appalachian region. Over the past half-century, the economy of the Appalachian region has indisputably lagged behind the rest of the United States by nearly every common indicator. Although certain federal, state and local programs, such as the Appalachian Region Commission (ARC), have been commissioned to evaluate these concerns and propose solutions, the stagnancy of the Appalachian economy has persisted and fueled generations of hardship for its citizens. Such concerns have led researchers in recent years to discuss the idea of a poverty trap in the region — effectively arguing that poverty may be not only persistent, but intergenerational in nature and increasingly difficult to escape (Durlauf 2012). Arguments for and against this premise have ranged across a variety of economic, political, social and cultural explanations, yet little research has yet been conducted on the long-term causes and impacts of depressed income dynamics in the Appalachian region specifically.

This thesis aims to evaluate income dynamics in the Appalachian region across the past half-century, understand its drivers, evaluate its impact and identify actionable sources for improvement going forward. Based on exploratory research across the existent literature, this analysis will focus primarily on educational attainment in the Appalachian region and determine the significance of its impact with regards to income dynamics and cyclical poverty within the region. In doing so, this thesis hopes to highlight the value of education for Appalachian

residents and provide a foundation for future policy research and proposals.

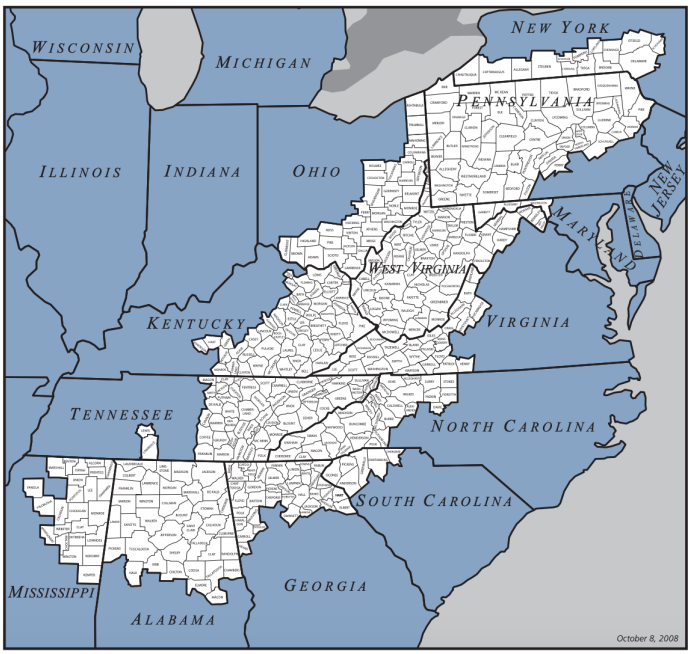
II. Research Question

This thesis primarily concerns itself with the nature of income dynamics and educational attainment in the Appalachian region across the past half century. However, these variables, the horizon of analysis and the concept of an "Appalachian region" can be ambiguously interpreted and require specification and operationalization to proceed effectively.

Background & Motivations

To evaluate any component of the "Appalachian region of the United States", it is first critical to define the exact geography of the region. Going forward, "Appalachia" will be defined as the specific 420 US counties currently designated as Appalachian by the Appalachian Regional Commission and US Government [**Figure 1**]. These 420 counties span across portions of 13 states, including: New York, Pennsylvania, Ohio, West Virginia, Maryland, Kentucky, Virginia, Tennessee, North Carolina, South Carolina, Georgia, Alabama and Mississippi.[1] This selection of counties, with the exception of a few small changes, has formally constituted the Appalachian region for the past half-century (Appalachian Regional Commission 2019). Despite the geographic breadth of the region, a distinct cultural homogeneity has been well documented across the region, and these similarities often extend into tangible economic outcomes (Eller 2008) (Fisher 1993).

Figure 1



source: Appalachian Regional Commission

1. See Appendix A for the full list of counties included in Appalachia by the Appalachian Regional Commission.

To provide a reasonable horizon for analysis, this thesis aims to track outcomes across the history of modern Appalachia, which will be defined as beginning with the creation of the Appalachian Regional Commission in 1965. While the culture of Appalachia existed long before this official designation from the Johnson administration, this period represents the first public recognition of economic hardship in the Appalachian region, offering an ideal horizon to evaluate the evolution of economic outcomes to present day. Coincidentally, this time frame also happens to be around the first time the United States government began collecting more detailed economic data at the county level, allowing for data-driven analysis of changes.

Research Question & Hypothesis Formation

In order to provide analysis on the factors fueling the lagging income dynamics of Appalachia, the nature of income dynamics themselves must be discussed. This thesis begins its analysis by characterizing the nature of income dynamics in Appalachia across the past half-century. In doing so, this thesis hopes to identify in exactly which ways Appalachia most acutely lags in economic performance and characterize the potential impact of these deficits. Next, this thesis proceeds to determine the most effective methods of evaluating education within the region to conduct multivariate analysis and determine its overall effect on economic shortfalls in the region. In doing so, this analysis aims to evaluate the question: *What is the influence of educational attainment on long-term, subpar economic outcomes in Appalachia?*

Based on depictions of Appalachian attitudes towards education in academic and popular literature, this analysis will operate under the hypothesis that lagging educational attainment in Appalachia has been a major contributor to cyclical poverty and intergenerational subpar economic outcomes in the region. In evaluating this hypothesis, this analysis aims to determine the degree to which education impacts long-term economic outcomes in the region, which levels of educational attainment may have the greatest impact and the unique impact this relationship may have on the Appalachian region in comparison to the greater United States.

Significance

Overall, the Appalachian region has been generally neglected in economic research, perhaps given its unique geography and esoteric cultural heritage. While the fundamental linkage between the 420 Appalachian counties may be a mountain range, research on the history, tradition and cultural homogeneity of the region indicates that the region is worthy of isolation for research. Still, the region has seen little significant attention from independent and government-sponsored research since its formal identification over a half-century ago. As of 2019, the Appalachian Regional Commission remains the only governmental organization dedicated to examining outcomes in the region. On repeated occasions, politicians, led by President Donald Trump, have suggested the disbandment of the Appalachian Regional Commission to save government funds due to a supposed inefficacy in their work (Godfrey 2017). However, given the dearth of adequate research on outcomes in the region, there perhaps has never been a more important time to support further academic inquiry into the region. This thesis hopes to provide additional support to this field and encourage additional research into hardships that have disproportionately affected the region across past decades.

III. Literature Review

The currently impoverished state of the Appalachian region is rarely disputed; yet, arguments on the persistence of poverty in the region and opportunities for economic mobility have spread across a wide spectrum. This debate has introduced a gap in modern academic literature evaluating the claim of a poverty trap, or cyclical poverty, in the Appalachian region. Still, a wealth of literature has emerged throughout the history of the region, both qualitative and quantitative, providing analysis of social, cultural and economic factors fueling different disparities in the region.

Anthropological Literature & Relevant History of Appalachia

The majority of literature exploring poverty in Appalachia focuses on ex-ante analysis of the history the Appalachian economy, as it relates to labor, industry, poverty and mobility. Salstrom (1994) provides perhaps the most detailed analysis of the Appalachian economy up to 1945 in his Appalachia's Path to Dependency, chronicling the historical reliance on agriculture in the region and its subsequent transformation to a dependence on natural resources. Billings and Blee (2000) support this argument, adding that southern, slave-owning states struggled especially to economically diversify after postbellum reconstruction. The transition that would follow this period emphasized a drastic shift away from land ownership as the primary catalyst of wealth. As Billings and Blee note, this transition left a newly-freed, yet uneducated African American population at odds with an increasingly destitute, white land-owning population – both of which struggled immensely to diversify income sources in a region so drastically dependent on agriculture and natural resource extraction. Outside of the wealthy and slave-owning populations, Haynes (1997) argues that an Appalachian ethnicity took shape over the 19th and early 20th centuries in the United States, fueled by a strict adherence to subsistence agriculture and an unwillingness to adapt to an industrialized economy. At this point, as early as the late 1800s, a lag in prioritization of educational attainment already begins to evidence itself. By Salstrom's account, as early as the New Deal era, the Appalachian economy began to falter as it failed to modernize and industrialize nearly as much as the remainder of the nation.

By the account of Eller (2008), national attention towards poverty in Appalachia began in the period leading up to the 1960 presidential election. By this time, about fifteen years after the New Deal era, local representatives, governors and members of the federal government agreed that Appalachia had fallen prey to increasingly dire economic circumstances. Rapidly increasing poverty and little support from the federal government led to the First and Second Conference of Appalachian Governors. This gathering would provide a strategic direction for the region and mark one of the first acknowledgments of Appalachia as an officially designated region of the United States. More importantly, as Eller notes, these meetings introduce the first claims of cyclical poverty in Appalachia, as debate emerged over whether to characterize the region as suffering from ongoing poverty or simply underdeveloped. Regardless of the characterization, these claims offer clear evidence of the first debates over a potential poverty trap in Appalachia – a debate so public, they would inspire the creation of the Appalachian Regional Commission under the direction of Presidents John F. Kennedy and Lyndon B. Johnson.

In 1965, the Appalachian Regional Development Act was passed by Congress, creating the Appalachian Regional Commission after years of debate surrounding the poverty problem in Appalachia. Additionally, this created the first legal designation of Appalachia, as the ARC

sought to utilize a variety of welfare, employment and anti-poverty programs to tackle the destitute Appalachian economy. While these efforts were well-intentioned and carefully crafted, over a half-century later, Appalachia maintains its status as one of the poorest regions in the United States. The literature cites a variety of historical reasons to support the sustained, contemporary poverty of Appalachia. Kahn (2009) offers that while historically impoverished urban regions have seen periods of revival through government support and flexible, diverse economies, Appalachia contains few major urban centers that have motivated similar growth. Holmes (1998) cites a more labor-driven analysis, arguing that a historical adherence to pro-labor policies has detracted the attention of major industrial companies throughout the 20th century.[2] A variety of other scholars, such as Eller (2008) and Fisher (1993) continue to cite the problems of decades prior, arguing that the Appalachian economy continues to be an anachronism that resists a rapidly modernizing economy and society. Overall, this analysis will focus primarily on the latter concern, evaluating how a cultural resistance to modernization may translate to a lower and possibly inadequate prioritization of education.

Economic Literature & Quantitative Analysis

While these perspectives provide valuable historical and anthropological insights into the persistence of poverty, other scholars have attempted to evaluate Appalachian poverty and the work of the Appalachian Regional Commission using quantitative measures. Isserman and Rephann (1995) presented one of the first, dedicated evaluations of the ARC and Appalachian poverty in the modern era, utilizing difference in differences analysis to determine the efficacy of the ARC in fighting a stagnant Appalachian economy. The methodology of Isserman and Rephann selected a variety of Appalachian counties and their "matched" counties to evaluate changes in a variety of economic metrics across several industries.[3] This analysis concluded that Appalachian counties grew markedly quicker than their matched counterparts over the period 1969-1991; however, the authors acknowledge this trend could be attributed to the selection of counties examined or the uniquely impressive growth of the south-eastern United States (including and excluding Appalachian counties.)

Other studies have attempted to explore Appalachian poverty by industry. A notable study from Lobao, Zhou, Partridge and Betz (2016) evaluated the association between coal employment and poverty in ARC counties. In many cases, this research found coal employment to be associated with higher poverty to different degrees, while also noting that high poverty in Appalachia is similarly linked to several other non-legacy industries like manufacturing, indicating a potentially broader poverty problem in the region.

The most comprehensive work on economic outcomes in Appalachia and the only work regarding poverty traps in Appalachia is included in *Appalachian Legacy: Economic Opportunity After the War on Poverty*, a compilation of analyses from leading scholars published by the Brookings Institution in 2012. As pertinent to this analysis, two specific chapters provide the most detailed research yet on cyclical poverty and education in Appalachia, one titled "Inequality and Human Capital in Appalachia: 1960-2000" by Professors Dan Black and Seth Sanders (of the University of Chicago and Duke University respectively) and another titled "Poverty Traps and Appalachia"

2. Speaking in terms of Appalachia specifically, pro-labor policies were generally rooted in the era of natural resource extraction, which was a highly unionized industry.

3. Counties were matched based on a variety of variables spanning across four major groups: spatial structure, economic structure, income and previous growth.

by Professor Steven Durlauf (also of the University of Chicago.) Citing a body of personal work, Durlauf (2011) introduced the first and only perspectives on evaluating the claim of a poverty trap in present-day Appalachia. By the account of Durlauf, two primary methodologies can be used to evaluate the claim: a sociological evaluation using specific indicators of cyclical poverty throughout the past century or an econometric, time-series-based evaluation of intergenerational poverty in the region. Durlauf highlights the benefits and pitfalls of each approach, noting that the potential for geographic self-selection bias and widespread demographic and economic heterogeneity across Appalachia could prove to be difficult, yet necessary controls in this type of analysis. Black and Sanders implement an approach similar to this idea of time-series analysis and make the only dedicated effort in the literature to evaluate the connection between education and income in Appalachia over time. Their analysis reaches several conclusions, noting that overall educational attainment increases over time, notably among those at the bottom of the income bracket — a phenomenon they refer to as *upskilling*. Additionally, this analysis also found a direct connection between educational attainment and income, indicating that furthered educational attainment often leads to higher incomes, although Appalachia does contain a disproportionately high number of individuals earning high incomes with lower levels of education compared to the rest of the United States. In summarizing their results, Black and Sanders note that other endogenous factors must be considered in future analyses, given that variables, such as proximity to an urban center, may also have a strong impact on both educational and economic outcomes. These analyses lay a strong foundation for verifying the necessity of further research on education in Appalachia and establishing the base criteria for a more dedicated analysis of the topic.

IV. Data & Methodology

Data Retrieval

To investigate the nature of income dynamics in Appalachia over the past half century, panel data will be utilized to determine changes over time. For reliable estimates of economic indicators at the county level, panel data from the Bureau of Economic Analysis have been selected for this analysis. These data provide a variety of economic indicators that can effectively characterize the construct in question of lagging income dynamics. These data span from 1969 to 2016, containing yearly estimates for every United States county, when available. With a few small exceptions, these data provide a year-to-year estimation of income dynamics for each of the 420 Appalachian counties relevant to this study.

Unfortunately, finding equally detailed data for predictors of these changes in income dynamics (such as educational attainment indicators) proves to be more difficult. Since 2005, the American Community Survey has provided excellent estimates of a variety of educational indicators at the county level on a yearly basis. However, prior to this expansion in the prioritization of data collections, research has generally been limited to the decennial estimates of the US Census. While these data are exceptionally specific, the significant gaps across the horizon intended for analysis can be problematic. This will undoubtedly limit the scope of analysis; however, the decennial estimates across four decades can still be informative of long-term trends. Collectively, these data have been retrieved from US Census and Appalachian Regional Commission reporting, some of which have already been synthesized for the region specifically.

Selection & Operationalization of Variables

The outcome of interest in this thesis centers around the construct of lagging income dynamics in the region — that is to say, common economic indicators that consistently produce results generally inferior to other regions of the United States over time. The body of literature on development economics and poverty research has implemented a variety of clever and innovative techniques for evaluating income dynamics around the world. However, given the United States' status as one of the world's most developed economies (inclusive of Appalachia) and the wealth of economic data available, more traditional metrics will be most appropriate for this analysis. This analysis will generally steer away from federal indicators of poverty, as these metrics will evaluate poverty in a binary fashion, classifying individuals as above or below the poverty line (i.e. "in" or "out" of poverty.) While this attempt to classify individuals can have practical value in many cases, it washes away a great deal of nuance in the income dynamics of a region. For example, two counties with drastically different average outcomes could have similar poverty rates, simply as a function of the number of families living *close to* the poverty line, albeit still above the federal threshold for that year. This nuance will be important to capture as a counties in a region such as Appalachia might have a high quantity of individuals living in and around the federal poverty line.

To effectively evaluate economic trends, two continuous indicators will be used to evaluate outcomes over time: per capita income and per capita income maintenance benefits.[4] Here, income maintenance benefits are defined using the methodology of the Bureau of Economic Analysis (from whom the data were collected.) This definition includes major social assistance programs, such as social security (SSI) benefits, the Earned Income Tax Credit (EITC) and the Supplemental Nutritional Assistance Program (SNAP, often referred to as "food stamps"), in addition to other smaller programs. These two outcomes are inversely related, meaning that as lower incomes are hypothesized in this analysis, higher levels of income maintenance benefits are expected. Ideally, these two variables characterize the construct of "income" dynamics well, given the specific nature of commentary on the economics of Appalachia. While per capita income will provide a traditional metric of individual economic performance, also including per capita income maintenance benefits in this analysis should provide valuable insights into common claims in the popular media that large quantities of individuals in the region may be attempting to subsist on welfare benefits. This comparison may also be valuable in evaluating whether the educational predictors speak more to the *quality* of employment people can find versus their ability to *secure* and *maintain* employment.

To evaluate the level educational attainment of a given county, traditional metrics will be used. Two common indicators provide a decent idea of educational attainment in the modern American economy: percentage of individuals who have achieved at least a high school diploma and percentage of individuals who have achieved at least a bachelor's degree. Undoubtedly, the minimal educational requirements for a variety of industries have increased across the past half century. Ideally, the use of these two levels of educational attainment as the predictors of interest can also provide insights into what specific degree of education is most vital for advancement within the modern Appalachian economy.

4. Both variables will be population weighted to achieve the "per capita" figure and are measured in inflation-adjusted 2016 US Dollars ($).

Methodology

Analysis will begin with a review of visual trends in the variables of interest to garner insights into each variable over the horizon of interest. Given the nature of the panel data available, several fixed effects pooled ordinary least squares (OLS) models will be constructed to analyze the nature of the data controlling for time and region specific variation. Each model will be weighted by population to account for vast differences in population size across counties in the region.[5] However, the first model for each set of variables will be a simple regression for a baseline. This naïve model follows the typical linear regression model to give an idea of the general relationship between the predictor (educational attainment) and outcome variables (income dynamics), irrespective of confounding effects.

Model 1

$$y_i = X_i \cdot \beta_{education} + \epsilon_i$$

Next, three fixed effects pooled OLS models will be created in an effort to better characterize the data while accounting for regional and time-based confounding. The first will include fixed effects for the year, the second for the region and the third for both the year and region. The regional fixed effects will be based on the state and subregion of the given county i. The subregions have been predetermined by the Appalachian Regional Commission in 2009 as five groups of counties sharing "relatively homogeneous characteristics (topography, demographics, and economics)" [**Figure 2**]. Ideally, these subgroups should account for important differences across the region, such as demographic makeup, industrial dependence and political climate.[6] In addition, adding the state by state effect should simultaneously capture variance in specific state-level policies pertaining to both the predictor and outcome. Although the Appalachian region shares a rich culture that spans its entire geography, these regional fixed effects aim to acknowledge and capture the heterogeneity that still does exist within the region. Therefore, the final three models will be constructed with a typical form for fixed effects models:

Model II

$$y_{it} = \alpha_{year} + X_{it} \cdot \beta_{education} + \epsilon_{it}$$

Model III

$$y_i = \alpha_{state} + \alpha_{region} + X_i \cdot \beta_{education} + \epsilon_i$$

Model IV

$$y_{it} = \alpha_{year} + \alpha_{state} + \alpha_{region} + X_{it} \cdot \beta_{education} + \epsilon_{it}$$

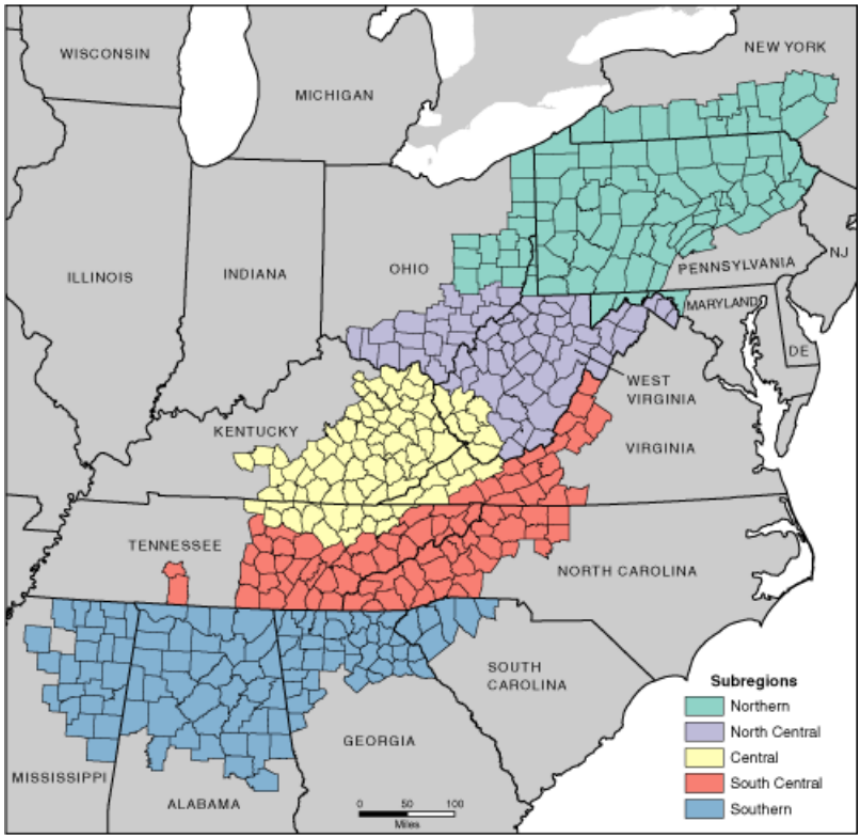
for $t = 1980, 1990, 2000, 2010$ and $i = 1, .., 420$; where y_{it} represents the economic outcome variables, X_{it} represents the educational predictors, β is the effect of the predictors, the αs are the fixed effects for year, state and subregion and ϵ_{it} is the error term.

5. While Appalachia contains a remarkable degree of cultural homogeneity, the landscape of Appalachian counties can range from remote and rural to suburban.

6. The five Appalachian subregions are named "North", "North Central", "Central", "South Central" and "South" based on their general geography. The specific borders of each boundary were drawn around specific nuances in demographics, culture, industry and history.

This methodology may encounter concerns given the limited scope of data for the predictors. Since the periods t are limited to decade-by-decade data, this analysis is restricted to the evaluation of long-term trends. Additionally, there always exists the possibility of an omitted variable bias issue, if the regional fixed effects do not fully capture the heterogeneity across the Appalachian region. Undoubtedly, this analysis is limited by the lack of reliable and comprehensive county-level panel data for many potential confounders. However, the subregions crafted by the Appalachian Regional Commission were created and updated for this exact purpose in the last decade, which should ideally assuage the majority of these concerns.

Figure 2



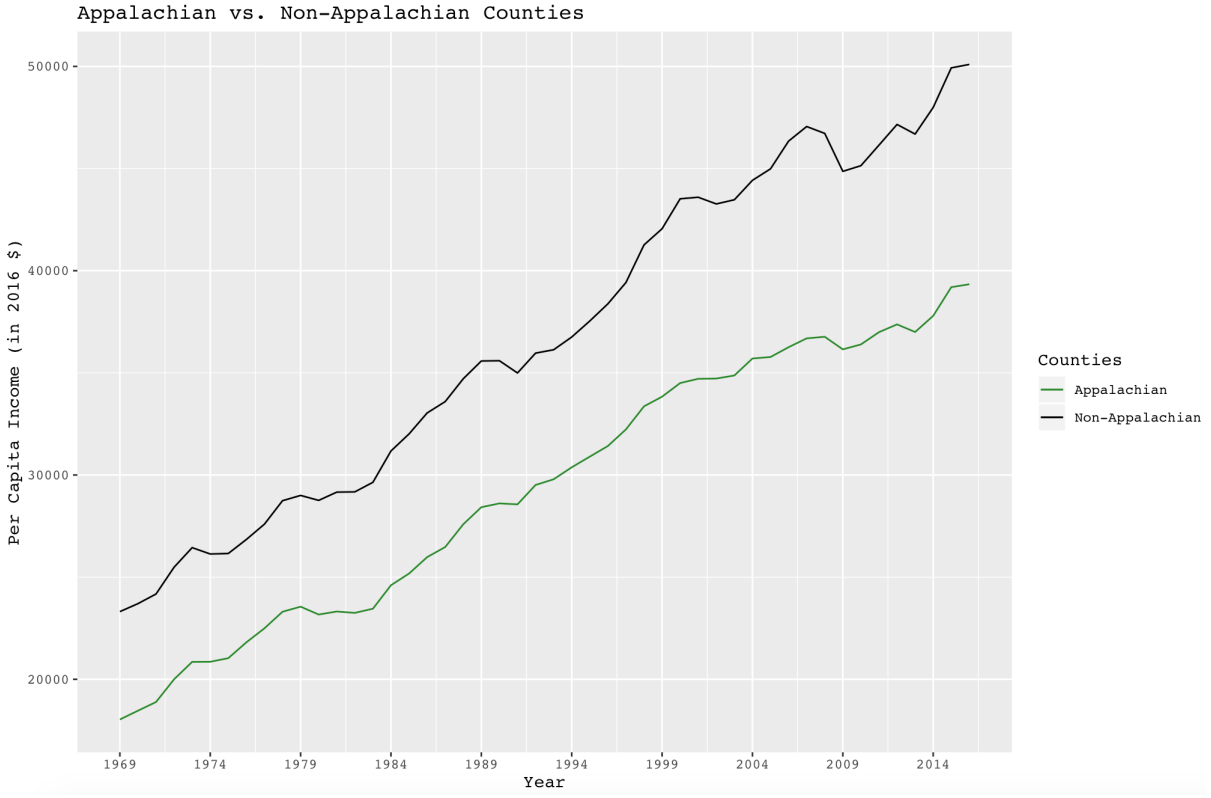
source: Appalachian Regional Commission

V. Results

Univariate Analysis: Outcomes

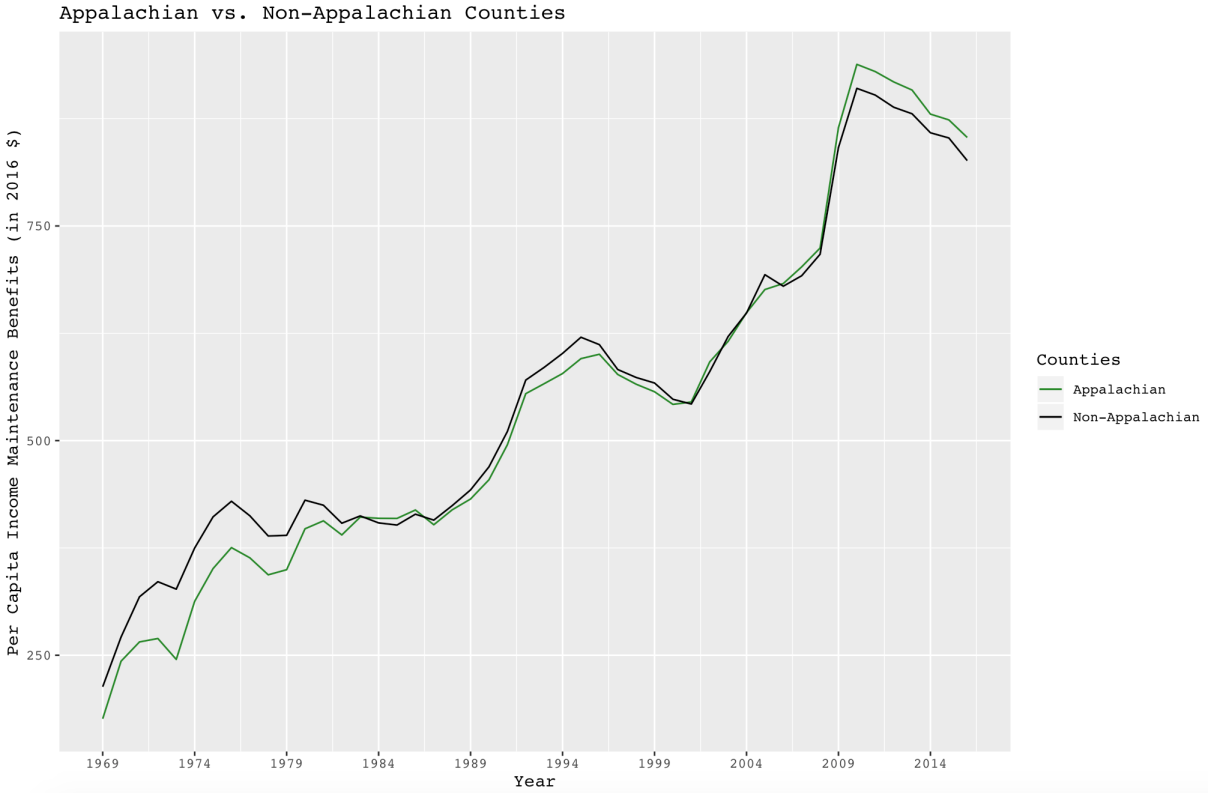
First, the nature of income dynamics in the region over time must be considered to evaluate the idea of cyclical poverty in the region. When mapped over time, each outcome variable demonstrates noticeably different trends across the past half-century. In the case of income, a steep divide can be observed between the mean per capita figure across Appalachian counties versus non-Appalachian counties [**Figure 3**]. Entering into the 1970s, this gap could be estimated around $5,000 per person, growing into a gap exceeding $10,000 in the past two decades (in 2016 dollars.)

Figure 3



However, the difference in income maintenance benefits between Appalachian and non-Appalachian counties appears generally much more ambiguous over time, indicating that, on average, Appalachian counties do not appear to have developed a unique reliance on income maintenance benefits across the past fifty years [**Figure 4**]. In fact, the earliest data on income maintenance shows the Appalachian average *below* non-Appalachian counties, and it does not definitely cross over until after the 2008 financial crisis.

Figure 4



This disparity in results between outcome variables tells a unique story about the economic situation of Appalachia. While incomes are unequivocally lower across the region, reliance on social assistance programs does not appear to be out of the ordinary. This could have occurred for a variety of reasons. One primary contributor may be heterogeneity in outcomes across Appalachian counties. While the region does share many cultural, demographic and economic features, the possibility of differences across subregions could explain a degree of variance erased by averages covering a large region. To aid these types of concerns, this thesis again refers to the five subregions of the 420 Appalachian counties designated by the Appalachian Regional Commission: North, North Central, Central, South Central and South [**Figure 2**]. Plotting the aforementioned outcomes by subregion provides a more detailed picture of income dynamics across the Appalachian region [**Figures 5 & 6**].

Figure 5

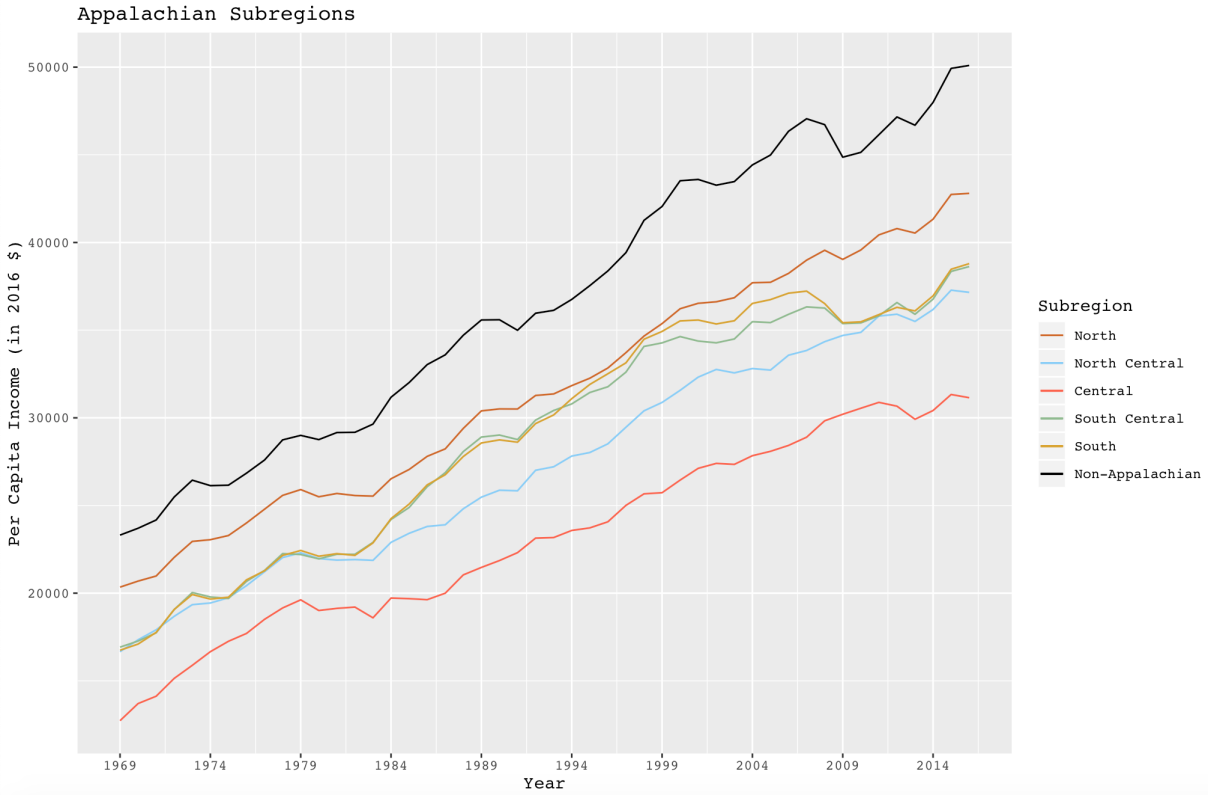
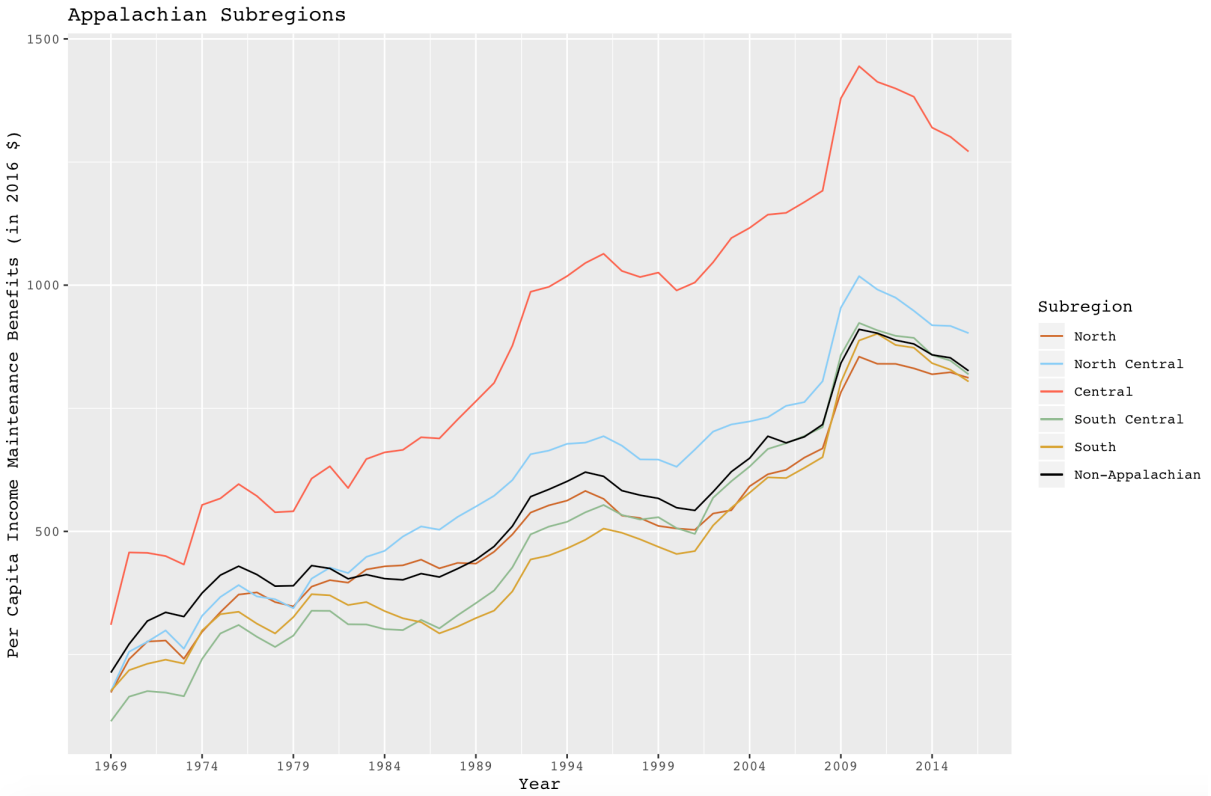


Figure 6



When breaking down the performance of outcome variables by subregion, a greater degree of variance is quickly exposed across Appalachia. Perhaps most notably, the individual economic performance of counties in the Central subregion of Appalachia appears to significantly lag behind non-Appalachian counties, in addition to all other Appalachian subregion. Both in terms of per capita incomes achieved and reliance on income maintenance benefits, the Central region visually dominates all other subregions, indicating that the severity of these concerns may vary greatly by geography within Appalachia. Naturally, this is not to say that their is a causal nature between the geography or landscape of the region and its reliance on social support benefits. Rather, this supports the use of the fixed effects model with regional controls proposed by this analysis to help account for heterogeneity in outcomes. Additionally, the general upward trend across all counties over time demonstrates reinforces the value of including models with time-based fixed effects, as expected.

Overall, incomes across each subregion still lag notably behind the non-Appalachian average and have continued to do so consistently across a fifty-year horizon. However, average collection of income maintenance benefits in the North, South and South Central regions have actually maintained slightly lower levels over time. This evidence further supports that the unique economic struggle of the region appears to be most closely linked to levels of personal income.

Univariate Analysis: Predictors

Given constraints on the data available, the changes in education over time can be more difficult to characterize. Nonetheless, population-weighted averages of high school diploma and bachelor's degree achievement have been calculated and plotted [**Figures 7 & 8**]. Here, achievement of both levels of educational attainment improve fairly significantly across the past thirty years — high school diplomas by about 20% and bachelor's degrees by about 10% in Appalachia.

Additionally, the difference in improvement between high school diploma attainment and bachelor's degree attainment may provide evidence in support of the qualitative literature on attitudes towards education in Appalachia. Although the economy has developed towards favoring more advanced degrees, the greatest change in educational attainment has favored high school diplomas by a noticeable amount. From univariate statistics it is impossible to say whether this difference in changes is a function of attitudes towards education, a natural response to the Appalachian job market or targeted policies in certain states. While this poses an interesting question, it is not directly relevant to the hypothesis of this thesis and will be left as a point for future research.

While these data do not provide tremendously nuanced insights in to the year-to-year changes in educational outcomes for the region, the steep improvement in educational attainment across the horizon of interest is unambiguous. Especially in a region where incomes have comparatively weakened compared to the rest of the United States, this improvement in educational attainment, albeit primarily in high school diploma attainment, could be indicative of promising changes within the region. To better determine if improved educational outcomes may be correlated with improved economic performance in the region, this analysis proceeds with multivariate analysis using the aforementioned pooled ordinary least squares (OLS) models.

Figure 7

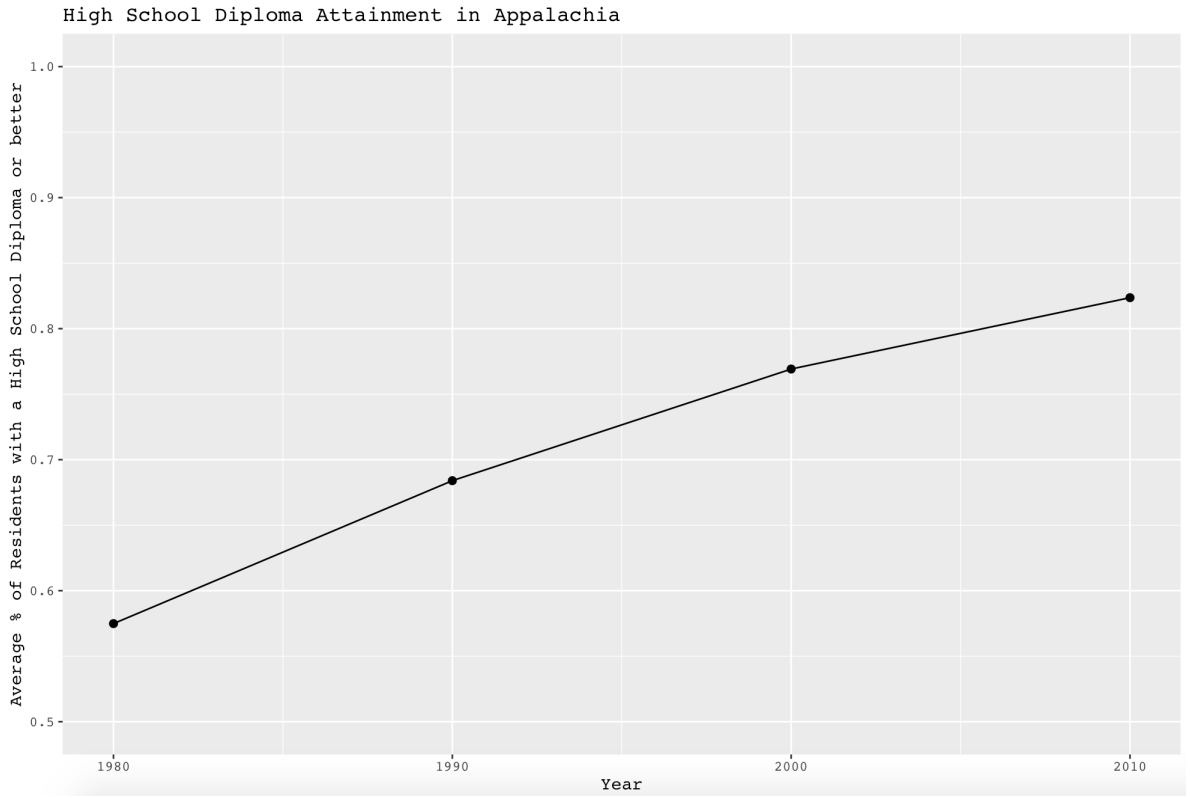
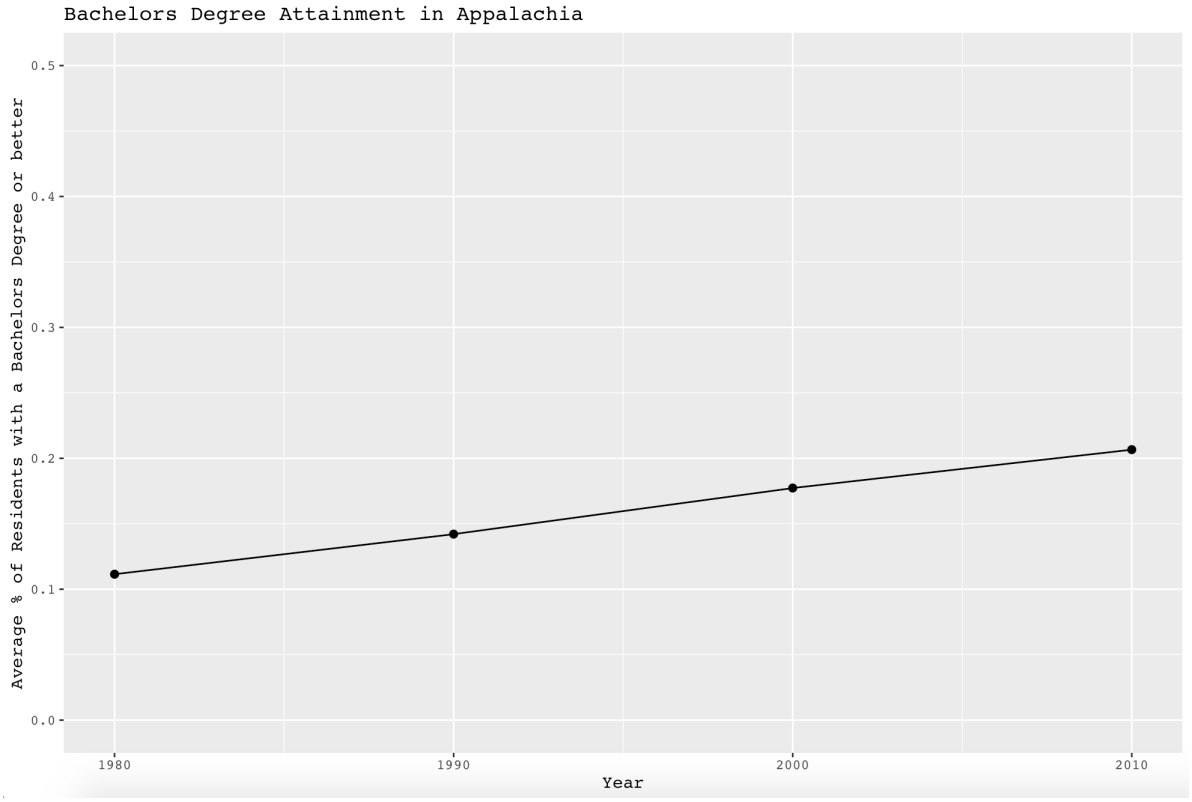


Figure 8



Simple Pooled OLS

Using pooled decennial data on education and income, this analysis begins by creating a simple pooled OLS[7] to observe the relationship between the county-wide percentages of high school diplomas received and per capita income in Appalachia [**Figure 9**].[8] This model produces a sensible result, observing the generally accepted trend that incomes appear to gradually increase as level of education achieved increases. A similar model, using bachelor's degree attainment instead as a predictor, produces comparable results [**Figure 10**].[9]

Figure 9

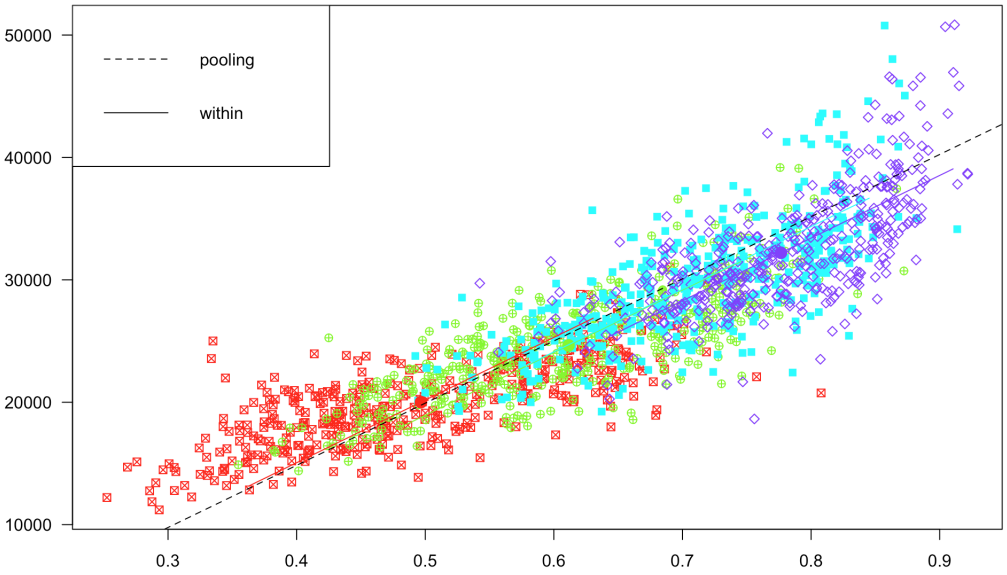
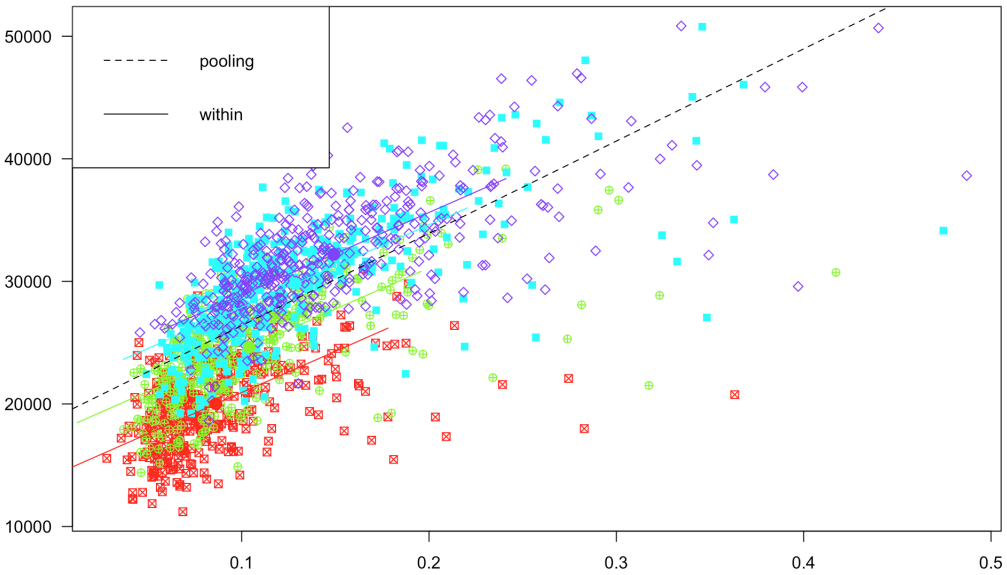


Figure 10



7. See numerical results for Model I under Figures 11 & 12 in the next section.

8. In this graphic, the 1980 decade data are in red, the 1990 data in green, the 2000 data in blue and the 2010 data in violet. As stated, the x-axis is high school diploma attainment and the y-axis is per capita income.

9. Figure 10 follows the same formatting as Figure 9, just with bachelor's degree attainment on the x-axis.

However, replicating these models using income maintenance benefits as the outcome variable produces much less favorable results.[10] Overall, error increases significantly model and simple regression produces a *weakly positive* relationship between increased educational attainment (using both predictors) and receipt income maintenance benefits. This provides further indication that the relationship between education and income maintenance benefits may vary greatly from county to county across Appalachia. This could very likely be a function of the variety of payout systems and entry qualifications for different social assistance programs in the US, meaning certain counties could receive income maintenance benefits of identical value but for very different socioeconomic reasons. Nonetheless, these results are still valuable, in that they provide further indication that educational outcomes are likely more informative when estimating income within an Appalachian county, but not necessarily that county's dependence on social assistance programs.

Pooled OLS with Fixed Effects

Lastly, this analysis proceeds by implementing the aforementioned fixed effects models in an effort to control for regional and time-based variance in understanding the impact of education on income within the Appalachian region. In doing so, this analysis hopes to understand the impact of differences in educational attainment across Appalachian counties and provide commentary on the value in improving educational attainment when seeking to improve individual economic outcomes. Overall, models seeking to relate both educational predictors to per capita income return significant results.

Figure 11

y = per capita income (\$)

	Model I	Model II	Model III	Model IV
HS Diploma Attainment (%) ($\hat{\beta}_{HS}$)	**50796.4**	**45858.3**	**53427.8**	**51435.6**
	(762.6)***	(1102.1)***	(783.9)***	(1407.0)***
with Year fixed effects (α_t)	no	yes	no	yes
with Regional fixed effects ($\alpha_s + \alpha_r$)	no	no	yes	yes

Figure 12

y = per capita income (\$)

	Model I	Model II	Model III	Model IV
Bach. Degree Attainment (%) ($\hat{\beta}_{Bach}$)	**75254.0**	**58019.8**	**75616.9**	**55251.5**
	(1462.6)***	(1311.4)***	(1466.6)***	(1227.1)***
with Year fixed effects (α_t)	no	yes	no	yes
with Regional fixed effects ($\alpha_s + \alpha_r$)	no	no	yes	yes

10. See numerical results for Model I under Figures 13 & 14 in the next section.

Pooled OLS for Per Capita Income

First, the model using high school diploma attainment to predict per capita income [**Figure 11**] confirms the unambiguously positive relationship between education and earnings in Appalachian counties. There is little variation in the slope estimates across each model. The original simple pooled OLS model (Model I), along with each fixed effects model (Models II, III & IV) produce slope estimates around 50,000, implying that a 1% change in high school diploma attainment results in approximately a $500 increase in per capita income. With small standard errors, this relationship is statistically significant and the size of this effect is notable.

Next, the model using bachelor's degree attainment to instead predict per capita income produces similar results [**Figure 12**]. Across all models, the influence of post-secondary education on personal incomes is overwhelmingly positive, at a statistically significant level. Across models, slope estimates are a bit more ambiguous. Here, when including fixed effects for year and region, slope estimates return results very similar to high school diploma attainment, where a 1% increase in bachelor's degree attainment results in about a $553 increase in per capita income. If the results from this sample are indeed representative of long term trends, this indicates that returns on education may be fairly similar between a high school diploma and bachelor's degree across Appalachian counties.

Collectively, these results provide encouraging evidence in favor of the significant monetary value in improving educational outcomes (in addition to the many intangible benefits.) This topic may benefit from future research on cost-effectiveness analysis for educational outcomes to determine whether states and counties may benefit more from in investing in increased levels of high school versus college education when trying to improve individual incomes in the region.

Pooled OLS for Per Capita Income Maintenance Benefits

Continuing, the identical methodology is executed using income maintenance benefits as the outcome variable of analysis. Again, high school diploma and bachelor's degree attainment remain the predictors of interest, to determine if a similar relationship exists as with per capita income, just reversed (given the nature of income maintenance as a supplement.)

Figure 13

y = per capita income maintenance benefits ($)

	Model I	Model II	Model III	Model IV
HS Diploma Attainment (%) ($\hat{\beta}_{HS}$)	**472.3**	**-1223.3**	**1027.6**	**-1102.7**
	(58.6)***	(55.6)***	(55.6)***	(63.2)***
with Year fixed effects (α_t)	no	yes	no	yes
with Regional fixed effects ($\alpha_s + \alpha_r$)	no	no	yes	yes

Figure 14

y = per capita income maintenance benefits ($)

	Model I	Model II	Model III	Model IV
Bach. Degree Attainment (%) ($\hat{\beta}_{Bach}$)	**-68.6**	**-1482.5**	**469.5**	**-1035.2**
	(96.3)	(68.6)***	(93.8)***	(61.5)***
with Year fixed effects (α_t)	no	yes	no	yes
with Regional fixed effects ($\alpha_s + \alpha_r$)	no	no	yes	yes

Here, the results are much more ambiguous — consistent with initial indicators. While each model comparing high school diploma attainment to per capita income maintenance benefits retrieves a significant result, the relationship appears ambiguous when looking across models. The inclusion of regional fixed effects bolsters the slope estimate to a more positive value with a negative intercept, while the inclusion of year fixed effects reverses this estimate entirely with negative slopes and positive intercepts. In general, both of the models are fairly uninterpretable, given it is impossible to receive negative income maintenance benefits. More than anything, these models further clarify the ambiguity in the relationship between education and supplemental income programs.

Unsurprisingly, using bachelor's degree attainment as a predictor retrieves similar results. The simple pooled OLS (Model I) does not retrieve a significant result, and other models, while significant, do not provide readily interpretable insights into education's impact on income maintenance received. Considering that the slope estimates become starkly negative after the inclusion of year fixed effects, it is likely that the issue of income maintenance benefits varies tremendously by county and subregion, while generally negative over time. More complete data across a longer horizon would be necessary to definitively draw conclusions from these results. This provides the final evidence that education may be a valuable predictor of per capita incomes, though not a strong predictor of per capita income maintenance across the region.

VI. Conclusions

This thesis sought to evaluate the connection between levels of educational attainment and individual economic outcomes in the Appalachian region of the United States in an attempt to better understand lagging income dynamics that have persisted for decades. Drawing on commentary from popular and academic literature, this thesis evaluated the hypothesis that improvements in educational attainment are strongly correlated with improved income dynamics for counties within Appalachia. Using county-level panel data collected by the Appalachian Regional Commission and US Census, several trends in these data are of note. Overall, both educational attainment and per capita income (adjusted for inflation) have improved on average throughout the region across the past half-century, though the region still lags behind many other regions of the United States. However, average utilization of income maintenance benefits (often known as "welfare benefits" or "income assistance") appear fairly similar to remainder of the United States. Additionally, there is a notable degree of heterogeneity in outcomes from subregion to subregion within Appalachia, showing that economic outcomes have been persistently worse in the Central subregion over the past several decades, especially with regards

to dependence on income maintenance benefits. In terms of predictors, while the region has enjoyed improvements in educational attainment at both the high school and collegiate levels, improvements in high school diploma achievement have risen much quicker than in bachelor's degrees. Evaluating which policies and conditions lead to more efficient improvements within the region remains an interesting point for future research relevant to this thesis.

In an effort to evaluate the correlation between educational attainment and income dynamics in Appalachia, four pooled OLS models were constructed using data spanning across the past four decades. These models found a definitively significant correlation between attainment of both levels of educational attainment analyzed and per capita income. However, when using fixed effects for both region and time, these models found that the estimated impact of an additional 1% increase in high school diplomas achieved versus a 1% increase in bachelor's degrees received was only about $38.16. Unfortunately, similar models comparing educational attainment to per capita income maintenance benefits received returned ambiguous results. While the relationship between both levels of educational attainment and income maintenance benefits received appears significantly negative with fixed effects for region and time, large variance in the slope estimates of each of the models indicates that education alone is not be the ideal predictor of dependence on income assistance.

Collectively, this thesis hopes to inform future research and discussion on the value of promoting education in the Appalachian region of the United States. The sizable impact of increased educational attainment on improved per capita incomes indicates that improvements in educational reform may be one of many solutions to improving economic outcomes for residence of the oft-forgotten region of Appalachia. In doing so, the Appalachian region has the potential to prepare future generations of its workforce for success in an increasing complex and diverse United States economy.

Works Cited

Appalachian Regional Commission. *Data Reports: Education*. Web. Data, 2018.

Appalachian Regional Commission. "Subregions in Appalachia." 2009. Accessed May 6, 2019. https://www.arc.gov/research/MapsofAppalachia.asp?MAP_ID=31.

Appalachian Regional Commission. "The Appalachian Counties." 2019. Accessed May 6, 2019. https://www.arc.gov/appalachian_region/TheAppalachianRegion.asp.

Barham, Vicky, Robin Boadway, Maurice Marchand, and Pierre Pestieau. "Education and the Poverty Trap." *European Economic Review* 39, no. 7 (1995): 1257–1275.

Billings, Dwight B., and Kathleen M. Blee. *The Road to Poverty: The Making of Wealth and Hardship in Appalachia*. Cambridge: Cambridge University Press, 2000. ISBN: 0-521-65229-4.

Black, Dan A., and Seth G. Sanders. "Appalachian Legacy: Economic Opportunity after the War on Poverty." Chap. 3: Inequality and Human Capital in Appalachia: 1960-2000, 45–80. Washington, D.C.: The Brookings Institution, 2012. ISBN: 978-0-8157-2214-4.

Bureau of Economic Analysis. *Regional Economic Accounts*. Web. Data, 2018.

Confessore, Nicholas, and Nate Cohn. "Donald Trump's Victory Was Built on Unique Coalition of White Voters." November 9, 2016. Accessed May 6, 2019. https://www.nytimes.com/2016/11/10/us/politics/donald-trump-voters.html.

Durlauf, Steven. "Appalachian Legacy: Economic Opportunity after the War on Poverty." Chap. 7: Poverty Traps and Appalachia, 169–206. Washington, D.C.: The Brookings Institution, 2012. ISBN: 978-0-8157-2214-4.

Eller, Ronald D. *Uneven Ground: Appalachia since 1945*. Lexington: University Press of Kentucky, 2008. ISBN: 978-0-8131-2523-7.

Fisher, Stephen L. "Fighting Back in Appalachia: Traditions of Resistance and Change." Chap. 16: Conclusion: New Populist Theory and the Study of Dissent in Appalachia, 317–338. Philadelphia: Temple University Press, 1993. ISBN: 0-87722-977-5.

Godfrey, Elaine. "Trump's Proposal to Scrap the Agency Devoted to Developing Appalachia." March 16, 2017. Accessed May 6, 2019. https://www.theatlantic.com/politics/archive/2017/03/why-the-appalachian-regional-commission-matters/519876/.

Haynes, Ada F. *Poverty in Central Appalachia: Underdevelopment and Exploitation*. New York: Garland Publishing, 1997. ISBN: 0-8153-2546-0.

Holmes, Thomas J. "The Effect of State Policies on the Location of Manufacturing: Evidence from State Borders." *Journal of Political Economy* 106, no. 4 (1998): 667–705.

Isserman, Andrew, and Terance Rephann. "The Economic Effects of the Appalachian Regional Commission: An Empirical Assessment of 26 Years of Regional Development Planning." *Journal of the American Planning Association* 61, no. 3 (1995): 345–364.

Kahn, Matthew. *Cities, Economic Development, and the Role of Place-Based Policies: Lessons for Appalachia*. University of Kentucky Center for Poverty Research, 2009.

Labao, Linda, Minyu Zhou, Mark Partridge, and Michael Betz. "Poverty, Place, and Coal Employment across Appalachia and the United States in a New Economic Era." *Rural Sociology* 81, no. 3 (2016): 343–386.

New York Times. "Combined Print & E-Book Nonfiction." August 6, 2017. Accessed May 6, 2019. `https://www.nytimes.com/books/best-sellers/2017/08/06/combined-print-and-e-book-nonfiction/`.

Salstrom, Paul. *Appalachia's Path to Dependency: Rethinking a Region's Economic History 1730-1940*. Lexington: University Press of Kentucky, 1994. ISBN: 0-8131-1860-3.

Valkila, Joni. "Fair Trade Organic Coffee Production in Nicaragua — Sustainable Development or a Poverty Trap?" *Ecological Economics* 68, no. 12 (2009): 3018–3025.

Vance, J.D. *Hillbilly Elegy: A Memoir of a Family and Culture in Crisis*. New York: HarperCollins, 2016. ISBN: 978-0-06-230054-6.

Appendix A: List of All Appalachian Counties

Alabama: Bibb, Blount, Calhoun, Chambers, Cherokee, Chilton, Clay, Cleburne, Colbert, Coosa, Cullman, De Kalb, Elmore, Etowah, Fayette, Franklin, Hale, Jackson, Jefferson, Lamar, Lauderdale, Lawrence, Limestone, Macon, Madison, Marion, Marshall, Morgan, Pickens, Randolph, St. Clair, Shelby, Talladega, Tallapoosa, Tuscaloosa, Walker, Winston

Georgia: Banks, Barrow, Bartow, Carroll, Catoosa, Chattooga, Cherokee, Dade, Dawson, Douglas, Elbert, Fannin, Floyd, Forsyth, Franklin, Gilmer, Gordon, Gwinnett, Habersham, Hall, Haralson, Hart, Heard, Jackson, Lumpkin, Madison, Murray, Paulding, Pickens, Polk, Rabun, Stephens, Towns, Union, Walker, White, Whitfield

Kentucky: Adair, Bath, Bell, Boyd, Breathitt, Carter, Casey, Clark, Clay, Clinton, Cumberland, Edmonson, Elliott, Estill, Fleming, Floyd, Garrard, Green, Greenup, Harlan, Hart, Jackson, Johnson, Knott, Knox, Laurel, Lawrence, Lee, Leslie, Letcher, Lewis, Lincoln, McCreary, Madison, Magoffin, Martin, Menifee, Metcalfe, Monroe, Montgomery, Morgan, Nicholas, Owsley, Perry, Pike, Powell, Pulaski, Robertson, Rockcastle, Rowan, Russell, Wayne, Whitley, Wolfe

Maryland: Allegany, Garrett, Washington

Mississippi: Alcorn, Benton, Calhoun, Chickasaw, Choctaw, Clay, Itawamba, Kemper, Lee, Lowndes, Marshall, Monroe, Montgomery, Noxubee, Oktibbeha, Panola, Pontotoc, Prentiss, Tippah, Tishomingo, Union, Webster, Winston, Yalobusha

New York: Allegany, Broome, Cattaraugus, Chautauqua, Chemung, Chenango, Cortland, Delaware, Otsego, Schoharie, Schuyler, Steuben, Tioga, Tompkins

North Carolina: Alexander, Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Davie, Forsyth, Graham, Haywood, Henderson, Jackson, McDowell, Macon, Madison, Mitchell, Polk, Rutherford, Stokes, Surry, Swain, Transylvania, Watauga, Wilkes, Yadkin, Yancey

Ohio: Adams, Ashtabula, Athens, Belmont, Brown, Carroll, Clermont, Columbiana, Coshocton, Gallia, Guernsey, Harrison, Highland, Hocking, Holmes, Jackson, Jefferson, Lawrence, Mahoning, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Pike, Ross, Scioto, Trumbull, Tuscarawas, Vinton, Washington

Pennsylvania: Allegheny, Armstrong, Beaver, Bedford, Blair, Bradford, Butler, Cambria, Cameron, Carbon, Centre, Clarion, Clearfield, Clinton, Columbia, Crawford, Elk, Erie, Fayette, Forest, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lawrence, Luzerne, Lycoming, McKean, Mercer, Mifflin, Monroe, Montour, Northumberland, Perry, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Venango, Warren, Washington, Wayne, Westmoreland, Wyoming

South Carolina: Anderson, Cherokee, Greenville, Oconee, Pickens, Spartanburg

Tennessee: Anderson, Bledsoe, Blount, Bradley, Campbell, Cannon, Carter, Claiborne, Clay, Cocke, Coffee, Cumberland, De Kalb, Fentress, Franklin, Grainger, Greene, Grundy, Hamblen,

Hamilton, Hancock, Hawkins, Jackson, Jefferson, Johnson, Knox, Lawrence, Lewis, Loudon, McMinn, Macon, Marion, Meigs, Monroe, Morgan, Overton, Pickett, Polk, Putnam, Rhea, Roane, Scott, Sequatchie, Sevier, Smith, Sullivan, Unicoi, Union, Van Buren, Warren, Washington, White

Virginia: Alleghany, Bath, Bland, Botetourt, Buchanan, Carroll, Craig, Dickenson, Floyd, Giles, Grayson, Henry, Highland, Lee, Montgomery, Patrick, Pulaski, Rockbridge, Russell, Scott, Smyth, Tazewell, Washington, Wise, Wythe

West Virginia: All counties: Barbour, Berkeley, Boone, Braxton, Brooke, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Grant, Greenbrier, Hampshire, Hancock, Hardy, Harrison, Jackson, Jefferson, Kanawha, Lewis, Lincoln, Logan, Marion, Marshall, Mason, McDowell, Mercer, Mineral, Mingo, Monongalia, Monroe, Morgan, Nicholas, Ohio, Pendleton, Pleasants, Pocahontas, Preston, Putnam, Raleigh, Randolph, Ritchie, Roane, Summers, Taylor, Tucker, Tyler, Upshur, Wayne, Webster, Wetzel, Wirt, Wood, Wyoming

* The following independent cities in Virginia are also within the Appalachian Region: Bristol, Buena Vista, Covington, Galax, Lexington, Martinsville, Norton, Radford.

source: Appalachian Regional Commission